



# GHANA WHOLESAL ELEC TRICIT Y MARKET BULLETIN

## MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 24: 1<sup>st</sup> December 2017 to 31<sup>st</sup> December 2017

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1<sup>st</sup> December, 2017 to 31<sup>st</sup> December, 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 presents the full year summary report of the Wholesale Electricity Market (WEM).

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

Electricity supply reduced marginally in December 2017 from 40.71 GWh per day in November 2017 to 40.39 GWh per day in December 2017. This is attributable to the reduced supply from the hydro power plants from 12.78 GWh per day in November 2017 to 12.36 GWh per day in December 2017. Thermal generation increased marginally from 27.69 GWh per day in November 2017 to 27.77 GWh per day in December 2017. Despite the drop in generation of the Akosombo GS, the rate of drop in the water level increased in December 2017 to 0.036 feet per day from 0.024 feet per day in November 2017. On the contrary, the Bui GS had a reduced rate of drop of its water level from 0.083 feet per day in November 2017 to 0.074 feet per day in December 2017.

There was a marginal increase in fuel consumption in December 2017 by 4.6%. Natural gas flow rate from the AGPP increased to 103.19 MMSCF per day in December 2017 from 100.5 MMSCF per day recorded in November 2017. On the contrary, natural gas flow rate from the WAGP decreased to 38.09 MMSCF per day in December 2017 from 40.62 MMSCF per day recorded in November 2017.

There was an increase in the System peak demand in December 2017 compared to that of November 2017 by 12.8 MW to 2,134.9MW from 2,122.1 MW in November 2017. Likewise, the Ghana Peak Demand increased by 8.6 MW to 2,127.7 MW in December from 2,119.1 MW in November 2017.

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

	December 2017		November 2017	
	Projected	Actual Outturn	Projected	Actual Outturn
Total Supply (GWh)	1,407.0	1,252.2	1,344.0	1,221.4
Source by Power Plants (GWh)				
AKOSOMBO	288.0	286.9	279.0	278.1
KPONG	57.0	55.1	55.0	54.8
BUI	71.0	41.1	69.0	50.5
Sunon Asogli	180.0	163.6	151.0	182.6
TAPCO	162.0	97.7	158.0	54.9
TICO	182.0	220.7	176.0	214.8
TT1PP	-	15.5	-	20.9
CENIT	-	-	-	-
TT2PP	-	-	-	-
MRP	-	-	-	-
Karpowership	160.0	195.1	145.0	156.3
AMERI	145.0	82.6	140.0	102.9
KTPP	-	2.0	-	0.0
Trojan Power	-	-	-	-
CENPOWER	-	-	-	-
AKSA	152.0	83.9	161.0	98.2
Total Generation (GWh)	1,397.0	1,244.1	1,334.0	1,214.2
Imports (GWh)	10.0	8.1	10.0	7.3
Total Supply (GWh)	1,407.0	1,252.2	1,344.0	1,221.4
Deficit (GWh)	-	(154.8)	-	(122.6)
Ghana Coincident Peak Load (MW)	2,211.0	2,127.7	2,140.0	2,119.1
System Coincident Peak Load (MW)	2,384.0	2,134.9	2,313.0	2,122.1

## HIGHLIGHTS OF THE MONTH

### Electricity Demand and Supply

#### Electricity Demand

The System Peak Load continued to increase further in December 2017 to 2134.9 MW from 2,122.1 MW in November 2017 and 2,126.9 MW in October 2017. Similarly, the Ghana Peak Load increased marginally by 7.8 MW to 2,127.7 MW in December 2017 from 2,119.1 MW in November 2017. Hydro generation contributed 42.8% of the System Peak Load and 40.4% of the Ghana Peak Load while thermal generation contributed the rest. These shares were marginally lower than the shares of 46.7% for System Peak Load and 46.8% for Ghana Peak Load recorded in November 2017.

#### Electricity supply

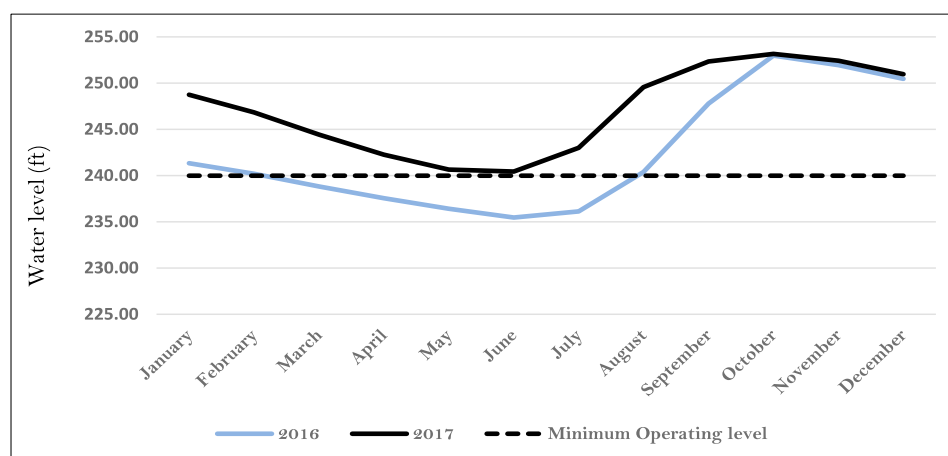
Average electricity supplied in December 2017 was marginally lower than in November 2017. Average electricity supply was 3.3% lower in December 2017 (40.39 GWh per day) than in November 2017 (40.71 GWh per day). Hydro supply in the total electricity supplied decreased from 31.4% in November 2017 to 30.6% in December 2017. The total electricity supplied in December 2017 was 1,252.21 GWh consisting of 1,244.14 GWh from domestic generation and 8.07 GWh of imports from La Cote D'Ivoire (CIE). The total supply of electricity in December 2017 was, however, 154.79 GWh lower than the 1,407 GWh projected under the Electricity Supply Plan (ESP) developed for the year 2017. This represents an 11% deviation between the outturn and the projection.

### Hydro Dam Levels

#### Akosombo Dam Water Level continued to decline in December 2017

The water level of the Akosombo dam reduced at an increasing rate of 0.036 feet per day in December 2017 from 0.024 feet per day recorded in November 2017. The water level reduced by 1.13 feet in December 2017 to 251.31 feet from 252.44 feet at the beginning of the month. The end year water level for the Akosombo dam was 251.31 feet, which was 0.84 feet higher than the same period in 2016. The water level is also 11.31 feet higher than 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 December 2017.

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

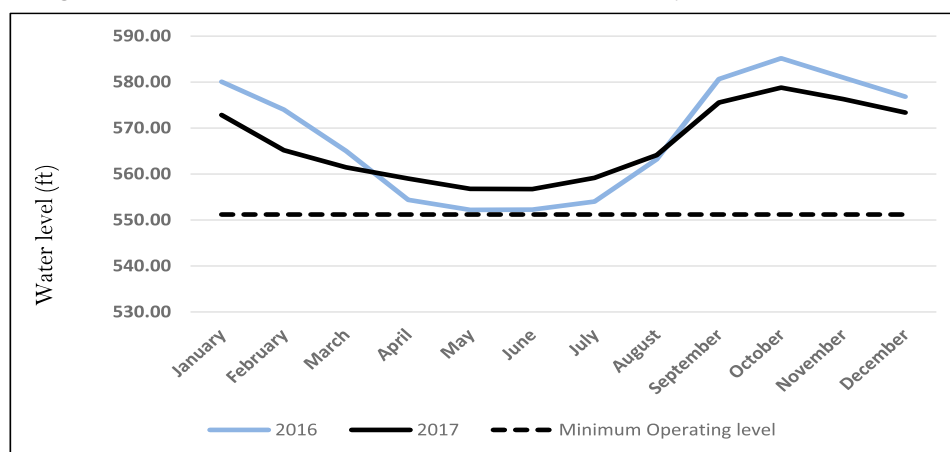


#### Bui Dam Water Level continued to decline December 2017

The Bui dam water level reduced at a reducing rate of 0.074 feet per day in December 2017 compared to 0.083 feet per day recorded in November 2017. The water level reduced by 2.3 feet in December 2017 to obtain an end year water level of 574.03 feet. The end year water level is 2.82 feet lower than the water level recorded the same time in 2016. We, therefore, will begin the year 2018 with a water level 22.85 feet above the minimum operating level and 26.36 feet below the maximum operating level. Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2016 to December 2017.

## HIGHLIGHTS OF THE MONTH

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



### Fuel Supply for Power Generation

Natural gas consumption continued to dominate the fuel supply mix and has dominated the total fuel supply mix since July 2017. Natural gas share of the total fuel supply mix increased to 64% in December 2017 from 63% in November 2017 with liquid fuel accounting for the rest. Share of natural gas supply from the WAGPCo in the total fuel supply decreased in December 2017 to 17% from 18% recorded in November 2017. On the other hand, natural gas supply from the AGPP increased to 47% in December 2017 from 45% in November 2017. The share of DFO consumption in the total fuel supply mix was marginal at 0.3% in December 2017. Similarly, the share of HFO consumed in December 2017 increased to 33% of the total fuel supply mix from 31% in November 2017 while the LCO consumption reduced to 3% in December 2017 from 6% in November 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

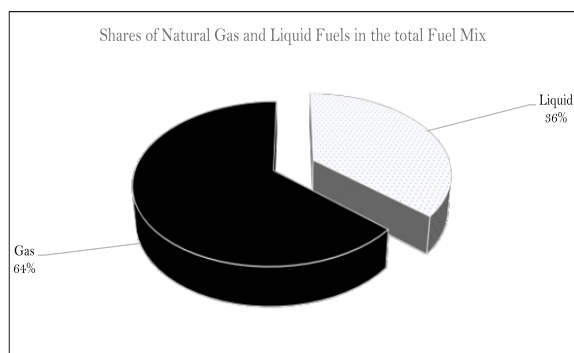
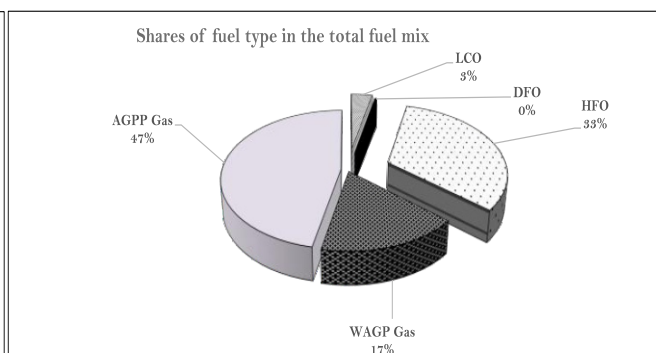


Figure 3b: Shares of fuel type in the generation fuel mix power generation



### Natural gas flow rate from WAGPCo declined marginally in December 2017

Natural gas flow rate from Nigeria through the WAGP to Tema and Kpone decreased marginally to 38.89 MMSCF per day in December 2017 from 40.62 MMSCF per day recorded in November 2017. Total gas consumption from the Tema-Kpone enclave decreased from 1,201.46 MMSCF in November 2017 to 1,154.74 MMSCF in December 2017, representing a 3.9% reduction. The natural gas consumption at the Tema and Kpone accounted for 29% of the total natural gas consumed in December 2017.

### Natural gas flow rate from GNGC increased marginally in December 2017

Natural gas flow rate from the AGPP to the Aboadze Power Enclave increased to 103.19 MMSCF per day in December 2017 from 100.5 MMSCF per day recorded in November 2017. Consequently, total gas consumption at the Aboadze Power Enclave increased to 3,050.74 MMSCF in December 2017 from 2,752.51 MMSCF in November 2017, a 10.8% increase in consumption. The increase in the gas flow at the Aboadze Power Enclave led to the increase in generation from the TAPCO and TICO power plants. Natural gas supply from the AGPP accounted for 71% of the total natural gas consumption in December 2017. Of the total natural gas supplied in December 2017 from the Aboadze enclave, 23.5% was used by the Ameri Power Plant for electricity generation, 53.3% was used by TICO Power Plant while the remaining 23.2% was used by the TAPCO Power plant.

## HIGHLIGHTS OF THE MONTH

Figure 4a: Contribution of Gas Supply by sources

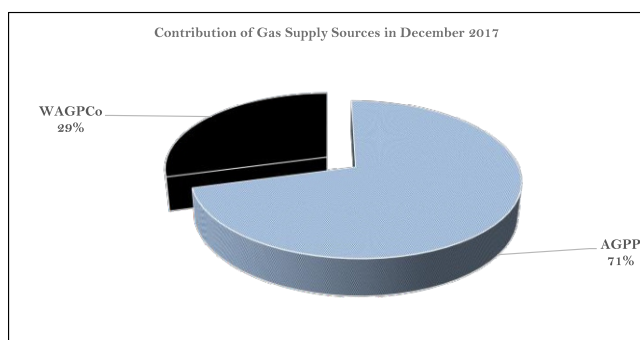
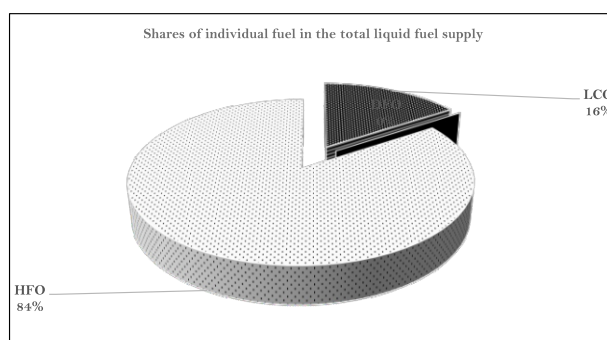


Figure 4b: Contribution of individual fuel in the liquid fuel supply



### Liquid Fuel

Liquid fuel consumption increased marginally by 1.4% to 435,791 barrels in December 2017 from 429,670 barrels in November 2017. HFO's share of the total liquid fuel consumption increased marginally from 84% in November 2017 to 90% in December 2017 while LCO's share decreased from 16% in November 2017 to 9% in December 2017. DFO also constituted 1% of the total liquid fuel consumption.

### Plant by Plant Highlights

#### Electricity Generation at the Akosombo Generation Station (GS) dropped marginally in December 2017

The average Akosombo GS generation dropped marginally by 0.2% from 9.27 GWh per day in November 2017 to 9.25 GWh per day in December 2017. This notwithstanding, the Akosombo GS share of the total electricity supply in December 2017 increased marginally to 22.91% from 22.77% in November 2017. Total electricity generation in December 2017 however increased by 3.2% from 278.12 GWh in November 2017 to 286.87 GWh in December 2017 due to the greater number of days in December 2017 than November 2017. The Akosombo GS generated 0.4% higher than the 288 GWh projected under the 2017 ESP. The Akosombo GS contributed 578 MW to meet the System Peak Load and 636 MW to meet the Ghana Peak Load in December 2017 which represented 27.07% of the System Peak Load and 29.89% of the Ghana Peak Load.

#### Electricity supply by Kpong Generation Station (GS) dropped marginally in December 2017

The average generation from the Kpong GS dropped marginally by 2.7% from 1.83 GWh per day in November 2017 to 1.78 GWh per day in December 2017. Consequently, Kpong GS's share of the total electricity supply decreased to 4.4% in December 2017 from 4.5% in November 2017. However, a total of 55.11 GWh was generated in December 2017, 0.32 GWh higher than the 54.79 GWh generated in November 2017 due to the higher number of days in December 2017 than in November 2017. The generation from the Kpong GS was 1.89 GWh lower than the 57 GWh projected for December 2017 under the 2017 ESP. The Kpong GS contributed 106 MW to meet the System Peak Load and 110 MW to meet the Ghana Peak Load in December 2017 representing 5% of the System Peak Load and 5.2% of the Ghana Peak Load.

#### Electricity supply by the Bui Generation Station (GS) dropped significantly in December 2017

The Bui GS, just like the other hydro power plants, witnessed a significant drop in its average electricity generation from 1.68 GWh per day in November 2017 to 1.33 GWh per day in December 2017. Consequently, Bui GS's share in the total electricity supply in December 2017 reduced from 4.1% in November 2017 to 3.3% in December 2017. Total supply also reduced to 41.13 GWh in December 2017 from 50.51 GWh in November 2017. The total electricity generated in December 2017 from the Bui Power Plant was, however, 42.1% lower than the 71GWh projected to be generated in December 2017 under the 2017 ESP. The Bui power plant contributed 229 MW to meet the System Peak Load and 114 MW to meet the Ghana Peak Loads which represents 10.7% of the System Peak Load and 5.4% of the Ghana Peak Load.

#### Generation by the Sunon Asogli Power Plant (SAPP) dropped significantly in December 2017

Generation from the Sunon Asogli Power Plant (SAPP) dropped significantly from 6.09 GWh per day in November 2017 to 5.28 GWh per day in December 2017. The Sunon Asogli Power Plant (SAPP) generated a total of 163.57 GWh in December 2017, which was 10.4% lower than the 182.63 GWh generated in November 2017. The Power Plant contributed 13.1% of the total electricity supplied in December 2017, a marginal decline from the 15% recorded in November 2017. The SAPP's generation in December 2017, nevertheless, was 9.1% higher than the estimated generation of 180 GWh in the 2017 ESP. The SAPP contributed 178.4 MW to meet the System Peak Load and 185.4 MW to meet the Ghana Peak Load which represented 8.4% of the System Peak Load and 8.7% of the Ghana Peak Load. The SAPP consumed a total of 981.06 MMSCF of natural gas and 44,745 bbls of LCO at an estimated heat rate of 7,684.88 Btu/kWh, an improvement in fuel efficiency compared to the heat rate of 7,803.62 Btu/kWh, recorded in November 2017.

#### CENIT Power Plant continued to be offline in December 2017

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

#### Ameri Energy Power Plant's generation decreased significantly in December 2017

Electricity generation from the Ameri Energy Power Plant decreased to 2.66 GWh per day in December 2017 from 3.43 GWh per day in November 2017. The total electricity generation in December 2017 of 82.61 GWh was also 19.8% lower than the generation recorded in November 2017 of 102.95 GWh and 43% lower than was projected under the 2017 ESP. The total electricity generated by the Ameri Power Plant in December 2017 represented 6.6% of total electricity supplied in the month. The Ameri Power Plant consumed 719.01 MMSCF of natural gas, to generate the 82.61 GWh of electricity at an estimated average heat rate of 10,103.9



## HIGHLIGHTS OF THE MONTH

Btu/kWh, similar to the fuel efficiency of 10,103.9 Btu/kWh recorded in November 2017. The Ameri Power Plant contributed 95.2 MW to meet the System Peak Load and 239.4 MW to meet the Ghana Peak Load in December 2017, representing 4.5% of the System Peak Load and 11.3% of the Ghana Peak Loads.

### **Kpone Thermal Power Plant (KTPP) operated for two days in December 2017**

The KTPP operated for two days in December 2017 generating a total of 2 GWh constituting 0.16% of the total electricity supply. The power plant was however projected to be offline in December 2017 as per the 2017 ESP. KTPP made no contribution to either the System Peak Load or Ghana Peak Load. The KTPP in December 2017 consumed 4,350 barrels of DFO to generate the 2 GWh of electricity at an estimated heat rate of 11,706.21 Btu/kWh

### **The Karpowership Power Plant generation increased significantly in December 2017**

The Karpowership's generation increased to 6.29 GWh per day in December 2017 from 5.21 GWh per day in November 2017, a 20.7% increase in average generation. Total generation from the Karpowership increased by 27.8% from 156.34 GWh in November 2017 to 195.05 GWh in December 2017. The total of 195.05 GWh generated in December 2017 was higher than the 160 GWh projected to be generated under the 2017 ESP. The Power Plant contributed 15.6% of the total electricity supplied in December 2017, which is higher than its contribution of 12.8% in November 2017. The Karpowership also contributed 323 MW to meet the System Peak Load and 417.9 MW to meet the Ghana Peak Load in December 2017 representing 15.1% of the System Peak Load and 19.6% of the Ghana Peak Load. The Karpowership Power Plant consumed 268,298 barrels of Heavy Fuel oil (HFO) to generate the 195.05 GWh in December 2017 at an average heat rate of 8,308.22 Btu/kWh which is a marginal improvement in fuel efficiency of 8,325.47 Btu/kWh recorded in November 2017.

### **AKSA Power Plant's generation dropped significantly in December 2017**

The AKSA power plant's electricity generation dropped significantly in December 2017 to 2.71 GWh per day from 3.27 GWh per day. The AKSA Power Plant generated a total of 83.87 GWh in December 2017 which was 14.36 GWh lower than the 98.23 GWh it generated in November 2017 and significantly lower than the 152 GWh projected for December 2017 under the 2017 ESP. The Power Plant supplied 6.7% of the total electricity supplied in December 2017, which was lower than the 8% it supplied in November 2017. The Power Plant contributed 153.3 MW to meet the System Peak Load and 224 MW to meet the Ghana Peak Load in December 2017 representing 7.2% of the System Peak Load and 10.5% of the Ghana Peak Load. A total of 118,397 barrels of HFO was consumed by the AKSA Power Plant at an average heat rate of 8,526.9 Btu/kWh, a marginal decline in efficiency from the 8,544.09 Btu/kWh recorded in November 2017.

### **Takoradi International Company (TICO)'s generation dropped marginally in December 2017**

The TICO Power plant's electricity supply in December 2017 dropped marginally to 7.12 GWh per day from 7.16 GWh per day in November 2017. The TICO power plant supplied 17.6% of the total electricity supplied in December 2017, the same as was recorded for November 2017. The TICO Power Plant's electricity generation of 220.74 GWh in December 2017 was however higher than the 214.76 GWh it generated in November 2017 due to higher number of days in December 2017 than in November 2017. Also, the TICO's generation of 220.74 GWh was 21.3% higher than the 182 GWh projected under the 2017 ESP. The TICO Power Plant in December 2017 contributed 323 MW to meet the System Peak Load and 157 MW to meet the Ghana Peak Load, representing 15.1% of the System Peak Load and 7.4% of the Ghana Peak Load. The Power Plant operated on natural gas consuming about 1,625.42 MMSCF of natural gas to produce the 220.74 GWh of electricity at an estimated average heat rate of 7,907.27 Btu/kWh, a drop in fuel efficiency over the 7,272.43 Btu/kWh recorded in November 2017.

### **Takoradi Power Company (TAPCO) Plant's generation increased significantly in December 2017**

The TAPCO Power Plant's generation increased significantly to 3.15 GWh per day in December 2017 from 1.83 GWh per day in November 2017. TAPCO's total generation increased to 97.73 GWh in December 2017 from 54.91 GWh in November 2017. The power plant contributed 7.8% of the total electricity supplied in December 2017, higher than the 4.5% it contributed in November 2017. The power plant generated 97.73 GWh, which was 39.7% lower than the 162 GWh for December 2017 estimated under the 2017 ESP. The TAPCO Power Plant in December 2017 contributed 149 MW to meet the System Peak Load and 27 MW to meet the Ghana Peak Load, representing a 7% of the System Peak Load and 1.3% of the Ghana Peak Load. The Power Plant operated on natural gas in December 2017 consuming about 706.31 MMSCF to produce 97.73 GWh of electricity at an estimated average heat rate of 7,760.95 Btu/kWh, an improvement in the fuel efficiency over the 7,864.14 Btu/kWh recorded in November 2017.

### **Tema Thermal 1 Power Plant (TT1PP)'s generation dropped marginally in December 2017**

Generation from the TT1PP dropped marginally from 0.7 GWh per day in November 2017 to 0.5 GWh per day in December 2017 primarily due to low natural gas supply to the Tema Power Enclave. The TT1PP's share of the total electricity supply reduced from 1.7% in November 2017 to 1.2% in December 2017. The power plant did not contribute to both the System Peak Load and Ghana Peak Load in December 2017. A total of 173.68 MMSCF of natural gas was used to generate 15.46 GWh of electricity at an average heat rate of 11,683.76 Btu/kWh, a marginal decline in the average heat rate of 11,613.2 Btu/kWh recorded in November 2017.

### **Trojan Power Plant continued to be offline in December 2017**

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

### **Electricity Exchange – Imports and exports increased marginally while Ghana still remained a net importer of electricity**

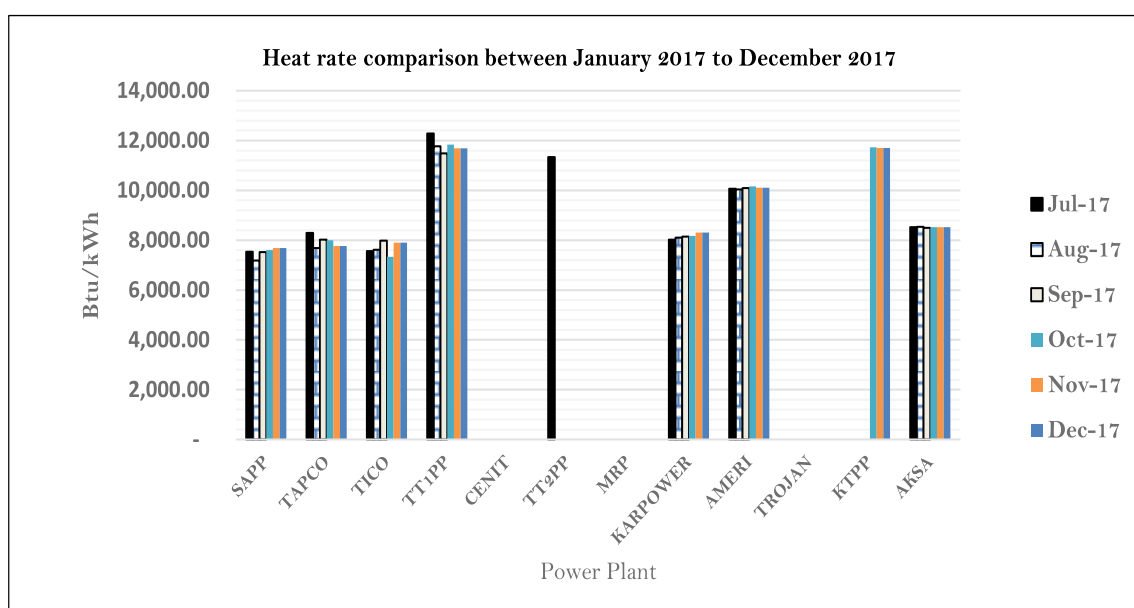
Electricity imports from La Cote D'Ivoire increased to 0.26 GWh per day in December 2017 from 0.24 GWh per day in November 2017. Total import in December 2017 of 8.07 GWh was also marginally lower than the 10 GWh projected under the 2017 ESP and contributed 0.6% of the total electricity supplied in December 2017. Daily peak import in October 2017 reached a maximum of 46 MW and contributed 20 MW to meet the Ghana Peak Load but did not contribute in meeting the System Peak Load.

Electricity export to CEB increased marginally to 0.39 GWh per day in December 2017 from 0.36 GWh per day in November 2017. A total of 12.18 GWh of electricity was exported in December 2017 which was significantly lower than the 80 GWh projected under 2017 ESP. Ghana was a net importer of electricity in December 2017.

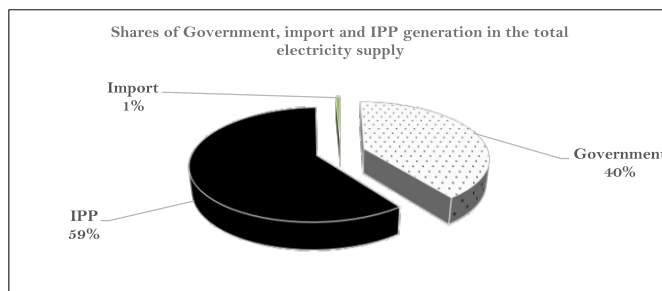
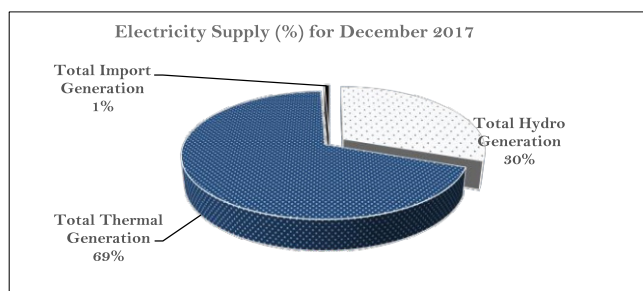
# OPERATIONAL FACT SHEET

Peak Electricity Supply - December 2017			
Source of Supply	Generation at System Peak Load of December 2017 (MW)	Generation at Ghana Peak Load of December 2017 (MW)	Electricity Supply (GWh)
AKOSOMBO	578.00	636.00	286.87
KPONG	106.00	110.00	55.11
BUI	229.00	114.00	41.13
SAPP	178.40	185.40	163.57
TAPCO	149.00	27.00	97.73
TICO	323.00	157.00	220.74
TT1PP	-	-	15.46
CENIT	-	-	-
TT2PP	-	-	-
MRP	-	-	-
KARPOWER	323.00	417.90	195.05
AMERI	95.20	239.40	82.61
KTPP	-	-	2.00
Trojan Power	-	-	-
CENPOWER	-	-	-
AKSA	153.30	224.00	83.87
IMPORT	-	20.00	8.07
Export	-	3.00	12.18
<b>System Coincident Peak Load</b>	<b>2,134.90</b>	-	-
<b>Ghana Coincedent Peak Load</b>	-	<b>2,127.70</b>	-
<b>Total Supply</b>	-	-	<b>1,252.21</b>
<b>Total Supply without export</b>	-	-	<b>1,240.02</b>

Ghana Electricity Demand		
		Dec-17
Maximum System Peak Load	MW	2,134.9
Minimum System Peak Load	MW	1,795.5
Average Peak Generation	MW	2,053.9
System Base Load	MW	1,122.9
Total Electricity	GWh	1,252.2
Load Factor (LF)	%	78.8



# OPERATIONAL FACT SHEET



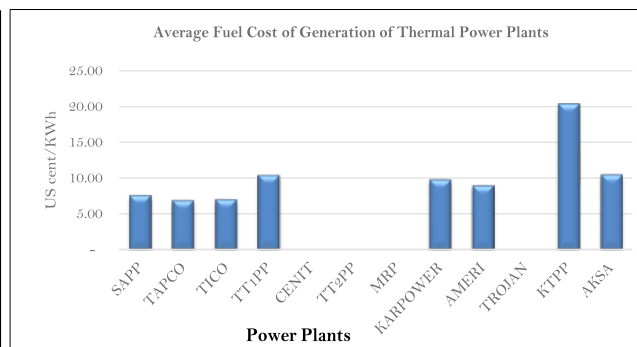
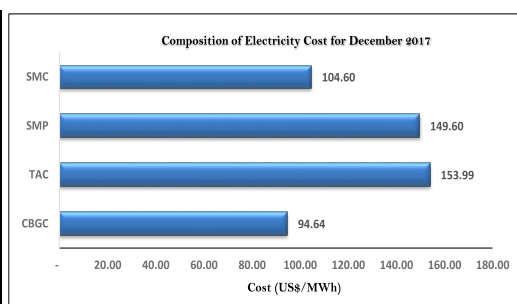
Power Plant Data for December 2017							
	Dependable Capacity (MW)	Plant Capacity Utilization (%)	Electricity Generation (GWh)	Gas Consumption (MMBtu)	LCO Consumption (MMBtu)	DFO Consumption (MMBtu)	HFO Consumption (MMBtu)
Akosombo	900.00	42.84	286.87	-	-	-	-
Kpong	140.00	52.91	55.11	-	-	-	-
Bui	340.00	16.26	41.13	-	-	-	-
SEAP	500.00	43.97	163.57	1,020,305.57	236,706.03	-	-
TAPCO	300.00	43.78	97.73	758,454.57	-	-	-
TICO	320.00	92.72	220.74	1,745,427.01	-	-	-
TT1PP	110.00	18.89	15.46	180,630.88	-	-	-
CENIT	110.00	-	-	-	-	-	-
TT2PP	45.00	-	-	-	-	-	-
MRP	70.00	-	-	-	-	-	-
KARPOWER	450.00	58.26	195.05	-	-	-	1,620,522.46
AMERI	230.00	48.28	82.61	834,723.98	-	-	-
TROJAN	56.00	-	-	-	-	-	-
KTPP	200.00	1.34	2.00	-	-	23,413.58	-
AKSA	230.00	49.01	83.87	-	-	-	715,115.58
<b>Total</b>	<b>4,001.00</b>	<b>41.80</b>	<b>1,244.14</b>	<b>4,539,542.02</b>	<b>236,706.03</b>		<b>1,620,522.46</b>

Location	Average Gas Flow (MMScfd) - December 2017				
	Week 1	Week 2	Week 3	Week 4	Monthly Average
Etoki	34.51	53.50	32.99	51.03	<b>43.78</b>
Tema	33.83	44.57	29.65	44.91	<b>38.89</b>
Aboadze	100.01	104.65	102.23	105.05	<b>103.19</b>

Hydro Dam	Water Level (ft) - December 2017				Change in water level (feet)
	Week 1	Week 2	Week 3	Week 4	
Akosombo	252.44	252.14	251.90	251.31	-1.13
Bui	576.33	575.77	575.21	574.03	-2.30

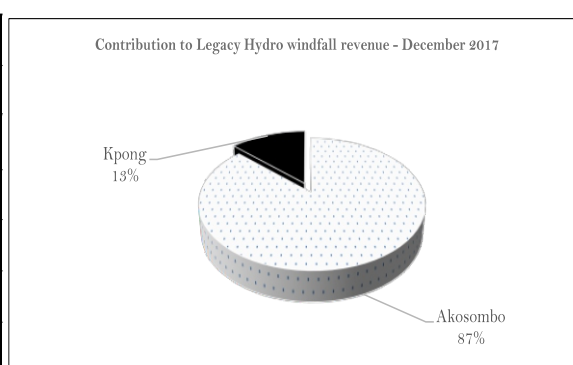
# ECONOMIC FACT SHEET

		Dec-17	Nov-17	Change
Average Market Energy Cost	US\$/MWh	101.78	95.04	6.74
Average Market Capacity Charge (AMCC)	US\$/MWh	52.21	51.47	0.74
Total Average Market Cost (TAC)	US\$/MWh	153.99	146.51	7.48
System Marginal Cost (SMC)	US\$/MWh	104.60	103.49	1.11
System Marginal Capacity Charge (SMCC)	US\$/MWh	45.00	-	45.00
Spot Market Price (SMP)	US\$/MWh	149.60	103.49	46.11
Composite Bulk Generation Charge (CBGC)	US\$/MWh	94.64	94.64	-
Deviation of TAC from CBGC	US\$/MWh	(59.35)	(13.78)	(45.57)
Deviation of SMP from CBGC	US\$/MWh	(54.96)	(14.32)	(40.64)



Dec-17				
Power Plant	Average Cost US\$/MWh	Average SMP US\$/MWh	Difference US\$/MWh	Windfall Revenue US\$/MWh
Akosombo	33.10	149.60	116.50	33,418,711.61
Kpong	59.20	149.60	90.40	4,981,763.45
<b>Total</b>	<b>92.30</b>	<b>-</b>	<b>-</b>	<b>38,400,475.06</b>

Average Fuel Prices		
Fuel Type	Unit	Dec-17 Delivered Cost
Natural Gas	US\$/MMBtu	9.02
LCO	US\$/BBL	74.37
HFO	US\$/Tonne	412.91
DFO	US\$/Tonne	701.13





## Other Market News and Trends

### 1.0 Review of the annual performance of electricity generation and supply

Ghana's installed capacity increased from about 3,700 MW at the beginning of the year to 4,388 MW by the close of the year (this does not include capacity for T3 and MRP), an 18.6% increase in the installed capacity. This is due to the increase in capacity of SAPP from 380 MW to 560 MW, Karpowership from 235 MW to 470 MW and the coming online of AKSA power plant with a capacity of 290 MW. Despite the increase in the installed capacity there was a significant load shedding in February 2017 due to fuel supply challenges, breakdown of plants and poor health of the hydro dams. Reserve margins, taking into consideration fuel supply challenges and technical challenges, to the power plants averaged about 15.24%. Average reserve margin for the first half of the year was 5.9% which improved to 26.4% in the second half of the year due to improved natural gas supply. Ghana's demand grew by 2.6% from 2,105.5 MW in 2016 to 2,160.8 MW in 2017 but lower than the 2,385 MW projected in the 2017 ESP. Average capacity factor for 2017 was 40.8% with the ratio of the capacity growth to demand growth averaging 7.2%.

There were two partial system collapses in 2017 both in the first half of the year. The first was on the 3rd May 2017 which was due to the sudden tripping of all the units at the Akosombo GS, Kpong GS, Bui, Karpowership, Ameri, AKSA and SAPP but there was supply for CIE. While restoring service, there was a total system collapse which occurred on the 4th May 2017. The second was on 12th June 2017, which was also due to the tripping of the 330kV Takoradi Thermal-Volta line with a number of transmission lines during the nationwide rainfall. In the two occasions, supply was restored within 24 hours of the collapse.

Table 1 shows the annual supply of electricity by sources and a comparison with the projections made under the 2017 ESP.

**Table Annual Electricity supply by source vrs ESP Projection - 2017**

Source of Supply	Total Supply (GWh)			Deviation (%)	Actual Contribution to total Generation (%)	Projected Contribution to total Generation (%)
	Actual	Projected	Deviation (GWh)			
AKOSOMBO	4,300.65	3,680.00	620.65	16.87	29.99	23.57
KPONG	761.72	720.00	41.72	5.79	5.31	4.61
BUI	581.68	841.00	(259.32)	(30.83)	4.06	5.39
SAPP	1,419.04	1,476.00	(56.96)	(3.86)	9.90	9.45
TAPCO	679.30	1,258.00	(578.70)	(46.00)	4.74	8.06
TICO	1,861.03	1,983.00	(121.97)	(6.15)	12.98	12.70
TT1PP	365.24	177.00	188.24	106.35	2.55	1.13
CENIT	58.89	154.00	(95.11)	(61.76)	0.41	0.99
TT2PP	0.51	-	0.51	-	0.00	-
MRP	-	-	-	-	-	-
KARPOWER	1,835.31	1,802.00	33.31	1.85	12.80	11.54
AMERI	1,228.21	1,619.00	(390.79)	(24.14)	8.56	10.37
KTPP	126.14	62.00	64.14	103.46	0.88	0.40
Trojan Power	52.03	19.00	33.03	173.87	0.36	0.12
CENPOWER	-	-	-	-	-	-
AKSA	798.36	1,174.00	(375.64)	(32.00)	5.57	7.52
BXC Solar	25.02	32.00	(6.98)	(21.81)	0.17	0.20
VRA Solar	2.66	4.00	(1.34)	(33.50)	0.02	0.03
IMPORT	244.69	615.00	(370.31)	(60.21)	1.71	3.94
Export	209.42	940.00	(730.58)	(77.72)	1.46	6.02
<b>Total Supply</b>	<b>14,340.47</b>	<b>15,616.00</b>	<b>(1,275.53)</b>	<b>(8.17)</b>	<b>100.00</b>	<b>100.00</b>
<b>Total Supply without export</b>	<b>14,131.05</b>	<b>14,676.00</b>	<b>(544.95)</b>	<b>(3.71)</b>		

There was a marginal deviation of 8.1% between the electricity supplied and the projections made in the 2017 ESP. There were negative deviation (generated lower than projected) with all the thermal power plants except the Karpowership, KTPP, TT1PP and Trojan power plants which had a positive deviation. A combination of fuel inadequacies, technical challenges and grid demands contributed to the lower than projected supply from most of the thermal power plants. About 98.6% of the total electricity supplied was for domestic consumption. Ghana was a net importer of electricity in 2017.

#### 1.1 Hydro Generation Sources

The hydro power plants contributed 39.4% of the total electricity supplied in 2017 against the projected 23.6% under the 2017 ESP. The increase in generation is to make up for the deficit in supply and prevent any load curtailment exercise. All the hydro plants except Bui GS generated above their projected generation levels. The Akosombo GS and Kpong GS generated 6.5% and 0.7% respectively above what they were projected to generate under the 2017 ESP. Bui GS on the other hand generated 1.3% lower than projected primarily due to lower than expected water levels.

The Akosombo GS water level began the year 2017 at 250.47 feet which was 2.06 feet lower than the same time in 2016. The end year water level for the Akosombo dam was 251.31 feet which is 0.84 feet higher than the beginning water level of 250.47 feet. Similarly, the Bui GS had a 5.81 feet lower water level in the beginning of 2017 compared to the same time in 2016. Unlike the Akosombo GS, the yearend water level for the Bui GS was 2.82 feet lower than at the beginning of the year. This means that without higher inflows in 2018, the Bui GS might generate a lower amount of electricity in 2018 than in 2017.

### 1.2 Thermal Generation Sources

Thermal generation sources contributed 58.9% of the total electricity supplied in the year 2017 against a projected 76.4% under the 2017 ESP. Fuel supply inadequacy and technical challenges contribution of Thermal Power Plants to the total electricity supply. All the thermal power plants deviated significantly from their projected generation except for the Karpowership, SAPP and TICO which had less than 10% deviation. The large negative deviations by most of the thermal power plants were compensated by increased supply from the hydro plants and the coming online of plants such as Trojan, KTRPP, TT1PP and CENIT which were projected to be offline for most of the period in 2017.

Ghana's fossil fuel dependency in 2017 averaged 59.88% with an average emission factor of 0.33 kgCO<sub>2</sub>/kWh of electricity produced in Ghana. Thermal generating capacity grew by 30.6% in 2017 largely from HFO based generation namely AKSA and Karpowership.

### 1.3 Fuel Supply Outturn for 2017

Table 1.3 Fuel Supply to Power Plants for 2017

Power Plant	GAS (MMSCF)	LCO (BBL)	DFO (BBL)	HFO (BBL)
TAPCO	4,233.74	171,425.54	72.38	-
TICO	10,436.61	671,133.34	901.84	-
AMERI	10,927.36	-	-	-
SAPP	8,775.65	374,988.22	-	-
TT1PP	2,081.48	387,785.22	518.10	-
CENIT	-	129,752.37	38.38	-
TT2PP	5.48	-	-	-
MRP	-	-	-	-
KARPOWERSHIP	-	-	-	2,467,958.70
TROJAN	-	-	134,889.05	-
KTRPP	27.48	-	248,050.17	-
AKSA	-	-	-	1,127,038.37
<b>TOTAL</b>	<b>36,487.79</b>	<b>1,735,084.69</b>	<b>384,469.93</b>	<b>3,594,997.06</b>

A total of 74.65 Trillion Btu of fuel (natural gas, LCO, HFO and DFO) was consumed in 2017 by the thermal power plants. Natural gas accounted for 54.6% of the total fuel consumption, HFO accounted for 29.9%, LCO accounted for 12.6% and DFO accounted for 2.9%. The Karpowership and TICO accounted for about 41% of the total fuel consumed with the two power plants accounting for 43.7% of the total thermal power plant electricity supply. A total of 36.49 BSCF of natural gas was consumed in 2017 with 70.2% being consumed in the Aboadze Power Enclave and the rest in Tema and Kpone 3.59 million Barrels of HFO, 1.74 million barrels of LCO and 0.38 million barrels of DFO was consumed in 2017.

### 2.0 The Electricity Market Oversight Panel (EMOP) Inaugurated

The Electricity Market Oversight Panel (EMOP) was inaugurated by the Minister for Energy, Hon. Boakye Kyeremateng Agyarko on 22nd December, 2017. The Panel is made up of the Chairman, Mr. Michael Opam, Executive Secretary of the Energy Commission, Dr. Alfred Ofori Ahenkorah, Executive Secretary of the PURC, Ms. Mami Dufie Ofori, CEO of GRIDCo, Mr. Jonathan Amoako Baah and the Head of System Operation at GRIDCo, Mr. Mark Awuah Baah. The other members include Mr. Ebenezer Baiden, a representative of the Electricity Company of Ghana, Dr. Samuel K. Desouza, a representative of Bulk Customers, Mr. Abubakari Obuama Addy and Nana Osae Nyampong VI both representative of wholesale suppliers. The last member is Mr. Eric Kyem responsible for the administration of the EMOP. The Minister in his speech tasked the EMOP to ensure the optimization of the hydro resource in the country, work hard to ensure adequate supply of electricity and ensure the establishment of a well-functioning Wholesale Electricity Market in Ghana.

The first task of the EMOP is to ensure the operationalization of the Wholesale Electricity Market (WEM) by coordinating with the GRIDCo to quickly develop the market design, market rules and procedures that will guide the operation of the WEM. The day-to-day administration of the EMOP will be conducted by the EMOP Secretariat which was established in 2015.

### 2.0 Performance Indicators of Power Plants

#### 2.1 Capacity Utilization Factor (CUF)

There was a marginal increase in the CUF of both the Akosombo GS and Kpong GS from 41.54% and 52.6% in November 2017 respectively to 42.84% and 52.91% in December 2017. On the contrary, the Bui GS witnessed a marginal reduction in its CUF in December 2017 from 19.97% in November 2017 to 16.26% in December 2017.

## Other Market News and Trends

Thermal power plants had a general decrease in their CUF in December 2017 except TICO and TAPCO. The TICO and TAPCO power plants had an increase in their CUF from 24.6% and 90.21% in November 2017 respectively to 43.78% and 92.72% in December 2017. The SAPP, TT1PP, Karpowership, Ameri and AKSA power plants had 5.12, 6.67, 31.16, 11.88 and 8.39 percentage points respectively lower than the CUF recorded in November 2017.

The System Load Factor (LF) increased from 77.4% in November 2017 to 78.8% in December 2017.

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

**Table 2.1.1: Power Plant Capacity Utilization, Average heat rate and Average Fuel Cost of Generation**

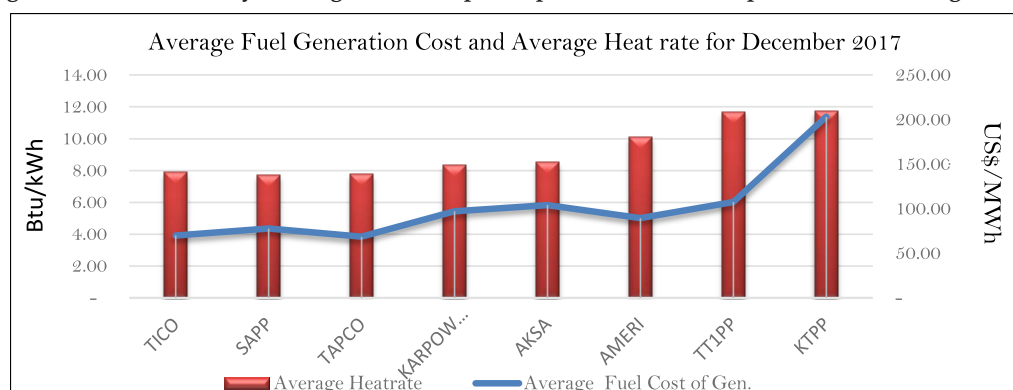
Power Plant	Capacity Utiliation (%)	Average Heatrate (Btu/KWh)	Average Fuel Cost of Generation (US\$/MWh)
<b>Akosombo</b>	42.84	-	-
<b>Kpong</b>	52.91	-	-
<b>Bui</b>	16.26	-	-
<b>SAPP</b>	43.97	7,684.88	77.73
<b>TAPCO</b>	43.78	7,760.95	68.61
<b>TICO</b>	92.72	7,907.28	69.90
<b>TT1PP</b>	18.89	11,683.76	107.49
<b>CENIT</b>	-	-	-
<b>TT2PP</b>	-	-	-
<b>MRP</b>	-	-	-
<b>KARPOWER</b>	58.26	8,308.22	97.14
<b>AMERI</b>	48.28	10,103.90	89.32
<b>TROJAN</b>	-	-	-
<b>KTPP</b>	1.34	11,706.21	203.18
<b>AKSA</b>	49.01	8,526.90	104.10

### 2.2 Heat Rate (Fuel Efficiency)

The SAPP, TAPCO, Karpowership and AKSA all had improved fuel efficiency in December 2017 compared to November 2017. These power plants had a 1.5%, 1.3%, 0.2% and 0.2% improvement in their Fuel efficiencies respectively. The SAPP heat rate reduced by 1.5% in December 2017 from 7,803.62 Btu/kWh in November 2017 to 7,684.88 Btu/kWh in December 2017. Similarly, the TAPCO power plant had a reduced heat rate in December 2017 of 7,760.95 Btu/kWh from 7,864.14 Btu/kWh in December 2017. The Karpowership and AKSA power plants all had 0.2% reduction in their heat rate from 8,325.47 Btu/kWh and 8,544.09 Btu/kWh respectively in November 2017 to 8,308.22 Btu/kWh and 8,526.9 Btu/kWh respectively in December 2017. Other power plants such as TICO, TT1PP, Ameri and KTPP had a reduction in their fuel efficiencies in December 2017 compared to November 2017. The TICO and TT1PP power plants had their heat rate increased from 7,272.43 Btu/kWh and 10,613.2 Btu/kWh respectively in November 2017 to 7,907.28 Btu/kWh and 11,683.76 Btu/kWh respectively in December 2017. The Ameri Power plant had a marginal increase in its heat rate from 10,103.25 Btu/kWh in November 2017 to 10,103.9 Btu/kWh in December 2017.

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.**



### 2.3 Average Fuel Cost of Electricity Generation

There were general increases in the average fuel cost of generation for thermal power plants in December 2017 compared to November 2017 from an average of US\$96.02/MWh to US\$102.33/MWh. The increase in the fuel cost of generation was mainly due to the increasing cost of liquid fuel and the reduced fuel efficiency of some thermal power plants. The AKSA and Karpowership power plants witnessed increased fuel cost of generation from US\$86.99/MWh and US\$93.71/MWh respectively in November 2017 to US\$97.14/MWh and US\$104.1/MWh in December 2017 respectively due to the marginal increase in HFO cost in December 2017 compared to November 2017. Average HFO cost increased from US\$9.41/MMBtu to US\$10.7/MMBtu.

The SAPP, TAPCO and the Ameri power plants had all improvements in their average fuel cost of generation due to improvement in their fuel efficiencies.

#### **Acronyms**

<i>AGPP = Atuabu Gas Processing Plant</i>	<i>Btu = British Thermal Units</i>
<i>CBGC = Composite Bulk Generation Charge</i>	<i>CUF = Capacity Utilization Factor</i>
<i>DFO = Distillate Fuel Oil</i>	<i>EC = Energy Commission</i>
<i>ECG = Electricity Company of Ghana</i>	<i>EMOP = Electricity Market Oversight Panel</i>
<i>ESP = Electricity Supply Plan</i>	<i>FPSO = Floating Production, Storage and Offloading</i>
<i>GHp = Ghana Pesewa</i>	<i>GNGC = Ghana National Gas Company</i>
<i>GWh = Giga-watt Hours</i>	<i>HFO = Heavy Fuel Oil</i>
<i>KTPP = Kpone Thermal Power Plant</i>	<i>kWh = Kilo-watt hours</i>
<i>MRP = Mine Reserve Plant</i>	<i>LEAP = Long-range Energy Alternative Planning</i>
<i>LCO = Light Crude Oil</i>	<i>LI = Legislative Instrument</i>
<i>LTA = Long Term Average</i>	<i>MW = Megawatt</i>
<i>MMscf = Million Standard Cubic Feet</i>	<i>MWh = Mega-watt hours</i>
<i>NITS = National Interconnected Transmission System</i>	<i>PV = Photovoltaic</i>
<i>SAPP = Sunon Asogli Power Plant</i>	<i>SMP = System Marginal Price</i>
<i>SNEP = Strategic National Energy Plan</i>	<i>TEN = Tweneboa, Enyenra, Ntomme</i>
<i>TT1PP = Tema Thermal 1 Power Plant</i>	<i>TT2PP = Tema Thermal 2 Power Plant</i>
<i>VRA = Volta River Authority</i>	<i>WAGPCo = West African Gas Pipeline Company</i>
<i>WAGP = West African Gas Pipeline</i>	<i>WEM = Wholesale Electricity Market</i>

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