GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 21: 1st September 2017 to 30th September 2017

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1st September 2017 to 30th September 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 continues with the series on the financial sustainability of the power sector with a look at the second quarter of 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 regretted.

HIGHLIGHTS OF THE MONTH

Overview of the Month

There was a marginal increase in the electricity supplied in September 2017 from 36.07 GWh per day in August 2017 to 36.5 GWh per day in September 2017 predominately due to the increase in generation from the hydro power plants. Contrary to the supply in August 2017, hydro supply in the total electricity supply in September 2017 increased by 8%. The Akosombo GS supply increased by 4.5%, 1.7% for Kpong GS and 90% for Bui GS. In terms of magnitude, Akosombo GS supply increased from 8.69 GWh per day in August 2017 to 9.38 GWh per day in September 2017, whiles Kpong GS increased from 1.8 GWh per day in August 2017 to 1.89 GWh per day in September 2017. Bui had the highest increase in September 2017 from 0.5 GWh per day in August 2017 to 0.95 GWh per day in September 2017. Consequent to the increase supply from the Akosombo GS, inflows into the Akosombo Dam reduced significantly from 0.212 ft per day in August 2017 to 0.093 ft per day in September 2017. On the contrary, whiles inflows into the Akosombo Dam declined in September 2017, inflows into the Bui Dam increased significantly from 0.159 ft per day in August 2017 to 0.382 ft per day in September 2017 despite the increase in generation.

Generation from the thermal power plants generally dropped marginally by 6.5% in September 2017. Supply from TAPCO, TICO, TTPP and Karpowership reduced by 8%, 32.4%, 17.1% and 3.9% respectively based on their average daily generation in September

Table 1 Projected and Actual Outturn of electricity demand and supply in August 2017

	September 2017		August 2017	
	Projected	Actual Outturn	Projected	Actual Outturn
Total Supply (GWh)	1,255.0	1,095.1	1,256.0	1,118.2
Source by Power Plants (GWh)				
AKOSOMBO	279.0	281.5	288.0	269.5
KPONG	55.0	56.8	57.0	55.6
BUI	69.0	29.6	71.0	15.4
Sunon Asogli	113.0	146.2	107.0	129.1
TAPCO	136.0	96.9	152.0	105.2
TICO	159.0	139.7	165.0	206.8
TT1PP	-	52.3	-	63.3
CENIT	-	-	-	-
TT2PP	-	-	-	-
MRP	-	-	-	-
Karpowership	145.0	103.3	155.0	107.5
AMERI	140.0	99.2	144.0	76.2
KTPP	-	-	-	-
Trojan Power	-	-	-	-
CENPOWER	-	-	-	-
AKSA	149.0	81.7	107.0	80.1
Total Generation (GWh)	1,245.0	1,087.1	1,246.0	1,108.8
Imports (GWh)	10.0	8.0	10.0	9.4
Total Supply (GWh)	1,255.0	1,095.1	1,256.0	1,118.2
Deficit (GWh)	-	(159.9)	-	(137.8)
Ghana Coincedent Peak Load (MW)	2,098.0	2,021.2	2,022.0	1,916.8
System Coincident Peak Load (MW)	2,271.0	2,021.2	2,195.0	1,929.8

2017. There were however increase in the average electricity supply by the Ameri, AKSA and Sunon Asogli power plants in September 2017 by 30%, 13.5% and 2.3% respectively but were not enough to increase its share in the total generation.

There was marginal increase in the natural gas flow rate in September 2017 from both the WAGP and AGPP. Natural gas supply from the WAGP increased marginally from 53.3 MMSCF per day in August 2017 to 54.05 MMSCF per day in September 2017. Likewise, natural gas supply from the AGPP increased from 95 MMSCF per day in August 2017 to 97.99 MMSCF per day in September 2017. The thermal power plants except Karpowership and AKSA continued to operate predominately on natural gas in September 2017 as in August 2017 especially power plants in the Aboadze Power Enclave.

There was a marginal increase in the System Peak Load in September 2017 compared to August 2017 by 91.4 MW from 1,929.8 MW to 2,021.2 MW. Likewise, the Ghana Peak Load increased by 104.4 MW from 1,916.8 MW in August 2017 to 2,021.2 MW in September 2017.

Electricity Demand and Supply

Electricity Demand

The System Peak Load increased marginally in September 2017 to 2,021.2 MW from 1,929.8 MW an increase of about 4.5% (91.4 MW). Similarly, the Ghana Peak Load has increased by about 5.4% (104.4 MW) from 1,916.8 MW in August 2017 to 2,021.2 MW in September 2017. The increase in the System Peak Load and Ghana Peak load in September 2017 compared to August 2017 was due to increase in peak load for the Akosombo GS.

Electricity supply

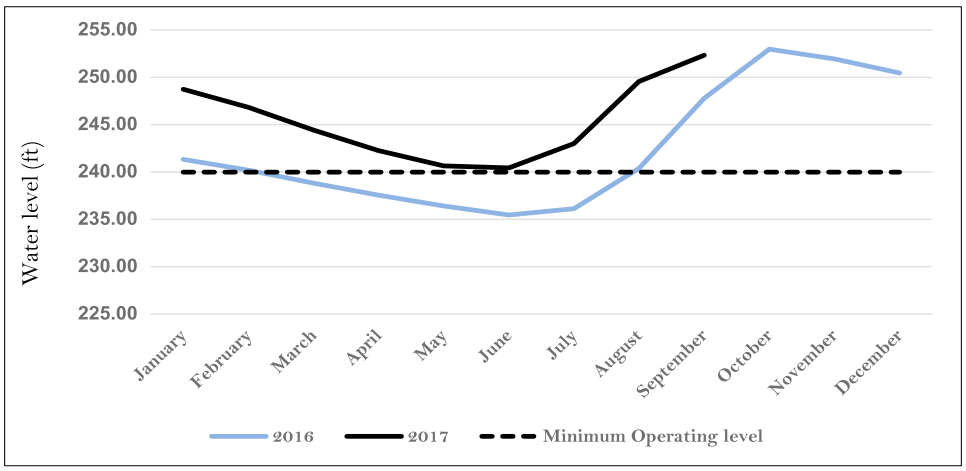
The marginal increase in the System Peak Load and Ghana Peak Load corresponded to marginal increase in electricity supply. Average daily electricity supplied to meet System requirement increased marginally to 36.5 GWh per day in September 2017 from 36.07 GWh per day recorded in August 2017. The total electricity supplied in September 2017 was 1,095.07 GWh consisting of 1,087.09 GWh from domestic generation and 7.98 GWh of imports from La Cote D'Ivoire. The total supply of electricity in September 2017 was 160 GWh lower than the 1,255 GWh projected under the Electricity Supply Plan (ESP) developed for the year 2017. This represents a 12.7% deviation between the outturn and the projection.

Hydro Dam Levels

Akosombo Dam Water Level continues to increase but at a reducing rate in September 2017

The rate of increase in the water level of the Akosombo dam increased at a reducing rate from 0.212 feet per day in August 2017 to 0.093 feet per day in September 2017. The water level increased at a reducing rate due to the reduced inflows into the dam and the marginal increase in electricity generation from the power plant. At the rate of increase, the water level is projected to reach a maximum of 255.23 ft by the end of the inflow cycle for 2017 which will be 2.25 ft above the maximum water level recorded in 2016. The water level increased by 2.78 feet in September 2017 from 249.57 feet at the beginning of the month to 252.35 feet at the end of the month. The water level at the end of September 2017 was also higher than the level at the same time in September 2016 by about 4.55 feet and 12.35 feet above the minimum operating level of 240 feet. Figure 1 shows comparative end of month trajectory of the level of water in the Akosombo dam from January 2016 to September 2017.

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

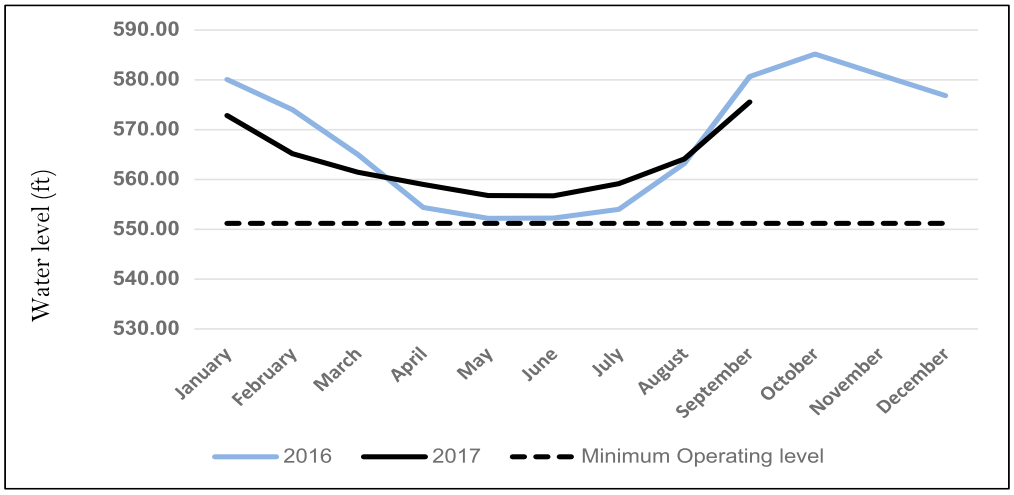


HIGHLIGHTS OF THE MONTH

Bui Dam Water Level continues to increase at an increasing rate in September 2017

The Bui dam water level continued to witness significant increases in September 2017. The water level for the Bui GS increased by 4.94 ft in August 2017 and 11.45 ft in September 2017 at an average of 0.159 feet per day in August 2017 and 0.381 feet per day in September 2017. The water level in September 2017 increased from 564.13 feet level at the beginning of the month to 575.57 feet at end of the month. The water level at the end of the month for Bui GS (575.57 feet) was however lower than the level of the dam at the same period in September 2016 (580.66 feet) by 5.09 feet. Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2016 to September 2017.

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



Fuel Supply for Power Generation

Natural gas consumption continued to dominate the fuel supply mix but it share in the total fuel supply mix decreased from 76% in August 2017 to 73% in September 2017 with liquid fuel accounting for the rest. Shares of natural gas supply from the WAGPCo in the total fuel supply remained the same in September 2017 at 26%. Also, natural gas supply from the AGPP decreased from 50% in August 2017 to 47% in September 2017. Shares of LCO consumption in the total fuel supply mix increased from no supply in August 2017 to 2% in September 2017. The share of HFO consumed in September 2017 increased to 25% of the total fuel mix from 24% in August 2017.

Figure 3a and Figure 3b shows the shares of sources of fuel and fuel type in the generation fuel mix for electricity generation respectively.

Figure 3a: Shares of sources of fuel in total fuel mix for power generation

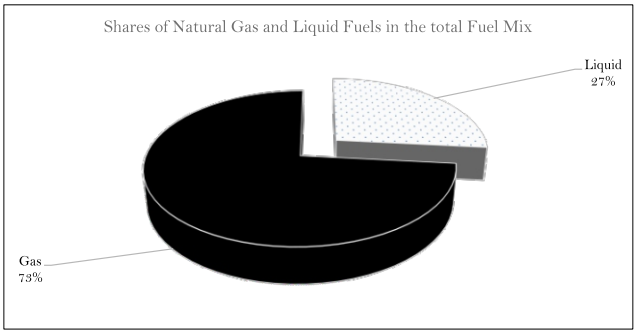
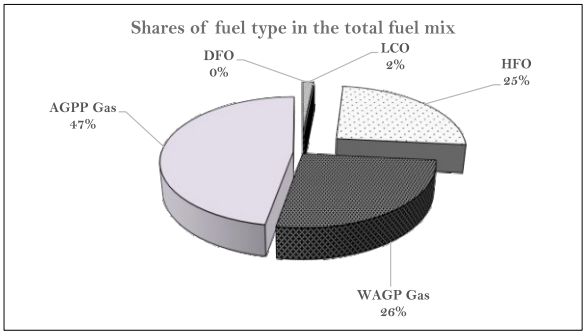


Figure 3b: Shares of fuel type in the generation fuel mix power generation



Natural gas flow rate from WAGPCo increased marginally despite a drop in consumption

Natural gas flow rate from Nigeria through the WAGP to Tema and Kpone increased marginally to 54.05 MMSCF per day in September 2017 from the 53.33 MMSCF per day recorded in August 2017. Total gas consumption decreased to 1,554.11 MMSCF in September 2017 from 1,608.22 MMSCF in August 2017 representing 4% reduction. The reduced natural gas consumption was due to the reduced generation from the TT1PP as a result of reduced natural gas pressure from the 3rd September 2017 to 9th September 2017. Natural gas consumption at the Tema and Kpone accounted for 36% of the total natural gas consumed in September 2017.

Natural gas flow rate from GNGC increased marginally

Natural gas flow rate from the AGPP to the Aboadze Power Enclave increased marginally from 94.99 MMSF per day in August 2017 to 97.99 MMSCF per day in September 2017. Total gas consumption at the Aboadze Power Enclave however reduced from 2,878.83 MMSCF in August 2017 to 2,624.88 MMSCF in September 2017, an 8.8% reduction in consumption. The reduced consumption at the Aboadze Power Enclave was due to the reduced generation from the TAPCO and TICO power plants as a result of technical challenges and grid demands. Natural gas supply from the AGPP accounted for 64% of the total natural gas consumption in

September 2017. Of the total natural gas supplied in September 2017, 34.6% was used by the Ameri Power Plant for electricity generation, 38.5% was used by TICO Power Plant whiles the remaining 26.9% was used by the TAPCO Power plant.

Figure 4a: Contribution of Gas Supply by sources

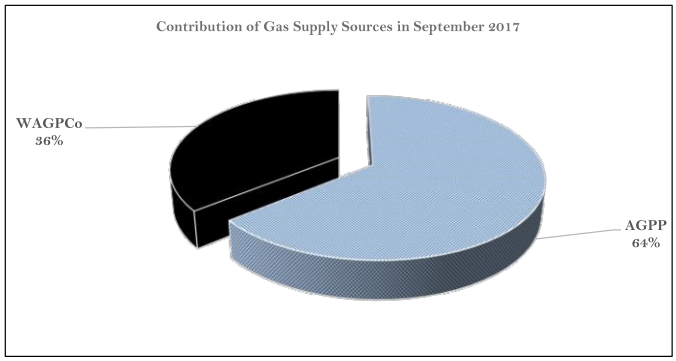
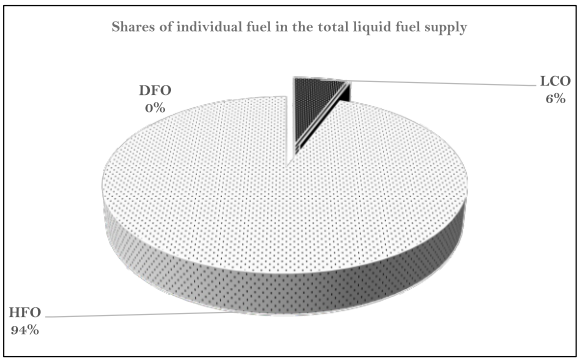


Figure 4b: Contribution of individual fuel in the liquid fuel supply



Liquid Fuel

Liquid fuel consumption increased by 5.7% from 257,364 barrels in August 2017 to 271,955 bbls in September 2017. This total comprised of only HFO, LCO and DFO used to start and stop the SAPP gas turbines were not consumed in September 2017. LCO constituted 6.4% of the total liquid fuel consumed whiles HFO constituted the rest. HFO was used by Karpowership and AKSA power plants. The Karpowership consumed 51.3% of the total liquid fuel consumed and 54.8% of the total HFO consumed whiles the AKSA Power Plant consumed 42.3% of the total liquid fuel consumed and 45.2% of the total HFO consumed.

Plant by Plant Highlights

Electricity Generation at the Akosombo Generation Station (GS) increased marginally in September 2017

The Akosombo GS witnessed a 4.4% increase in the electricity generated in the month of September 2017 from 269.49 GWh in August 2017 to 281.46 GWh. Average generation from the Akosombo GS increased from 8.69 GWh per day in August 2017 to 9.38 GWh per day in September 2017 due to decreased supply of electricity from the thermal sources. The Akosombo GS share of the total electricity supply increased from 25.5% in August 2017 to 25.7% in September 2017. The Akosombo GS generated 0.9% higher than the 279 GWh projected under the 2017 ESP. The Akosombo GS contributed 602 MW to meet both the System Peak Load and Ghana Peak Load in September 2017 which represent 29.8% of both the System and Ghana Peak Loads.

Electricity supply by Kpong Generation Station (GS) increase marginally in September 2017

The Kpong GS generated 2% higher in September 2017 as compared to its generation in August 2017. A total of 56.79 GWh was generated in September 2017, 1.14 GWh higher than the 55.65 GWh generated in August 2017. The Kpong GS generated an average of 1.89 GWh a day in September 2017 which was 5% higher than the 1.8 GWh generated in August 2017. Generation from the Kpong GS accounted for 5.2% of the total electricity supplied in September 2017 an improvement over the share of 5% in August 2017. The generation from the Kpong GS was 1.79GWh higher than the 55 GWh projected for September 2017 under the 2017 ESP. The Kpong GS contributed 111 MW to meet both the System Peak Load and Ghana Peak Load in September 2017 representing 5.5% System and Ghana Peak Loads in September 2017.

Electricity supply by the Bui Generation Station (GS) to increased significantly in September 2017

Electricity production from the Bui Power Plant increased significantly in September 2017 to 29.6 GWh (0.99 GWh per day) from 15.4 GWh (0.5 GWh per day) in August 2017. This represents an increase of 95.7% between September 2017 and August 2017, based on the daily average production of the months. The daily average generation suggests that the Bui GS operated largely with two units only at peak in September 2017. The Bui GS supplied 2.7% of the total electricity supplied in September 2017, higher than the 1.38 % supplied in August 2017. The total electricity generated in September 2017 from the Bui Power Plant was however over two folds lower than the 69 GWh projected to be generated in September under the 2017 Electricity Supply Plan (ESP). The Bui power plant contributed 100 MW to meet both the System Peak and Ghana Peak Loads which represents 5% of both the System and Ghana peak load.

Generation by the Sunon Asogli Power Plant (SAPP) increased marginally in September 2017

The continuous supply of natural gas enabled the Sunon Asogli Power Plant (SAPP) to operate for the whole month of September 2017, generating a total of 146.19 GWh of electricity (4.87 GWh per day), a significant increase from the 129.1 GWh (4.16 GWh per day) generated in August 2017. The Power Plant contributed 13.4% of the total electricity supplied in September 2017, an increase from the 11.6% recorded in August 2017 and higher than the 9% projected under the 2017 ESP for September 2017. The SAPP contributed 207.5 MW to meet the System Peak Load and Ghana Peak Load representing 10.3% of the System and Ghana Peak Load in September 2017. The SAPP consumed a total of 967.78 MMSCF of natural gas and 17,570 bbls of LCO at an estimated heat rate of 7,520.76 Btu/kWh, a significant reduction in fuel efficiency as compared to 7,185.55 Btu/KWh recorded in August 2017.

CENIT Power Plant continued to be offline in September 2017

The CENIT Power Plant was offline for the whole of September 2017 due to low levels of Light Crude Oil (LCO) stocks to power the plant and system demands. The Power Plant was also correctly projected to be offline in September 2017 under the 2017 ESP.

Ameri Energy Power Plant generation increase significantly in September 2017

Electricity generation from the Ameri Energy Power Plant increased sinificantly from 2.46 GWh per day in August 2017 to 3.31 GWh per day in September 2017. The total electricity generation of 99.18 GWh in September 2017 was also higher than the 76.22 GWh

supplied in August 2017. The increase in supply from the Ameri Power Plant was due to the reduced generation from the TICO and TAPCO power plant making natural gas available to power the Ameri power plants. The Ameri Power Plant generated 29.2% lower than the 140 GWh projected under the 2017 ESP. The total electricity generated by Ameri Power Plant in September 2017 represented 3.2% of total electricity supplied in the month which was higher than the 2.5% recorded in August 2017. The Ameri Power Plant consumed 862.72 MMSCF of natural gas, 204 MMSCF higher than in August 2017 to generate the 99.18 GWh of electricity at an estimated average heat rate of 10,098.06 Btu/kWh a marginal decrease in fuel efficiency from the 10,037.55 Btu/kWh recorded in August 2017. The Ameri Power Plant contributed 99.1 MW to meet both the System Peak Load and Ghana Peak Load in September 2017, representing 4.9% of the System and Ghana peak Load.

Kpone Thermal Power Plant (KTPP) continues to be offline

The KTPP was offline for the whole of September 2017 due system demands. The Power Plant was also correctly projected to be offline in September 2017 under the 2017 ESP.

The Karpowership Power Plant generation dropped marginally

The new 470 MW power ship which arrived on the 28th August 2017 begun preparation for commissioning in September 2017 and therefore did not supply any electricity into the grid. The 225 MW karpowership on the otherhand operated for 27 days in September 2017. It generated 0.26% lower in September 2017 than in August 2017 from an average of 3.84 GWh per day to 3.83 GWh per day. Total electricity supplied by Karpowership of 103.35 GWh in September 2017 was also 3.9% lower than the 107.49 GWh generated in August 2017 and 27.8% lower than the 145 GWh projected under the 2017 ESP. The Power ship contributed 9.4% of the total electricity supplied in September 2017, which is lower than its contribution of 9.6% in August 2017 and 11.5% projected under the 2017 ESP. The Karpowership also contributed 183.2 MW to meet both the System Peak Load and Ghana Peak Loads in September 2017 representing 9.1% of the System and Ghana Peak Load. The Karpowership Power Plant consumed 139,379 barrels of Heavy Fuel oil (HFO) to generate the 103.35 GWh in September 2017 at an average heat rate of 8,145.95 Btu/kWh which is a marginal decline in fuel efficiency of 8,101.85 Btu/kWh recorded in August 2017.

AKSA Power Plant generation increased marginally in September 2017

The AKSA power plant had a marginal increase in its electricity generation in September 2017 from 2.58 GWh per day in August 2017 to 2.72 GWh per day in September 2017. The AKSA power plant generated a total of 80.09 GWh in August 2017 which was also 1.61 GWh lower than it generated in September 2017 and significantly lower than the 149 GWh projected under the 2017 ESP. The Power Plant supplied 7.4% of the total electricity supplied in September 2017, which is marginally higher than the 7.2% supplied in August 2017. The Power Plant contributed 122.4 MW to meet both the System Peak Load and the Ghana Peak Load in September 2017 representing 6.1% of the System and Ghana Peak Loads in September 2017. A total of 115,006 barrels of HFO was consumed by the AKSA Power Plant at an average heat rate of 8,502.52 Btu/kWh a marginal improvement from the 8,535.61 Btu/kWh recorded in August 2017.

Takoradi International Company (TICO) generation in September 2017 dropped significantly

The TICO Power plant electricity supply in September 2017 dropped significantly to 139.67 GWh (4.66 GWh per day) from 206.79 GWh (6.67 GWh per day) in August 2017 due to technical issues and grid demands from the 2nd to 17th September 2017. The TICO Power Plant electricity supply of 139.67 GWh constituted about 12.8% of the total electricity supply in September 2017, marginally lower than the 18.49% recorded in August 2017 but higher than the 12.6% under the 2017 ESP. The TICO Power Plant contributed 336 MW to meet both the System Peak Load and Ghana Peak Load in September 2017, representing 16.6% of the System and Ghana Peak Loads. The Power Plant operated on natural gas consuming about 1,038.57 MMSCF of natural gas to produce the 139.67 GWh of electricity at an estimated average heat rate of 7,985.12 Btu/kWh, a reduction in fuel efficiency over the 7,616.89 Btu/kWh recorded in August 2017.

Takoradi Power Company (TAPCO) Plant dipped in September 2017

The TAPCO Power plant generation dipped marginally from 3.63 GWh per day in August 2017 to 3.23 GWh per day in September 2017 due to technical challenges. Likewise, total supply reduced from 105.24 GWh in August 2017 to 96.87 GWh in September 2017. The power plant contributed 8.9% of the total electricity supplied in September 2017 lower than the 9.4% recorded in August 2017. The TAPCO Power Plant in September 2017 contributed 154 MW to meet both the System Peak Load and Ghana Peak Load, representing 7.6% of the System and Ghana Peak loads. The Power Plant operated on natural gas in September 2017 consuming about 723.59 MMSCF of natural gas to produce the 96.87 GWh of electricity at an estimated average heat rate of 8,020.96 Btu/kWh, a reduction in the fuel efficiency over the 7,684.02 Btu/kWh recorded in August 2017.

Tema Thermal 1 Power Plant (TT1PP) generation dropped in September 2017

Low gas pressure limited the operational period of the TT1PP to 27 day in September 2017, generating a total of 52.28 GWh which was 11.01 GWh lower than it generated in August. The power plant contributed 4.8% of the total electricity supplied in September 2017, lower than the 5.7% supplied in August 2018. The power plant contributed 106 MW to both the System Peak Load and Ghana Peak Load in August 2017, representing 5.2% of the System and Ghana Peak Loads. A total of 577.33 MMSCF of natural gas was used to generate 52.28 GWh of electricity at an average heat rate of 11,484.77 Btu/kWh a significant improvement over the 11,770.02 Btu/kWh recorded in August 2017.

Trojan Power Plant continues to be offline in September 2017

The Trojan Power Plants in both Tema and Kumasi have been offline since July 2017 due to fuel supply challenges.

Electricity Exchange – Imports and export decreased whiles Ghana still remained a net importer of electricity

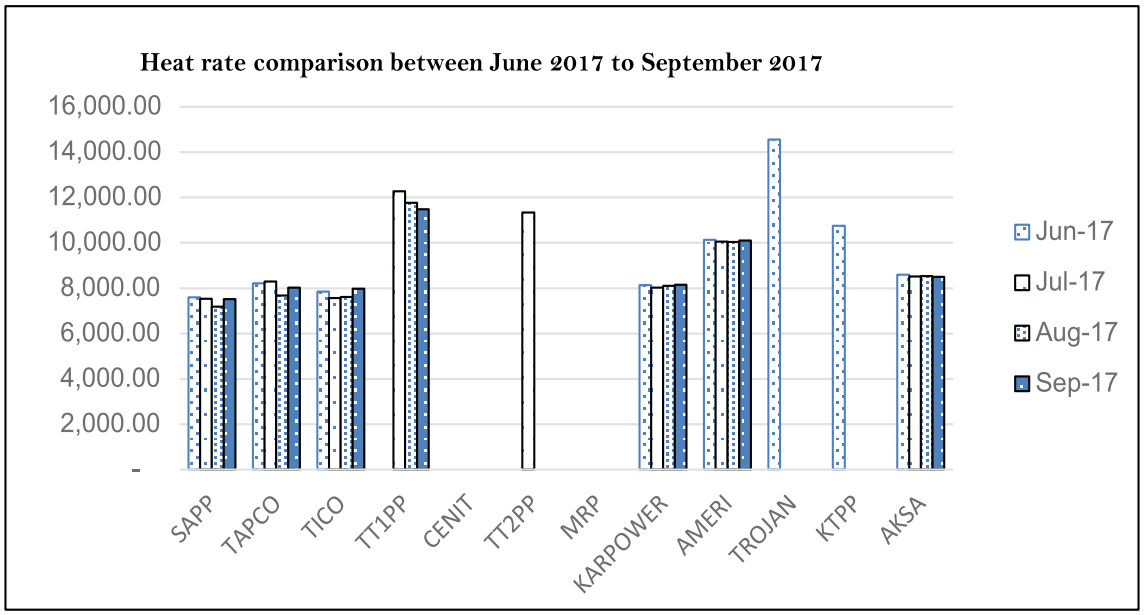
Electricity imports from La Cote D'Ivoire decreased to 7.98 GWh in September 2017 from 9.38 GWh in August 2017. Total import in September 2017 was also marginally lower than the 10 GWh projected under the 2017 ESP. Electricity import contributed 0.73% of the total electricity supplied in September 2017. Daily peak import in September 2017 reached a maximum of 38 MW and did not contribute to both the System Peak Load and Ghana Peak Load.

Electricity export to CEB increased marginally from 4.51 GWh in August 2017 to 5.28 GWh in September 2017 and was significantly lower than the 77 GWh projected under 2017 ESP. Ghana was a net importer of electricity in September 2017.

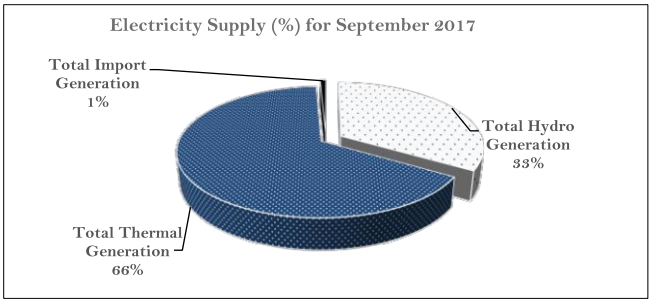
OPERATIONAL FACT SHEET

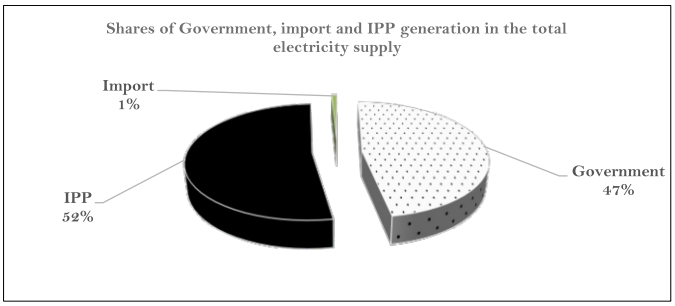
Peak Electricity Supply – September 2017			
Source of Supply	Generation at System Peak Load of September 2017 (MW)	Generation at Ghana Peak Load of September 2017 (MW)	Eleectricity Supply (GWh)
AKOSOMBO	602.00	602.00	281.46
KPONG	111.00	111.00	56.79
BUI	100.00	100.00	29.60
SAPP	207.50	207.50	146.19
TAPCO	154.00	154.00	96.87
TICO	336.00	336.00	139.67
TT1PP	106.00	106.00	52.28
CENIT	–	–	–
TT2PP	–	–	–
MRP	–	–	–
KARPOWER	183.20	183.20	103.35
AMERI	99.10	99.10	99.18
KTPP	–	–	–
Trojan Power	–	–	–
CENPOWER	–	–	–
AKSA	122.40	122.40	81.70
IMPORT	–	–	7.98
Export		–	5.28
System Coincident Peak Load	2,021.20	–	–
Ghana Coincedent Peak Load	–	2,021.20	–
Total Supply	–	–	1,095.07
Total Supply without export	–	–	1,089.79

Ghana Electricity Demand		
		Sep-17
Maximum System Peak Load	MW	2,021.2
Minimum System Peak Load	MW	1,709.0
Average Peak Generation	MW	1,892.3
System Base Load	MW	932.2
Total Electricity	GWh	1,095.1
Load Factor (LF)	%	72.8



OPERATIONAL FACT SHEET





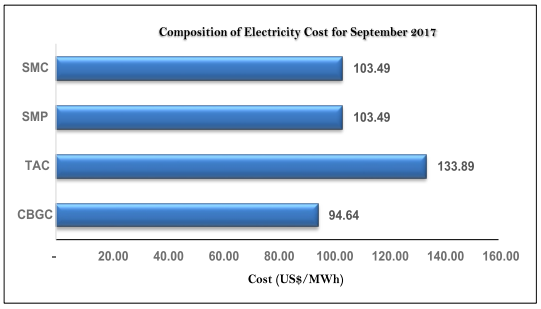
Power Plant Data for September 2017							
	Dependable Capacity (MW)	Plant Capacity Utilization (%)	Electricity Generation (GWh)	Gas Consumption (MMBtu)	LCO Consumption (MMBtu)	DFO Consumption (MMBtu)	HFO Consumption (MMBtu)
Akosombo	900.00	43.43	281.46	-	-	-	-
Kpong	140.00	56.34	56.79	-	-	-	-
Bui	340.00	12.09	29.60	-	-	-	-
SEAP	500.00	40.61	146.19	1,006,491.73	92,942.78	-	-
TAPCO	300.00	44.85	96.87	777,014.55	-	-	-
TICO	300.00	64.66	139.67	1,115,247.64	-	-	-
TT1PP	110.00	66.01	52.28	600,423.91	-	-	-
CENIT	110.00	-	-	-	-	-	-
TT2PP	45.00	-	-	-	-	-	-
MRP	70.00	-	-	-	-	-	-
KARPOWER	225.00	63.79	103.35	-	-	-	841,848.89
AMERI	230.00	59.89	99.18	1,001,556.38	-	-	-
TROJAN	56.00	-	-	-	-	-	-
KTPP	200.00	-	-	-	-	-	-
AKSA	230.00	49.33	81.70	-	-	-	694,636.71
Total	**3,756.00**	40.20	**1,087.09**	**4,500,734.22**	**92,942.78**		**841,848.89**

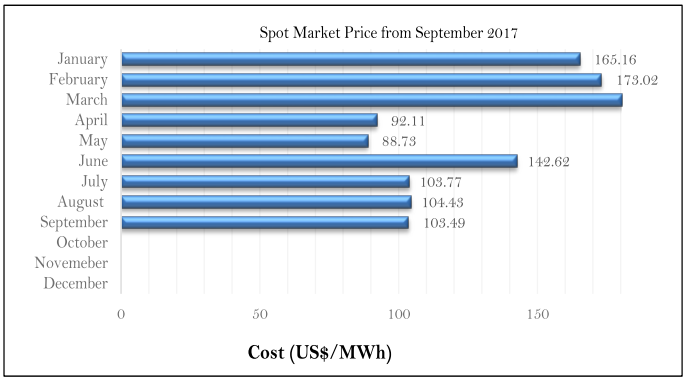
	Average Gas Flow (MMScfd) - September 2017				
Location	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Monthly Average**
Etoki	32.79	67.39	74.12	73.93	**63.24**
Tema	35.74	48.07	65.88	63.74	**54.05**
Aboadze	88.80	100.70	101.90	99.98	**97.99**

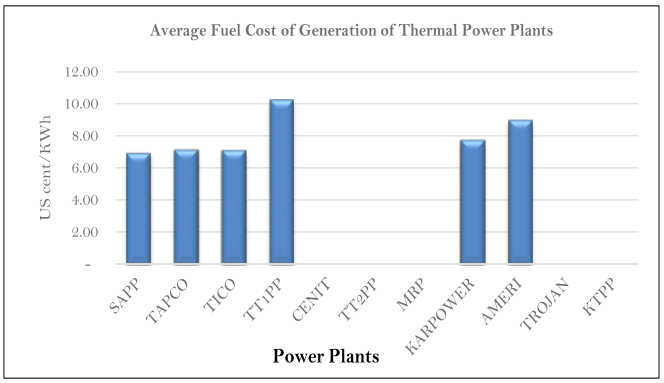
	Water Level (ft) - September 2017				Change in water level
Hydro Dam	**Week 1**	**Week 2**	**Week 3**	**Week 4**	(feet)
Akosombo	249.57	250.26	251.05	252.35	2.78
Bui	564.13	567.08	571.31	575.57	11.45

ECONOMIC FACT SHEET

		Sep-17	Aug-17	Change
Average Market Energy Cost	US$/MWh	83.33	77.76	5.57
Average Market Capacity Charge (AMCC)	US$/MWh	50.55	22.85	27.70
Total Average Market Cost (TAC)	US$/MWh	133.89	100.61	33.28
System Marginal Cost (SMC)	US$/MWh	103.49	108.96	(5.47)
System Marginal Capacity Charge (SMCC)	US$/MWh	-	-	-
Spot Market Price (SMP)	US$/MWh	103.49	108.96	(5.47)
Composite Bulk Generation Charge (CBGC)	US$/MWh	94.64	94.64	-
Deviation of TAC from CBGC	US$/MWh	(39.25)	(13.78)	(25.46)
Deviation of SMP from CBGC	US$/MWh	(8.85)	(14.32)	5.47

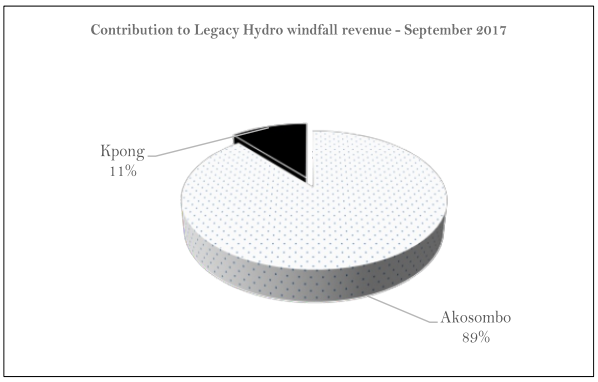






Sep-17				
	Average Cost	Average SMP	Difference	Windfall Revenue
Power Plant	US$/MWh	US$/MWh	US$/MWh	US$/MWh
Akosombo	33.10	103.49	70.39	19,810,632.40
Kpong	59.20	103.49	44.29	2,515,134.80
Total	92.30	-	-	22,325,767.20

Average Fuel Prices		
		Sep-17
Fuel Type	Unit	Delivered Cost
Natural Gas	US$/MMBtu	8.73
LCO	US$/BBL	63.00
HFO (Karpowership)	US$/Tonne	364.02
HFO (Tema)	US$/Tonne	384.02
DFO	US$/Tonne	621.00



1.0 Financial Sustainability of the Power Sector

1.1 Ability to Recover Cost

1.1.1 Electricity generation unit cost

The ability to recover the cost of the electricity generated (fixed cost and variable cost) in the second quarter of 2017 was similar to the situation in the first quarter of 2017 where the gazetted BGT were lower than the average cost of generation. Average cost of generation increased from GHp40.09/kWh in April 2017 to GHp46.37kWh in June 2017 due to the reduction in hydro generation and increasing use of liquid fuel, that is, DFO, HFO and LCO which are more expensive than natural gas. Liquid fuel prices were on the average 29% higher than the average natural gas prices in April 2017, 28% higher in May 2017 and 32% higher in June 2017. Therefore average cost of generation was GHp4.12/kWh higher than the PURC gazette tariff of GHp35.97/kWh in April 2017, GHp6.56/kWh in May 2017 and GHp10.4/kWh in June 2017

Table 1.1.1 shows the comparison between the cost of generation of power plants from April 2017 to June 2017 with the approve BGT tariff by the PURC showing the effect of exchange rate variability on the ability to recover cost. Analysis A presents the BGT in terms of GHp which is the predominate currency for payment in the regulated market. Analysis B present the effect of exchange rate on the BGT.

Table 1.1.1 Comparison between cost of generation and PURC approve tariff from April 2017 to June 2017

	Apr-17	May-17	Jun-17
Cost of Generation (GHp/kWh)	40.09	42.53	46.37
PURC CBGT (GHp/kWh)	35.97	35.97	35.97
Difference (GHp/kWh)	-4.12	-6.56	-10.40
Cost of Generation (USCent/kWh)	9.57	9.92	10.63
PURC CBGT (USCent/kWh)	9.48	9.48	9.48
Difference (USCent/kWh)	-0.09	-0.44	-1.15
Average Monthly Exchange rate (GHS/US$)	4.19	4.29	4.36

The effect of exchange rate were not very significant as average generation prices were higher than the gazette tariff in US dollar terms. The ability to recover cost were not clearly meet in the second quarter of 2017.

1.2 Ability to reliability meet demand

1.2.1 Ratio of installed capacity to Demand and Capacity Factor

The ratio of installed capacity to demand measures the extent to which our installed capacity adequately meets demand. Globally, this ratio is above 2.0 in all the economic classes of the economy and other regions of the world and averages 2.5. The ratio of installed capacity to demand for Ghana was lower than the average 2.5 in all the three month in the second quarter of 2017. It was also 1.21 point lower than its peers in the lower middle income economies for April 2017 and May 2017 and 1.14 points lower in June 2017. This notwithstanding, our installed capacity was at least 89% higher than our demand.

The capacity factor of a power system measures the extent to which the supply system is being utilized. Despite the fact that installed capacity was on the average 1.9 time higher than demand for the second quarter of 2017, only 44% of these capacity were utilized in April 2017, 43% in May 2017 and 42% in June 2017. The capacity factor fell 6% short in April, 7% short in May 2017 and 8% short in June 2017 compared with the average (50%) of the other economies but was higher than the average for the low income economies. This below average capacity factor is due to technical and fuel supply challenges as well as the reduced demand in June 2017. There were however no load shedding within the period with imports used to make up for the short falls.

Table 1.2.1 Ratio of installed capacity to demand and capacity factor for the second quarter of 2017

	April 2017 indicator							
	Ghana	World	SSA	OECD	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Ratio Installed capacity to Demand	1.89	2.6	2.2	2.3	2.5	2.4	3.1	2.9
Capacity Factor	0.44	0.5	0.5	0.5	0.5	0.5	0.5	0.4

	May 2017 indicator							
	Ghana	World	SSA	OECD	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Ratio Installed capacity to Demand	1.89	2.6	2.2	2.3	2.5	2.4	3.1	2.9
Capacity Factor	0.43	0.5	0.5	0.5	0.5	0.5	0.5	0.4

	June 2017 indicator							
	Ghana	World	SSA	OECD	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Ratio Installed capacity to Demand	1.96	2.6	2.2	2.3	2.5	2.4	3.1	2.9
Capacity Factor	0.42	0.5	0.5	0.5	0.5	0.5	0.5	0.4

1.2.2 Reserve Margin

The reserve margin of supply system serves as an indicator in measuring the reliability of a power system. The reserve margin, especially the constrained reserve margin throws more light on the low capacity utilization. Constrained reserve margin takes into consideration planned maintenance, unplanned maintenance and fuel supply difficulties. That is, power plants that are technically available, has fuel available and could come up online when needed within the period under study.

Table 1.2.2 Constrained and unconstrained reserve margin

	Apr-17	May-17	Jun-17
Constrained Reserve margin (%)	3.71	2.92	4.01
Uncontrained reserve margin (%)	46.96	47.03	49.00

Available capacities were just enough to meet demand with lower than 5% reserve margin. These reserve margins is far below the 18% to 25% recommended by the International Energy Agency (IEA). There was however over 43% capacity unavailable due to technical and fuel supply challenges.

1.3 Ability to make investments

1.3.1 Capacity Annual Growth and Ratio of installed Capacity growth to demand growth

This indicator measures the annual growth in the installed capacity as a means of our ability to make investment in the power sector. Installed capacity grew by 23.57% between April 2016 and April 2017, 23.57% between May 2016 and May 2017 and 15.84% between June 2016 and June 2017. This growth was higher than the indicators recorded for SSA, High income economies, Upper middle income economies, Lower middle income economies and low income economies as shown in table 1.4 below. That is, Ghana has made significant new investment in generation capacity primarily from the KTPP which came online in June 2016 and the emergency power plants, AKSA which came online with part capacity (160 MW instead of 250 MW) in March 2017.

Table 1.3.1 Capacity annual growth and Ratio of installed capacity growth to demand growth

	April 2017 indicator					
	Ghana	SSA	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Capacity annaul growth (%)	23.57	3.1	3.1	2.7	3.9	3.4
Ratio of installed capacity growth to demand growth	3.36	0.2	0.6	0.7	0.3	0.02

	May 2017 indicator					
	Ghana	SSA	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Capacity annaul growth (%)	23.57	3.1	3.1	2.7	3.9	3.4
Ratio of installed capacity growth to demand growth	3.22	0.2	0.6	0.7	0.3	0.02

	June 2017 indicator					
	Ghana	SSA	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Capacity annaul growth (%)	15.84	3.1	3.1	2.7	3.9	3.4
Ratio of installed capacity growth to demand growth	1.55	0.2	0.6	0.7	0.3	0.02

A 23.6% and 18.7% growth in capacity will not be important if it is not able to meet the growth in demand. The indicator that measures the ability of the growth in capacity to meet the growth in demand is the ratio of the growth installed in capacity to growth in demand. Ghana's capacity growth to meet demand growth were significantly higher than the average recorded for SSA, High Income economies, Upper middle income economies, Lower middle income economies and low income economies as seen in table 1.3.1. This attest to the fact that the capacity additions were enough to meet our demand growth for the second quarter of 2017.

1.4 Ability to operate according to environmental and social norms

1.4.1 Emission factor and Fossil fuel dependency

With declining supply of hydro generation in the second quarter of 2017, thermal power plants shares increased above 50% of the total electricity supplied. Fossil fuel dependency increased from 47.5% in March 2017 to 54.1% in April 2017 and 67.32% in June 2017. Thermal power generation has become increasingly important in electricity supply with the increasing drop in water level of the hydro power plants limiting the amount of hydro supply in the second quarter of 2017. Ghana continue to have lower fossil fuel dependency than it peers in lower middle income economies (59.4%) and the world average (60.7%).

The Plant utilisation factors of the various plants is contained in table 2.1. water level of the hydro power plants limiting the amount of hydro supply in the second quarter of 2017. Ghana continue to have lower fossil fuel dependency than it peers in lower middle income economies (59.4%) and the world average (60.7%).

The emission factors for the first quarter of 2017 is revised and is shown in table 1.4.1. The correction became necessary when calculation errors where witnessed in the August edition.

Table 1.4.1 Revised emission factor for the first quarter of 2017

	January	February	March	Average
Revised emission factor (kgCO2/kWh)	0.36	0.22	0.30	0.29

With the increase in fossil fuel dependency in the second quarter of 2017 to an average of 59.3% from 44.6% in the first quarter of 2017, it is expected that the emission factor for the second quarter will be higher than the first quarter. Average emission factor for the second quarter of 2017 increased from an average of 0.29 kgCO2/kWh in the first quarter of 2017 to 0.34 kgCO2/kWh in the second quarter of 2017. The emission factor reached it maximum in the first half of the year at 0.37 kgCO2/kWh in June 2017 when the fuel dependency reached its peak of 67.3% in June 2017. On the average, Ghana's emission factor for the second quarter of 2017 of 0.34 kgCO2/kWh was lower than the world average (0.6 kgCO2/kWh), high income economies (0.9 kgCO2/kWh) and upper middle income economies (0.7 kgCO2/kWh). The average of 0.34 kgCO2/kWh was however marginally higher than the average for lower middle income (0.5 kgCO2/kWh) and average for South Saharan Africa (0.5 kgCO2/kWh) but marginally higher than the average of the low income economies (0.3 kgCO2/kWh). Table 1.4.2 compares Ghana's emission factor and fossil fuel dependency with indicators from economies and region of the world.

Table 1.4.2 Emission Factor and Fossil fuel dependency

	April 2017 indicator						
	Ghana	World	SSA	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Emission Factor ($KgCO_2$/kWh)	0.30	0.6	0.5	0.9	0.7	0.5	0.3
Fossil fuel dependency (%)	52.56	60.7	45.3	84.4	66.4	59.4	40.6

	May 2017 indicator						
	Ghana	World	SSA	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Emission Factor ($KgCO_2$/kWh)	0.34	0.6	0.5	0.9	0.7	0.5	0.3
Fossil fuel dependency (%)	57.95	60.7	45.3	84.4	66.4	59.4	40.6

	June 2017 indicator						
	Ghana	World	SSA	High Income Non-OECD	Upper Middle Income	Lower Middle Income	Low Income
Emission Factor ($KgCO_2$/kWh)	0.37	0.6	0.5	0.9	0.7	0.5	0.3
Fossil fuel dependency (%)	67.32	60.7	45.3	84.4	66.4	59.4	40.6

1.4 Conclusions

Ghana continue to have healthy growth in capacity primarily due to the emergency power plants procured in 2016. Capacity grew by a minimum of 15% in the second quarter of 2017 and was adequate in meeting our growing demand in the second quarter of 2017. Reserve margins (constrained) continues to be below 5% in the second quarter of 2017 due to fuel and technical challenges. Fossil fuel dependency continues to increase in the second quarter of 2017 due to reduced hydro generation as a result of low water levels. With the increase in fossil fuel dependency, emission factor for the second quarter of 2017 increased from an average of 0.29 kgCO2/kWh in the first quarter of 2017 to 0.34 kg of CO2/kWh of electricity produced due to increased consumption of liquid fuel.

2.0 Performance Indicators of Power Plants

2.1 Capacity Utilization Factor (CUF)

The hydro power plants CUF increased again in September 2017 after it declined in July 2017. Akosombo GS had a marginal increase in its CUF in September 2017 from 40.3% in August 2017 to 43.4% in September 2017, Kpong GS CUF also increased marginally from 53.4% in August 2017 to 56.3% in September 2017. Likewise, the Bui GS had 98.2% increase in its CUF in September 2017 from 6.1% in August 2017 to 12.1% in September 2017. The general increase in the CUF for the hydro power plants attest to the increase in hydro supply in September 2017 (35.6%) as compared to August 2017 (30.5%).

Except for the Ameri Power Plant, there was a general decline in the CUF of thermal power plants in September 2017. The TICO power plant had the highest decline in its CUF from 92.65% in August 2017 to 64.66% in September 2017. TAPCO, TTIPP, AKSA and Kapowership all had marginal reductions in their CUF in September 2017 compared to August 2017. Ameri power plant which had a marginal increase in its CUF in September 2017 with an increase of about 15.35% over the 44.54% recorded in August 2017.

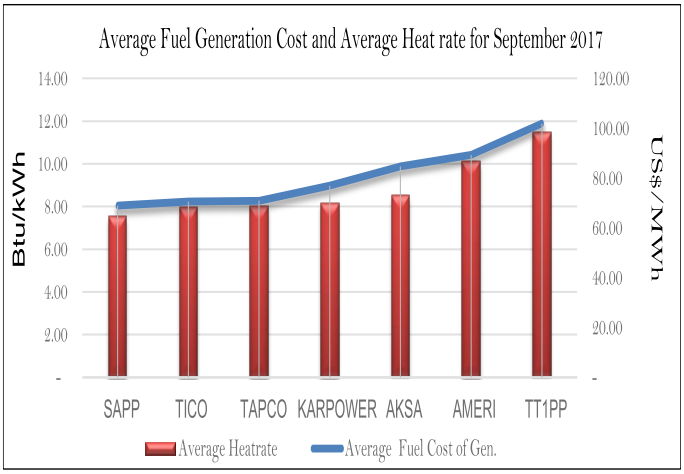
The System Load Factor (LF) reduced marginally from 77.9% in August 2017 to 72.8% in September 2017.

The Plant utilisation factors of the various plants is contained in table 2.1.

Table 2.1.1: 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	43.43	-	-
Kpong	56.34	-	-
Bui	12.09	-	-
SAPP	40.61	7,520.76	68.92
TAPCO	44.85	8,020.96	70.91
TICO	64.66	7,985.12	70.59
TT1PP	66.01	11,484.77	101.90
CENIT	-	-	-
TT2PP	-	-	-
MRP	-	-	-
KARPOWER	63.79	8,145.95	76.92
AMERI	59.89	10,098.06	89.27
TROJAN	-	-	-
KTPP	-	-	-
AKSA	49.33	8,502.52	84.69

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



2.2 Heat Rate (Fuel Efficiency)

There was a significant decline in the heat rate of the SAPP in September 2017 compared to August 2017. The fuel efficiency declined from 7,185.53 Btu/kWh in August 2017 to 7,520.76 Btu/kWh in September 2017. Likewise, the fuel efficiency of TAPCO, Ameri, Karpowership and TICO all had marginal decline in September 2017. TAPCO and TICO had decline in their fuel efficiency from 7,684.02 Btu/kWh and 7,616.89 Btu/kWh respectively in August 2017 to 8,020.96 Btu/kWh and 7,985.12 Btu/kWh respectively in September 2017. Also, Ameri and Karpowership power plants had marginal decline in their fuel efficiency from 10,037.88 Btu/kWh and 8,101.85 Btu/kWh respectively in August 2017 to 10,098.06 Btu/kWh and 8,145.95 Btu/kWh respectively in September 2017. There were however improvement in the heat rate for AKSA and TT1PP with fuel efficiency increasing from 8,535.61 Btu/kWh and 11,769.99 Btu/kWh in August 2017 respectively to 8,502.52 Bu/kWh and 11,484.77 Btu/kWh in September 2017 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.

2.3 Average Fuel Cost of Electricity Generation

There were generally increases in the average fuel cost of generation of all the thermal power plants except TT1PP in September 2017 compared to August 2017 due to the decline in fuel efficiency and increases in liquid fuel prices. TT1PP had an improvement in its fuel cost of generation from US$104.43/MWh in August 2017 to US$101.9/MWh in September 2017 due to improvement in fuel efficiency. The SAPP which had a decline in its fuel efficiency but was the most efficient thermal power plant in September had an increase in its fuel cost of generation from US$63.75/MWh in August 2017 to US$68.92/MWh in September 2017 due to decline in its fuel efficiency and increased average LCO cost. The TAPCO and TICO also had an increase in their fuel cost of generation from US$67.93/MWh and US$67.33/MWh respectively in August 2017 to US$70.91/MWh and US$70.59/MWh respectively in September 2017 due to decline in fuel efficiency. The AKSA and Karpowership power plants like the TICO and TAPCO power plants had increase in their fuel cost of generation from US$71.86/MWh and US$80.1/MWh respectively in August 2017 to US$76.92/MWh and US$84.69/MWh respectively in September 2017. This was primarily due to increase in HFO cost from US$8.87/MMBtu and US$9.38/MMBtu for Karpowership and AKSA in August 2017 respectively to US$9.44/MMBtu and US$9.96/MMBtu respectively.

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
EMOP = Electricity Market Oversight Panel
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
LTA = Long Term Average
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 1 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

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