GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 13: 1st January 2017 to 31st January 2017

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1st January 2017 to 31st January 2017. It analyses the performance of the key WEM indicators against their benchmarks, and examines the likely implications of any discernable trends in the market. This edition of the bulletin also presents the Electricity Supply Plan (ESP) for 2017.

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, nevertheless any errors, omissions or inaccuracies therein are deeply regretted.

HIGHLIGHTS OF THE MONTH

Overview of the Month

The month of January 2017 witnessed a significant reduction in generation from TICO, TAPCO and Ameri Power Plants. The total shortfall in generation from these power plants in January 2017 compared to December 2016 was about 169 GWh. This was as a result of routine maintenance works on TICO (warranty inspection on Steam Turbine) and TAPCO (mandatory maintenance on Unit 2). In the case of the Ameri Power plant, the significant reduction in generation was as a result of reduced gas flow from the Atuabo Gas Processing Plant (AGPP), by about 33%, to the Aboadze Power Enclave attributed to unfavorable weather conditions within the vicinity of the FPSO Kwame Nkrumah between January 1 and January 9, 2017. To make up for the deficit, generation from the hydro plants, notably Akosombo and some other relatively more expensive thermal plants (all of which use liquid fuels and are Simple Cycle Plants) were increased, in addition to increased imports. Compared to December 2016, Akosombo GS increased its generation by 93.2 GWh representing 26%, electricity import from La Cote D'Ivoire also increased by 24.9 GWh representing 68%, TT1PP increased its generation by 26.3 GWh representing 78%, CENIT Plant increased its generation by 29.8 GWh representing over 5 folds increase and KTPP increased its generation by 15.2 GWh representing over 7 folds increase. The net effect of the mitigation measures which effectively made up for the deficit, was accelerated drop in the Akosombo dam level by 1.71 feet representing about 14.7% more than that of December 2016, and also increased System Marginal Cost by 34.4%. Table 1 shows a comparison of the projected and actual electricity demand and supply for January 2017 and December 2016

Table 1 Projected and Actual Outturn of electricity supply and demand in January 2017 and December 2016

	January 2017		December 2016	
	Projected	Actual Outturn	Projected	Actual Outturn
Total Supply (GWh)	1,294.0	1,244.1	1,471.0	1,239.1
Source by Power Plants (GWh)				
AKOSOMBO	388.0	451.2	278.0	357.9
KPONG	72.0	71.0	53.0	68.1
BUI	72.0	70.4	86.0	79.1
Sunon Asogli	55.0	54.3	229.0	62.1
TAPCO	25.0	27.0	195.0	86.3
TICO	104.0	105.8	193.0	196.6
TT1PP	60.0	59.9	65.0	33.6
CENIT	60.0	35.2	68.0	5.4
TT2PP	-	-	-	-
MRP	-	-	-	-
Karpowership	152.0	165.0	113.0	164.3
AMERI	149.0	114.9	154.0	134.9
KTPP	-	17.2	37.0	2.0
Trojan Power	7.0	10.7	-	12.1
Total Generation (GWh)	1,144.0	1,182.6	1,471.0	1,202.5
Imports (GWh)	147.0	61.5	-	36.6
Total Supply (GWh)	1,291.0	1,244.1	1,471.0	1,239.1
Deficit (GWh)	-	(46.9)	-	(231.9)
Reduction in Consumption		4%	0	16%
Ghana Peak Load (MW)	1,973.0	2,049.6	2,250.0	2,037.8
System Peak Load (MW)	2,106.0	2,099.8	2,402.0	2,077.8

Electricity Demand

The System Peak Load (Ghana Peak Load plus Imports) in January 2017 was 2,099.8 MW, a marginal reduction from the 2,105.5 MW

recorded in December 2016. The Ghana Peak Load (Domestic Peak Load including Valco minus export), however, increased marginally to 2,049.6 MW in January 2017 from 2,034.5 MW recorded in December 2016. The actual System Peak Load was marginally lower (0.3%) than the projected System Peak Load of 2,106 MW while the actual Ghana Peak Load was higher (3.9%) than the projected Ghana Peak Load of 1,973 MW for January 2017 under the 2017 ESP. This suggests that, there was lower export at peak than projected.

Electricity supply

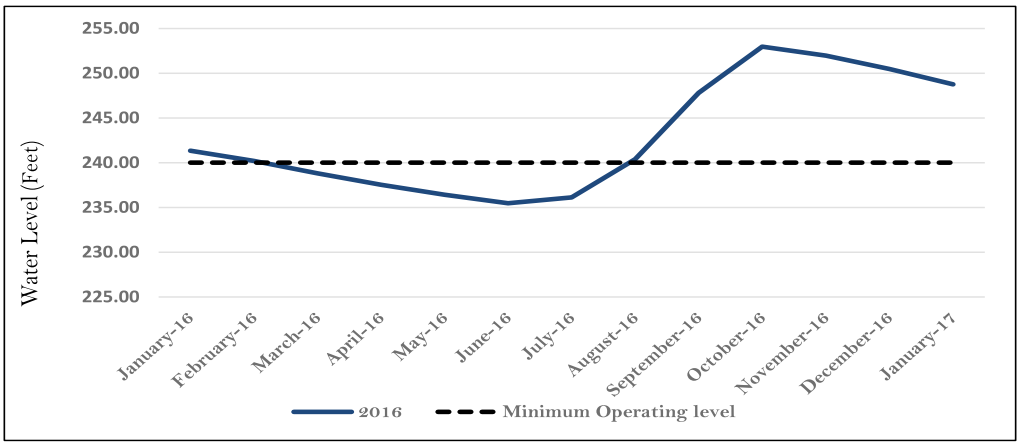
Total electricity supplied to meet Ghana's requirement increased marginally to 1,244.09 GWh in January 2017 from the 1,239.1 GWh supplied in December 2016. The January 2017 supply was made up of 1,182.6 GWh from domestic generation and 61.49 GWh of imports from La Cote D'Ivoire. The total supply of electricity in January 2017 was 47.21 GWh lower than the 1,291.3 GWh projected in the Electricity Supply Plan (ESP) developed for the year 2017 representing a 3.8% deviation between the outturn and projection.

Hydro Dam Levels

Akosombo Dam Water Level continued its decline.

The level of water in the Akosombo dam dropped by 1.71 feet in January 2017, from 250.47 feet level at the beginning of the month to 248.76 feet at end of the month, but still remained above the minimum design operating level of 240 feet, and higher than the level at the same time in January 2016 by about 7.59 feet. Figure 1 shows comparative end of month trajectory of the level of water in the Akosombo dam from January 2016 to January 2017.

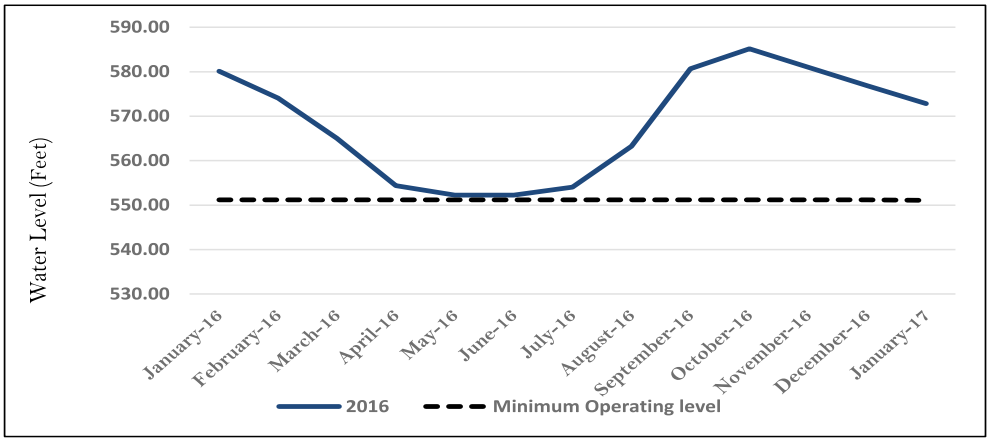
Figure 1: Month-End Water Level for Akosombo Dam from January 2016 to January 2017



Bui Dam Water level continued its decline but at a reduced rate

The Bui dam water level dropped by 4.03 feet in January 2017, starting the month at 576.85 feet and ending the month at 572.82. Although the water level fell by 4.03 feet, its level was still above the minimum design operating level of 551.04 feet. It is worrying to note however that, the water level at the end of January 2017 was lower than the level at the same time in January 2016 by about 7.28 feet. Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2016 to January 2017.

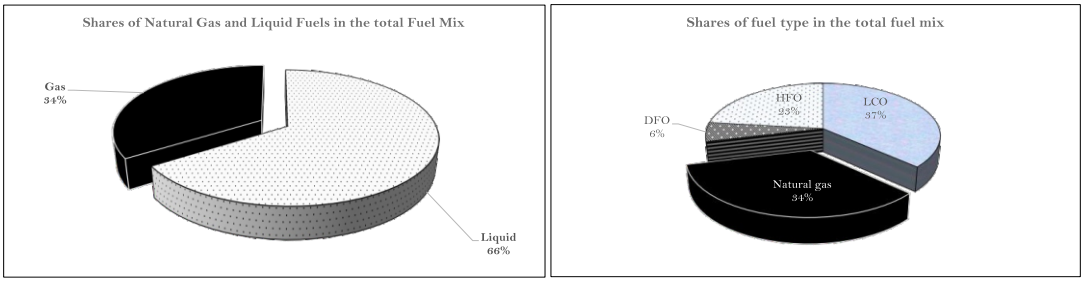
Figure 2: Month-End Water Level for Bui Dam from January 2016 to January 2017



Fuel Supply

Liquid fuels (LCO, HFO, DFO) were the dominant fuels in the fuel supply mix for power generation in January 2017. Combined liquid fuels constituted 65.8% of the total fuel supply mix in January 2017 with the remaining 34.2% accounted for by natural gas. Of the total liquid fuel supply, LCO accounted for 56.0%, HFO accounted for 35.1% and DFO accounted for 8.9%.

Figure 3 Shares of sources of fuel and fuel type in the generation fuel mix



Natural gas supply from WAGPCo dipped marginally

The total gas supply from the West African Gas Pipeline Company (WAGPCo) to Tema and Kpone for the month of January 2017 was 507.60 MMSCF and constituted 28.2% of the total gas supply in the fuel supply mix. This volume was only adequate to feed half the capacity of phase I of the Sunon Asogli power plant which relies solely on natural gas. The resulting average WAPCo gas flow to Tema in January 2017 was 16.35 MMSCF per day, a fall from the average gas supply of 18.25 MMSCF per day in December 2016. The inadequacy of the gas supply compelled the other power plants in Tema and Kpone to run on LCO and DFO respectively, when needed, at a much higher cost.

Natural gas supply from AGPP to the Aboadze power Enclave dropped

Total gas supply from the Atuabo Gas Processing Plant to the Aboadze Enclave for January 2017 was 1,220.72 MMSCF, averaging 43.4 MMSCF per day which was a significant drop when compared to a total of 2,114.2 MMSCF (68.2 MMSCF per day) recorded in December 2016. The AGPP gas supply constituted 71.8% of the total gas supply in the fuel supply mix in January, 2017. Out of the total of 1,220.72 MMSCF of natural gas consumed in January 2017 at the Aboadze Power Enclave, the Ameri Energy Power Plant consumed 82.61% while the remaining 17.39% was consumed by TAPCO.

LCO continued to dominate the liquid fuel supply

LCO constituted 56% of the total liquid fuel supplied for electricity generation in January 2017. This is however, lower than the 69.4% recorded in December 2016. A total of 398,478 bbls of LCO was used for electricity generation in January 2017. Out of the total, 52.6% was used at the Tema Thermal Power Enclave, with the remaining 47.4% being used in the Aboadze Power Enclave.

A total of 62,187 bbls of DFO was used for electricity generation in January 2017. Proportionately, 56.5% was used by power plants in the Kpone Power Enclave, 28.3% was used by power plants in the Tema Power Enclave, 14.9% was used by Trojan Power Kumasi and 0.3% was used in Aboadze Power Enclave purposely for starting and stopping the gas turbines. Of the 28.3% DFO used in the Tema Power Enclave, 0.4% was used for starting and stopping of the gas turbines and the remaining 99.6% was used for actual electricity generation.

Karpowership Power Plant which was the only HFO fired power plant in operation in January 2017 utilized a total of 218,480 bbls of HFO.

Plant by Plant Highlight

Akosombo Generation Station increased generation significantly

Generation of electricity from the Akosombo Generation Station (GS) increased to 451.22 GWh in January 2017 from 358.95 GWh in December 2016 averaging 14.56 GWh per day. The electricity generation from Akosombo GS in January 2017 was 26% more than the generation in December 2016. The 451.22 GWh of electricity produced by Akosombo GS in January 2017 was also higher than the 388.00 GWh projected to be generated under the 2017 ESP. The Akosombo GS generated 36.3% of total electricity supplied in January 2017 up from 28.9% of total electricity supplied in December 2016. The power plant contributed 878.0 MW (41.8%) to meet total System Peak Load of 2,099.8 MW in January 2017 compared to 594 MW (28.2%) in December 2016 to meet System Peak Load of 2,105.5 MW. The Akosombo GS contributed an 832.0 MW (40.6%) to meet the Ghana Peak Load of 2,049.6 MW in January 2017 compared with 594 MW (29.2%) recorded in December 2016 to meet the Ghana Peak Load of 2,034.5 MW.

Kpong Generation Station increased generation marginally

Kpong Generation Station (GS) produced a total of 71.02 GWh at an average of 2.29 GWh per day, 4.3% higher than that of December 2016. The Kpong GS generated marginally lower (by 0.98 GWh) than the projected 72 GWh in the 2017 ESP. The Kpong GS contributed 109 MW to System Peak Load and 112 MW to Ghana Peak Load in January 2017 representing 5.2% and 5.5% of the System Peak Load and Ghana Peak load respectively.

Bui Generation Station decreased generation

Electricity production from the Bui Power Plant decreased to 70.42 GWh in January 2017 from 79.11 GWh in December 2016, representing a decrease of 11% as it generated mainly as a peaking plant. The total electricity generated in January 2017 from the Bui Power Plant was marginally lower than the 72 GWh projected to be generated under the 2017 Electricity Supply Plan (ESP). The Bui GS contributed 10.5% and 10.2% of System Peak Load and Ghana Peak Load respectively.

Sunon Asogli Power Plant reduced generation as gas from WAGPCo dropped further

Even though it operated throughout January 2017, the Sunon Asogli Power Plant produced less electricity in January 2017 (54.29 GWh) than in December 2016 (62.08 GWh) due to inadequate gas supply. In January 2017, Asogli generated 54.29 GWh, marginally less than the projected value of 55.00 GWh under the 2017 ESP. It contributed 44.9 MW to meet the System Peak Load of 2,099.80 MW and 96.2 MW to meet the Ghana Peak Load of 2,049.60 MW. This represented 2.1% and 4.7% of System Peak Load and Ghana Peak Load respectively. The Sunon Asogli power plant generated 54.29 GWh in January 2017 using 16.37 MMSCF of gas per day at an estimated heat rate (fuel efficiency) of 9,912.28 Btu/kWh.

HIGHLIGHTS OF THE MONTH

CENIT Power Plant increased generation to meet system demand

CENIT Power Plant operated for 18 days in January 2017, generating 35.19 GWh significantly up from its 4 days of operation in December 2016 when it generated 5.4 GWh. This increased generation by the simple cycle CENIT Power Plant which operates on LCO was due to the need to fill the generation deficit created by unavailability of cheaper sources of generation due to routine maintenance work and gas flow challenges. Despite the increase in generation by CENIT, the power plant generated 41.4% lower than the projected generation of 60 GWh under the 2017 ESP due to low stocks of LCO at the Tema Power Enclave. Unlike December 2016, the CENIT Power Plant contributed 94 MW to meet both the System Peak and Ghana Peak Loads in January 2017. The plant consumed 77,942 barrels of LCO at an estimated average heat rate of 11,717.20 Btu/kWh.

Ameri Energy Power Plant decreased generation as gas flows slumped

Electricity generation from the Ameri Energy Power Plant slumped in January 2017 to 114.91 GWh from 134.91 GWh in December 2016 due to curtailment of gas flow to the Aboadze Power Enclave at some periods in the month which caused the plant to be offline for 2 days in addition to a reduced generation at other periods in January 2017. The generation by Ameri Plant in January 2017 was also lower than the 149 GWh projected for the month of January 2017 under the 2017 ESP. The Ameri Energy Power Plant contributed 217.20 MW (10.3%) to meet the System Peak Load of 2,099.80 MW and 228.30 MW (11.1%) to meet the Ghana Peak Load of 2,049.60 MW. The Ameri Energy Power Plant consumed 1,008.47 MMSCF of gas to generate 114.91 GWh of electricity in January 2017 at an average heat rate (fuel efficiency) of 10,188.38 Btu/kWh in January 2017.

Kpone Thermal Power Plant (KTPP) increased generation significantly

Electricity generated from the Kpone Thermal Power Plant (KTPP) significantly increased to 17.16 GWh in January 2017 from 2.02 GWh in December 2016 although it was projected to be offline in January 2017 under the ESP 2017. The KTPP operated for 11 days in the month of January 2017 compared to the 2 days it operated in December 2016 but did not contribute to meeting both System Peak and Ghana Peak loads for the of January 2017. The relative increase in generation by KTPP which operates on the more expensive DFO in a simple cycle mode in January 2017 was as a result of unavailable generation from cheaper sources to meet system demand. The 17.16 GWh of electricity generated in January 2017 was achieved with a consumption of 35,138.38 barrels of DFO at an average heat rate of 11, 003.23 Btu/kWh.

Karpowership Power Plant maintained its high generation level once again

The Karpowership Power Plant operated every day in the month of January 2017 generating 165.02 GWh at an average of 5.32 GWh /day, marginally up from 164.32 GWh in December 2016. Electricity generation in January 2017 of 165.02 GWh was higher than the projected generation of 149 GWh forecasted under the 2017 ESP. The power plant contributed 13.9% of total electricity supplied in January 2017 compared to 13.6% in December 2016. The Power Plant contributed 227.7 MW to meet the System Peak Load of 2,099.8 MW and 229.1 MW to meet the Ghana Peak Load of 2049.6 MW. Thus, the power plant contributed 10.8% and 11.2% to meet the System and Ghana Peak Loads respectively in January 2017. The Karpowership plant consumed 218,479 barrels of Heavy oil (HFO) to generate the 165.02 GWh in January 2017 at an average heat rate (fuel efficiency) of 8,124.95 Btu/kWh.

Electricity generation from Takoradi International Company (TICO) slumped

The TICO Power plant operated throughout the month of January 2017 but with a reduced capacity from 25th January 2017 when its steam turbine was taken out for Warranty Inspection. It generated a total of 105.8 Gwh of electricity (average 3.41 GWh/day) compared to a generation of 196.58 GWh (average of 6.34 GWh/day) in December 2016 marginally higher than the 104 GWh projected under the 2017 ESP. The TICO plant operated largely in a combined cycle mode in January 2017 (until the steam Turbine was shut down), contributing 155 MW to meet the System Peak Load and 100 MW to meet the Ghana Peak Load, representing 7.3% and 4.9% respectively. The TICO Power Plant operated solely on light crude oil (LCO) consuming about 188,841.60 barrels of the fuel to produce the 105.8 GWh of electricity at an average heat rate of 9,446.27 Btu/kWh.

Electricity generation from Takoradi Power Company (TAPCO) also slumped

The TAPCO Power Plant generated a total of 26.97 GWh of electricity in January 2017 which was about 69% less than the 86.33 GWh generated in December 2016 but marginally 7.9% higher than the 25 GWh projected under the 2017 ESP. The Power Plant operated for only 9 days in January 2017 when the Gas Turbine 2 (GT2) which was the only Gas Turbine in operation with half capacity of the Steam Turbine had to be shut down for mandatory maintenance works. The TAPCO Power Plant did not contribute to either System Peak Load or Ghana Peak Load for the month.

Tema Thermal 1 Power Plant (TT1PP) increased generation

The Tema Thermal 1 Power Plant, (TT1PP) operated for 28 days in January 2017 as compared to 14 days of operation in December 2016 and generated a total of 59.90 GWh of electricity (average of 2.14 GWh per day) in January 2017 compared to the 33.61 GWh generated in December 2016 (average of 1.77 GWh per day). The increased generation from this simple cycle power plant using LCO as fuel was due to unavailability of cheaper sources of generation. The power plant's generation in January 2017 was however marginally lower than the 60 GWh projected under the 2017 ESP. The TT1PP contributed 98 MW to both the System Peak Load (4.6%) and Ghana Peak loads. The power plant operated solely on LCO consuming about 131,694 barrels of the oil to produce 59.9 GWh at an average heat rate of 11,631.64 Btu/kWh.

Trojan Power Plant

Trojan Power Plant, an embedded generation plant generated a combined total of 10.72 GWh of electricity in January 2017 from its Kumasi and Tema Plants at an average of 0.3 GWh a day. The Tema Plant generated 6.68 GWh (62.3%) whiles the Kumasi Plant generated 4.04 GWh (37.7%). Trojan Plant in Tema consumed 17,549 bbls of DFO to generate 6.68 GWh at an average heat rate 14,123.65 Btu/kWh while the Kumasi plant consumed 9,246 bbl of DFO to generate 4.04 GWh of electricity at an average heat rate of 12,296.2 Btu.kWh. The power plant also generated 3.72 GWh higher than the projected 7 GWh in the 2017 ESP.

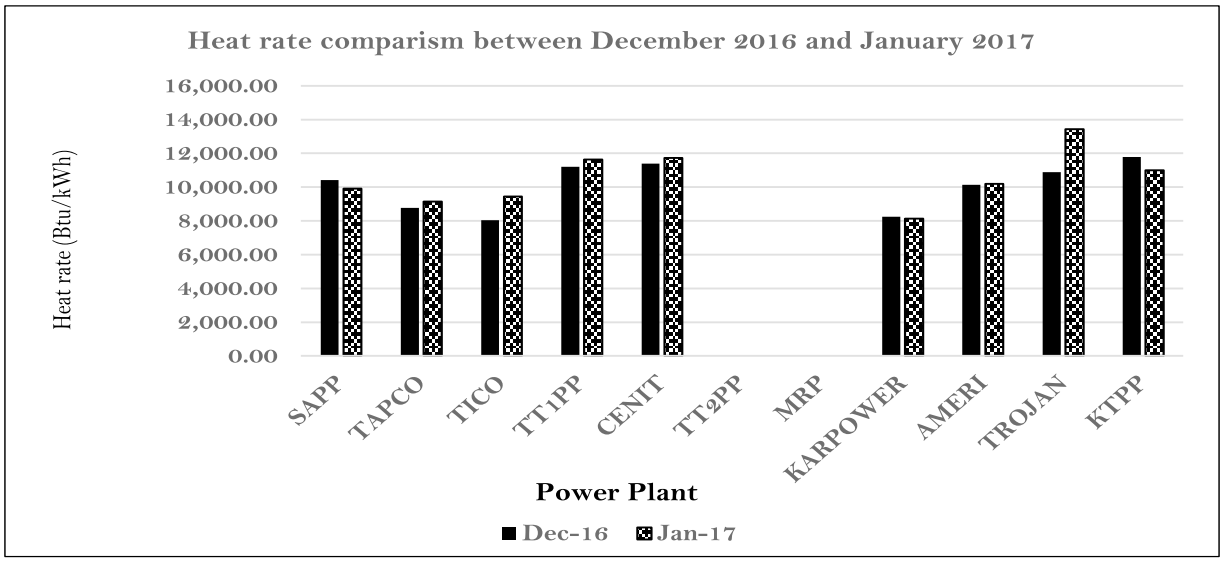
Electricity Exchange

Electricity imports from La Cote D'Ivoire almost doubled in January 2017 from 36.6 GWh in December 2016 to 61.49 GWh. The total electricity import was however lower than the 133 GWh projected under the 2017 ESP. Of the total imports of 61.49 GWh, 45.33 GWh, representing 71.7%, was exported to CEB making Ghana a net importer of electricity. Electricity imports to meet daily peak demand in January 2017 ranged between 14 MW and 162 MW and contributed 2.67% and 2.54% to System Peak Load and Ghana Peak Load respectively.

OPERATIONAL FACT SHEET

Electricity Supply in January 2017			
Source of Supply	Generation at System Coincident Peak Load of January (MW)	Generation at Ghana Coincedent Peak Load of January (MW)	Electricity Supply (GWh)
AKOSOMBO	878.00	832.00	451.22
KPONG	109.00	112.00	71.02
BUI	220.00	208.00	70.42
SEAP	44.90	96.20	54.29
TAPCO	-	-	26.97
TICO	155.00	100.00	105.77
TT1PP	98.00	98.00	59.90
CENIT	94.00	94.00	35.19
TT2PP	-	-	-
MRP	-	-	-
KARPOWER	227.70	229.10	165.02
AMERI	217.20	228.30	114.91
KTPP	-	-	17.16
Trojan Power	-	-	10.72
IMPORT	56.00	52.00	61.49
EXPORT		-	45.33
System Coincident Peak Load	2,099.80	-	-
Ghana Coincedent Peak Load	-	2,049.60	-
Total Supply	-	-	1,244.09
Total Supply without export	-	-	1,198.76

Ghana Electricity Demand		
		Jan-17
Maximum System Peak Load	MW	2,099.8
Minimum System Peak Load	MW	1,428.7
Average Peak Generation	MW	1,983.7
System Base Load	MW	1,152.6
Total Electricity Consumption	GWh	1,244.1
Total Energy Imported	GWh	61.5
Load Factor (LF)	%	79.6



OPERATIONAL FACT SHEET

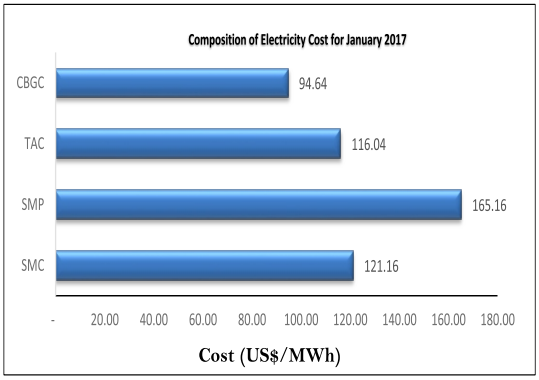
Power Plant Data for January 2017							
	Dependable Capacity (MW)	Plant Utilization (%)	Electricity Generation (GWh)	Gas Consumption (MMBtu)	LCO Consumption (MMBtu)	DFO Consumption (MMBtu)	HFO Consumption (MMBtu)
Akosombo	900.00	67.39	451.22	-	-	-	-
Kpong	140.00	68.18	71.02	-	-	-	-
Bui	340.00	27.84	70.42	-	-	-	-
SAPP	500.00	14.59	54.29	538,091.03	-	-	-
TAPCO	300.00	12.08	26.97	246,409.65	-	-	-
TICO	300.00	47.39	105.77	-	999,149.19	-	-
TT1PP	110.00	73.20	59.90	-	696,784.64	-	-
CENIT	110.00	43.00	35.19	-	412,387.32	-	-
TT2PP	45.00	-	-	-	-	-	-
MRP	70.00	-	-	-	-	-	-
KARPOWER	225.00	98.58	165.02	-	-	-	1,340,749.27
AMERI	230.00	67.15	114.91	1,170,767.18	-	-	-
TROJAN	52.00	27.70	10.72	-	-	143,988.00	-
KTPP	200.00	11.53	17.16	-	-	188,819.90	-
AKSA	-	-	-	-	-	-	-
Total	**3,522.00**		**1,182.60**	**1,955,267.86**	**2,108,321.15**		**1,340,749.27**

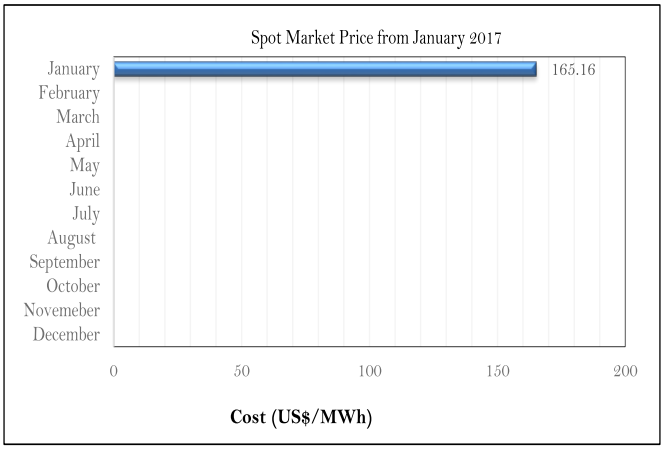
	Average Gas Flow (MMScfd) - January 2017				
Location	Week 1	Week 2	Week 3	Week 4	Monthly Average
Etoki	16.57	10.56	23.84	16.50	**16.83**
Tema	18.05	12.40	15.62	15.72	**15.47**
Aboadze	42.44	46.31	32.83	49.33	**43.37**

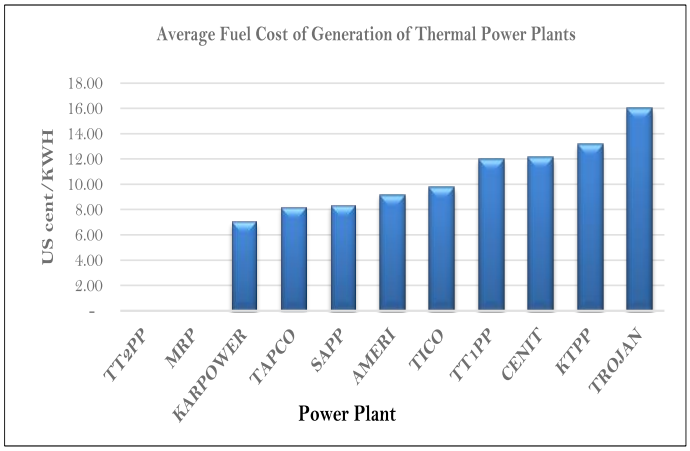
	Water Level (ft) - January 2017				Change in water level
Hydro Dam	Week 1	Week 2	Week 3	Week 4	(feet)
Akosombo	250.47	250.18	249.82	248.76	-1.71
Bui	576.85	575.71	574.79	572.82	-4.03

ECONOMIC FACT SHEET

		Jan-17	Dec-16	Change
Average Market Energy Cost	US$/MWh	93.25	88.27	4.98
Average Market Capacity Charge (AMCC)	US$/MWh	22.79	17.28	5.51
Total Average Market Cost (TAC)	US$/MWh	116.04	105.55	10.49
		-	-	-
System Marginal Cost (SMC)	US$/MWh	121.16	90.18	30.98
System Marginal Capacity Charge (SMCC)	US$/MWh	44.00	-	44.00
Spot Market Price (SMP)	US$/MWh	165.16	90.18	74.98
		-	-	-
Composite Bulk Generation Charge (CBGC)	US$/MWh	94.64	94.64	-
Deviation of TAC from CBGC	US$/MWh	(21.40)	1.49	(22.89)
Deviation of SMP from CBGC	US$/MWh	(70.52)	(44.98)	(25.54)

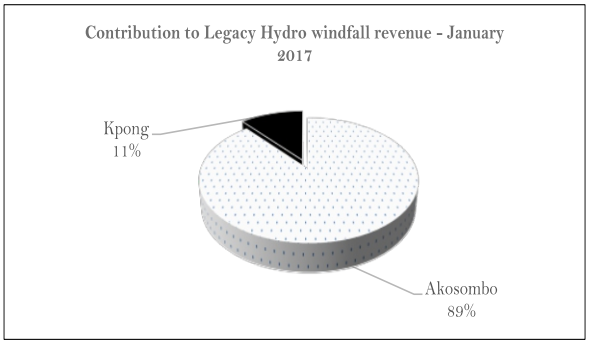






Jan-17				
	Average Cost	Average SMP	Difference	Windfall Revenue
Power Plant	US$/MWh	US$/MWh	US$/MWh	US$/MWh
Akosombo	33.10	165.16	132.06	59,588,407.50
Kpong	59.20	165.16	105.96	7,524,754.56
Total	92.30	-	-	67,113,162.06

Average Fuel Prices		
		Jan-17
Fuel Type	Unit	Delivered Cost
Natural Gas	US$/MMBtu	8.73
LCO	US$/BBL	54.70
HFO	US$/Tonne	337.57
DFO	US$/Tonne	477.68



1. The 2017 Electricity Supply Plan (ESP)

The Ghana Grid Company (GRIDCo) coordinated the development of the 2017 Electricity Supply Plan (ESP) that involved key stakeholders of the power sector. A committee was made up of representatives from GRIDCo, Energy Commission, Volta River Authority (VRA), Bui Power Authority (BPA), Electricity Company of Ghana (ECG) and Northern Electricity Development Company (NEDCo).

The 2017 ESP provides an outlook of power demand and supply for 2017 taking into consideration all the firm additional new projects and existing generation sources. The subsequent editions of the Market Watch in 2017 will make reference and comparison of actuals and the projections of the 2017 ESP.

1.2 Methodology

Peak demand for 2017 was forecasted based on an econometric projection of a population growth of 2.6% and a GDP growth of 7.7% with VALCO operating at one pot line. Other factors considered in the demand forecast included; increased rural electrification, network expansion by the distribution companies to extend coverage and improve service quality, increased demand by the Enclave Power Company by 30 MW and increase demand by the introduction of a new mining company.

1.3 Demand and Supply outlook for 2017

Table 1.4.1: 2017 Demand and Supply Balance (GWh)

Projected Demand/Supply	Demand/Supply (GWh)
Total Domestic	**14,055**
VALCO	620
Exports (CEB+SONABEL+CIE)	940
Total Projected Demand	**15,615**
Projected Supply	
Total VRA Hydro (Akosombo & Kpong GS)	4,400
Bui GS	841
VRA Existing Thermal & Solar Generation	
T1	1,258
T2	1,983
TT1PP	177
TT2PP + TT2PP-X	0
MRPP	0
KTPP	62
Solar	4
Total VRA Thermal Generation	**3,484**
Existing IPP Thermal Generation	
SAPP (includes new plant)	1,477
CENIT	154
AMERI	1,619
Karpower Barge	1,802
AKSA	1,174
Trojan	19
Central Solar	**32**
Total IPP Thermal Generation	**6,277**
Total VRA Supply	**7,884**
Total Non-VRA Supply	**7,118**
Import	613
Total Supply	**15,615**

According to the supply plan developed for 2017, a total of 15,615 GWh is projected to be supplied to meet the needs of the economy and for export. The total projected supply of 15,615 GWh represents 14% increase in the total electricity supplied in 2016. Hydro generation sources is projected to account for 34% of the total supply, 62% from thermal sources and 3.9% from imports and 0.1% from solar sources.

Taking planned maintenance and fuel constraints into consideration, the monthly System Peak Demand will range between 2,106 MW and 2,384 MW with the annual System Peak Demand estimated to occur in December 2017. Total available generation will also range between 2,327 MW at the beginning of the year to 2,758 MW by the close of the year. The increase in the available generation is due primarily to the projected coming online of Genser Power Plant (18 MW), AKSA (240 MW increasing to 330 MW) and phase II of SAPP (320 MW). There is no projected demand and supply imbalance in 2017 with reserve margins ranging from 8% to 21%.

Further analysis of the projections considering generation sources in Ghana alone, indicates that reserve margins will range between 2% and 21% with a deficit in February 2017. Therefore without adequate imports in February 2017, demand for electricity will not be met. This is almost the same for the first five months in the year as reserve capacity range between 36 MW and 117 MW. An unanticipated shut down of any available plant such as TAPCO, TICO, AMERI or SAPP could cause a demand and supply imbalance if adequate imports are not received. The situation is projected to improve with the coming online of AKSA and phase II of SAPP.

Table 1.4.2 monthly demand and supply projection for 2017.

	January	February	March	April	May	June	July	August	September	October	November	December
Demand (MW)	2,106	2,134	2,151	2,235	2,238	2,183	2,200	2,195	2,271	2,250	2,313	2,384
Available generation capacity (MW)*	2,142	2,127	2,292	2,355	2,355	2,435	2,435	2,585	2,743	2,700	2,615	2,743
Import (MW)	200	200	150	150	60	30	45	15	15	15	15	15
Total Generation capacity with import (MW)	2,342	2,327	2,442	2,505	2,415	2,465	2,480	2,600	2,758	2,715	2,630	2,758
Surplus/Deficit with import	236	193	291	270	177	282	280	405	487	465	317	374
Surplus/deficit without Import (MW)*	36	(7)	141	120	117	252	235	390	472	450	302	359
Reserve Margin with import (%)	11	9	14	12	8	13	13	18	21	21	14	16
Reserve Margin without import (%)*	2	(0.3)	7	5	5	12	11	18	21	20	13	15
Domestic Supply (GWh)*	1,147	1,024	1,209	1,250	1,304	1,243	1,232	1,249	1,247	1,357	1,337	1,401
Import (GWh)	147	133	95	91	45	20	33	10	10	10	10	10
Total Projected Supply (GWh) with imports	1,294	1,157	1,304	1,341	1,349	1,263	1,265	1,259	1,257	1,367	1,347	1,411
Export to CEB and SONABEL (GWh)	80	72	80	77	80	77	80	80	77	80	77	80

*Author's own analysis based on projected figures

Electricity supply (GWh) is projected to increase by 22% from its minimum value of 1,157 GWh in February 2017 to 1,411 GWh by December 2017. Import will account for 1% to 11% of the total projected supply for 2017. Domestic electricity demand will account for 93.7% to 94.3% of the total supply while electricity export to CEB will account for with 5.4% to 6% of the total supply in 2017. Ghana is projected to be a net exporter of electricity by May 2017 with net export ranging between 35 GWh to 70 GWh.

2.0 Sunon Asogli Commissions 360 MW Phase II Project

Sunon Asogli Power completed the commissioning of the Sunon Asogli expansion (phase II) project on natural gas to add 360 MW installed capacity to the grid. This is a dual fuel combined cycle thermal plant with natural gas as primary fuel and LCO as secondary fuel. The plant, which comprises of a total of 2 gas turbines (120MW each) and 2 steam turbines (60 MW each) is categorized into 2 units with each unit comprising of 1 gas turbine and 1 steam turbine with a total installed capacity of 180MW. The commissioning process which started in December 2016 with Unit 1 and completed on 21st January 2017 with Unit 2, was affected by the erratic natural gas supply from the WAGPCo. The commissioning of Unit 1 of this plant on LCO is expected in February 2017 and Unit 2 later in the year. The Sunon Asogli expansion project brings the total installed capacity of the Sunon Asogli Power Plant to 560 MW.

3.0 Performance Indicators of Power Plants

Two key performance indicators of Power Plants are the capacity utilisation and the Heat Rate (fuel efficiency) which influences the variable cost of generation by the plant. In 2017, we shall be reporting on the performance of the power plants with respect to these 2 key indicators on monthly basis

3.1 Capacity Utilization Factor

Capacity Utilisation Factor (CUF) is the ratio of actual electricity generated by a plant to the maximum possible generation output within a period. Low capacity utilisation indicates that, there could be high and adequate capacity installed yet a system could be in deficit in real terms. A 100% CUF is hardly achievable due to scheduled maintenance of plants, breakdowns of plants, low water levels in dams (in the case of hydro plants), unavailability of fuel (thermal plant) and frequency of dispatch, among others. A high CUF is however desirable. Peaking Plants generally have low CUF because they operate only during a small fraction of the time to meet peak shortfalls. A typical illustration of the effect of CUF manifest in the Ghana Power System where the total dependable capacity is about 3,550 MW which is more than adequate to meet the Ghana's System Peak Load of about 2,200MW with adequate reserve margins that could absorb any unexpected shutdown of some plants. However, due to low CUF (especially thermal power plants), an unexpected shutdown of a plant could sometimes plunge the nation into load shedding.

In January 2017, Karpowership had the highest capacity utilization of 98.58%, an increase of 4.11% from its capacity utilization in December 2017. The continually high capacity utilization rate recorded by Karpowership is due to the constant availability of fuel supply to the power plant compared to the other plant and adherence to its planned maintenance schedule which reduces breakdowns. While scheduled maintenance work on TICO and TAPCO reduced their capacity utilization for the month, TT1PP, CENIT and KTPP benefited from the shortfall created by the absence of TICO and TAPCO by being dispatched because they had fuel, hence the improved CUFs, although KTPP yet still had the lowest CUF in the month

Akosombo GS utilized 67.39% of its capacity in January 2017, 18.55% higher than in December 2016 and 9.41% higher than projected. The Kpong Hydro Power Plant, on the other hand, still had one of its units unavailable because it is undergoing retrofitting and had a CUF of 68.18%. Bui GS had a capacity utilization of 27.84%, slightly higher than its design capacity utilization of 25% as a peaking plant. The Plant Capacity Utilisation Factors of the various plants is contained in table 2.1.

[1]*Assuming average export to SONABEL is 4.5 GWh which has been the average supply since 2014*
[2]*Includes embedded generation (Trojan) but excludes T3 Plant*

Table 2.1: Power Plant Capacity utilization .Average Heat rate and Average Fuel Cost of Generation

Power Plant	Capacity Utiliation (%)	Average Heatrate (Btu/KWh)	Average Fuel Cost of Generation (US$/MWh)
Akosombo	67.39	-	-
Kpong	68.18	-	-
Bui	27.84	-	-
SAPP	14.59	9,912.28	83.76
TAPCO	12.08	9,135.79	82.22
TICO	47.39	9,446.27	97.68
TT1PP	73.20	11,631.73	120.28
CENIT	43.00	11,717.28	121.16
TT2PP	-	-	-
MRP	-	-	-
KARPOWER	98.58	8,124.95	70.42
AMERI	67.15	10,188.38	91.70
TROJAN	27.70	13,434.66	160.44
KTPP	11.53	11,003.23	131.40

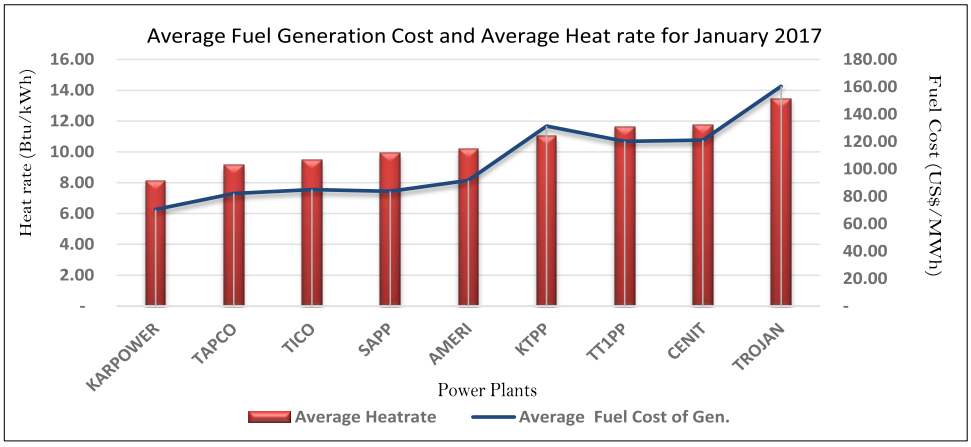
3.2 Heat Rate (Fuel Efficiency)

The quantum of fuel used to generate a unit of electricity by a power plant is referred to as its heat rate measured in Btu/kWh. Heat Rate is therefore the inverse of the fuel efficiency of the plant. High heat rates signify low fuel efficiency and vice versa. A plant with a high heat rate will consume more fuel to generate a unit of electricity and this will increase the fuel cost for electricity supply. Combined Cycle Power Plants have lower heat rates than Simple Cycle Power Plants due to the presence of the steam turbine which produces additional electricity without any additional fuel consumption. Table 2.1 contains the estimated heat rate of the thermal power plants for January 2017 and fig 2.1 indicates the chart of heat rates and the associated fuel cost for electricity generation for January 2017.

In January 2017, Karpowership had the lowest heat rate and thus was the most efficient plant in the month with a heat rate of 8,124.95 Btu/kWh. The least efficient power plants were TT1PP, CENIT and Trojan with 11,631.73 and 11,717.28 Btu/kWh and 13,434.66 Btu/kWh respectively.

Figure 2.1 shows the ranking of the thermal power plants based on their efficiency levels with their corresponding fuel cost of electricity generation. The chart indicates the effect of fuel prices on the cost of generation of the thermal power plants.

Figure 2.1: Fuel efficiency ranking of thermal power plants with their respective fuel cost of generation



3.3 Average Fuel Cost of Electricity Generation

The fuel cost of electricity generated is determined from the quantity of fuel consumed by plant for electricity generation and the cost of the fuel used. Based on the heat rates of the plants, the fuel cost of electricity generation by the power plants were estimated. It turned out that, Karpowership Power Plant, which was the most fuel efficient plant in January 2017, had the lowest fuel cost of generation of US$70.42/MWh due to its high efficiency coupled with relatively lower average cost of HFO (US$8.67/MMBtu) than natural gas (US$8.73/MMBtu), LCO (US$10.34) and DFO (US$11.94). On the other hand, Trojan power plant which was the least efficient power plant in January 2017

had the highest average fuel cost of generation of US$160.44. Even though KTPP was more efficient (Lower Heat Rate) than TT1PP and CENIT Plant, it had a higher average fuel cost of generation (US$131.4/MWh) than TT1PP and CENIT due to relatively higher cost of DFO compared with LCO in the month of January 2017.

3. Ghana Could Have Saved USD 4.00 Million In January 2017 if there was enough Gas Supply for Power Plants

Gas supply inadequacy in January 2017 and previous months compelled dual fuel thermal power plants to resort to the use of liquid fuels especially LCO which is more expensive than gas causing an increase in fuel cost of electricity generation, a major component of the variable cost of electricity generation.

In January 2017, 4 thermal plants (TICO, TT1PP, CENIT and KTPP) which are all configured to run on Natural Gas operated on liquid fuel instead due to gas supply inadequacy. The total fuel cost of generation by these 4 thermal plants in January 2017, was estimated at USD 24.06 Million. However, if these 4 thermal plants had operated on gas instead, the resulting total fuel cost of generation would have been USD 19.96 Million. This means there could have been a cost savings of USD 4.10 Million in the month alone. This provides a strong case for concerted effort to ensure gas adequacy especially from Nigeria through WAGPCo and also alternative sources such as Liquefied Natural Gas (LNG) at reasonable cost.

Table 3.1 below shows the estimated savings per plant if they had operated on gas instead of liquid fuel in January 2017.

		Fuel cost of Generation (US$)		
	Actual Fuel Used	Using Actual fuel	Using Gas	Savings
TICO	LCO	10,331,467.04	8,992,342.70	1,339,124.34
TT1PP	LCO	7,204,937.60	5,887,830.23	1,317,107.38
CENIT	LCO	4,264,194.02	3,484,672.85	779,521.17
KTPP	DFO	2,254,887.27	1,595,528.17	659,359.10
Total		**24,055,485.94**	**19,960,373.95**	**4,095,111.99**

[3]*This is based on the assumption that, heat rate remain the same for both fuels. It is known that, heat rate for plants using gas is lower than when it is operating on gas and hence more savings would have been expected.*

Acronyms

AGPP = Atuabu Gas Processing Plant
Btu = British Thermal Units
CBGC = Composite Bulk Generation Charge
CUF = Capacity Utilization Factor
DFO = Distillate Fuel Oil
EC = Energy Commission
ECG = Electricity Company of Ghana
ESP – Electricity Supply Plan
FPSO = Floating Production, Storage and Offloading
GHp = Ghana Pesewa
GNGC = Ghana National Gas Company
GWh = Giga-watt Hours
HFO = Heavy Fuel Oil
KTPP = Kpone Thermal Power Plant
kWh = Kilo-watt hours
MRP = Mine Reserve Plant
LEAP = Long-range Energy Alternative Planning
LCO = Light Crude Oil
LI = Legislative Instrument
MW = Megawatt
MMscf = Million Standard Cubic Feet
MWh = Mega-watt hours
NITS = National Interconnected Transmission System
PV = Photovoltaic
SAPP = Sunon Asogli Power Plant
SMP = System Marginal Price
SNEP = Strategic National Energy Plan
TEN = Tweneboa, Enyenra, Ntomme
TT1PP = Tema Thermal 2 Power Plant
TT2PP = Tema Thermal 2 Power Plant
VRA = Volta River Authority
WAGPCo – West African Gas Pipeline Company
WAGP = West African Gas Pipeline
WEM = Wholesale Electricity Market

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