GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 19: 1st July 2017 to 31st July 2017

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1st July 2017 to 31st July 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 commends a series of publication on the financial sustainability of the power sector in Ghana.

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

The month of July 2017 witnessed the commencement of the rise in water levels of the hydro dams. The water level of the Akosombo GS rose by 2.55 feet in July 2017 and that of Bui GS rose by 2.46 feet. Compared to May 2017, the water level for the Akosombo GS has rose by 3.66 feet whiles the Bui GS has rose by 2.39 feet. Aside the significant inflows into the dams, the rise in water level was aided by the significant reduction in generation for the hydro sources in June 2017 and July 2017 compared to the generation in May 2017. From May 2017 to July 2017, the Akosombo GS electricity generation reduced by 25.3% while generation for the Bui GS has reduced by 43.6%.

Thermal power generation on the average fell by 8.2% to 23.41 GWh. per day in July 2017 from 25.5 GWh per day in June 2017 due to the decrease in generation from the Sunon Asogli Power Plant (SAPP) and the AMERI Power Plant. The SAPP decreased by 1.3 folds from 5.52 GWh per day in June 2017 to 4.42 GWh per day in July 2017 due to the fall in the LCO supply in July 2017. The AMERI Power Plant's generation also decreased significantly by 30.4% from 4.01 GWh per day in June 2017 to 2.79 GWh per day in July 2017 due to scheduled maintenance work, fuel supply challenges and grid demands. Despite the decrease in generation by some of the thermal power plants, there were marginal increases in others namely TICO and Karpowership power plants and the coming online of TT1PP.

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

	July 2017		June 2017	
	Projected	Actual Outturn	Projected	Actual Outturn
Total Supply (GWh)	1,262.0	1,137.8	1,261.0	1,149.5
Source by Power Plants (GWh)				
AKOSOMBO	288.0	290.2	279.0	284.4
KPONG	57.0	61.0	55.0	59.1
BUI	71.0	28.5	69.0	28.0
Sunon Asogli	92.0	132.7	143.0	171.2
TAPCO	95.0	63.8	92.0	62.6
TICO	193.0	192.5	184.0	177.1
TT1PP	-	20.1	-	-
CENIT	-	-	-	-
TT2PP	-	0.5	-	-
MRP	-	-	-	-
Karpowership	155.0	159.6	150.0	151.1
AMERI	147.0	83.8	140.0	120.3
KTPP	-	-	-	4.7
Trojan Power	-	0.0	-	0.0
CENPOWER	-	-	-	-
AKSA	131.0	85.7	129.0	77.8
Total Generation (GWh)	1,229.0	1,118.5	1,241.0	1,136.2
Imports (GWh)	33.0	19.3	20.0	13.3
Total Supply (GWh)	1,262.0	1,137.8	1,261.0	1,149.5
Deficit (GWh)	-	(124.2)	-	(111.5)
Ghana Coincedent Peak Load (MW)	2,027.0	2,026.2	2,105.0	2,129.2
System Coincident Peak Load (MW)	2,200.0	2,042.2	2,183.0	2,158.2

Import increased by 45% from 0.44 GWh per day in June 2017 to 0.64 GWh per day in July 2017. On the other hand, export reduced from 0.19 GWh per day in June 2017 to 0.17 GWh in July 2017.

Electricity Demand and Supply

Electricity Demand

The System Peak Load (Ghana Peak Load plus Import) decreased marginally by 35.4 MW to 2,042.2 MW in July 2017 from 2,077.6 MW in June 2017. Similarly the Ghana Peak Load (Domestic Peak Load including VALCO minus Export) decreased marginally by 51.4 MW to 2,026.2 MW in July 2017 from 2,077.6 MW in June 2017. The System Peak Load in July 2017 of 2,042.2 MW was lower (7.17%) than the projected System Peak load of 2,200 MW under the 2017 ESP, while the Ghana Peak Load of 2,026.2 MW was also lower than the projected Ghana Peak Load of 2,027 MW for June 2017 under the 2017 ESP.

Electricity supply

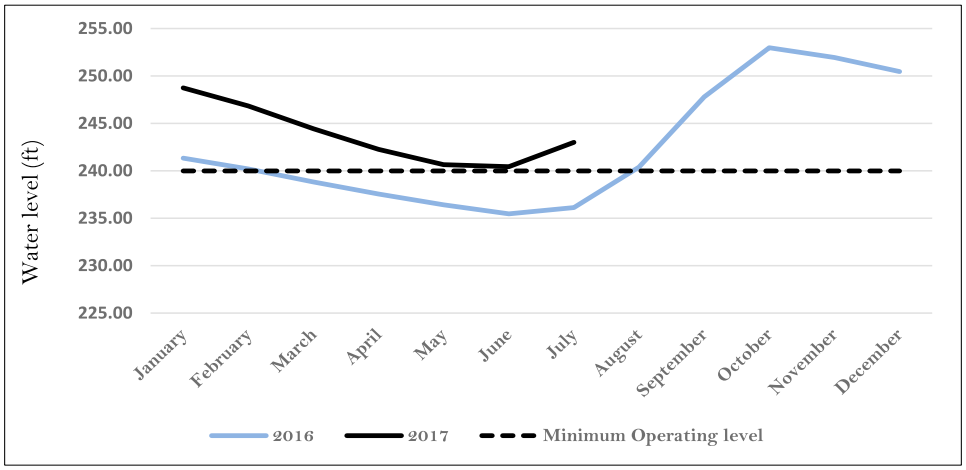
The average daily electricity supplied to meet Ghana's requirement decreased marginally to 36.70 GWh per day in July 2017 from 38.34 GWh per day recorded in June 2017. The total electricity supply in July 2017 was 1,137.79 GWh consisting of 1,118.45 GWh from domestic generation and 19.34 GWh of imports from La Cote D'Ivoire. The total supply of electricity in July 2017 was 125.21 GWh lower than the 1,263 GWh projected under the Electricity Supply Plan (ESP) developed for the year 2017. This represents a 9.9% deviation between the outturn and the projection.

Hydro Dam Levels

Akosombo Dam Water Level began Rising

For the first time in 2017, the Akosombo water level began rising in July. Significant inflows into the Akosombo dam coupled with a lower generation from the Akosombo GS in July 2017 resulted in the rising of the water level in July 2017. The water level rose by 2.55 feet in July 2017 from 240.45 feet at the beginning of the month to 243.00 feet at the end of the month. The water level at the end of July 2017 was also higher than the level at the same time in July 2016 by about 6.88 feet and 3.0 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 July 2017.

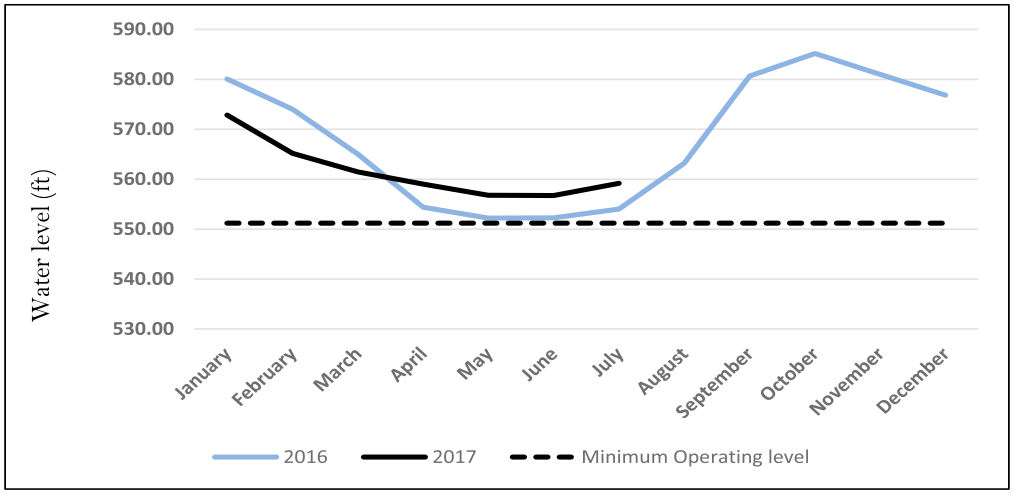
Figure 1: Month-End Water Level for Akosombo Dam from January 2016 to July 2017



Bui Dam Water Level began rising

The Bui dam water level also witnessed a rise for the first time this year in July. The rise in the water level was due to the significant inflows into the Bui dam and the reduction in generation in July 2017. The water level rose by 2.46 feet in July 2017 increasing from 556.71 feet level at the beginning of the month to 559.17 feet at end of the month. The water level at the end of the month for Bui GS (559.17 feet) was above the level of the dam at the same period in July 2016 (554.16 feet) by 5.01 feet. Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2016 to July 2017.

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



Fuel Supply for Power Generation

In July 2017, Natural gas dominated the fuel supply mix for the first time in 2017. The share of natural gas to the fuel mix was 58% while liquid fuel accounted for the remaining 42%. This was a major turnaround as liquid fuel dominated the fuel mix from January to June of this year. DFO had no share in the total fuel mix in July 2017 whiles the share of HFO increased marginally to 33% in July 2017 from 30% in June 2017. The liquid fuel for July 2017 only comprised of LCO and HFO as DFO was not used used by any of the plants which generated in the month. The share of LCO to the total fuel mix also fell to 9% from 23% in June 2017.

On the individual fuel level, natural gas continued to dominate the fuel supply mix. Natural gas constituted 58% of the total fuel supply mix in July 2017, which was 12% higher than the 46% recorded in June 2017. Natural gas supply from the WAGPCo increased from 12% in June 2017 to 17% in July 2017. Natural gas supply from the AGPP also increased to 41% from 34% in June 2017 of the total natural gas supply.

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

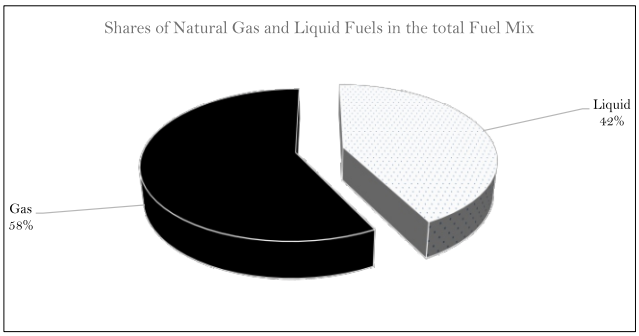
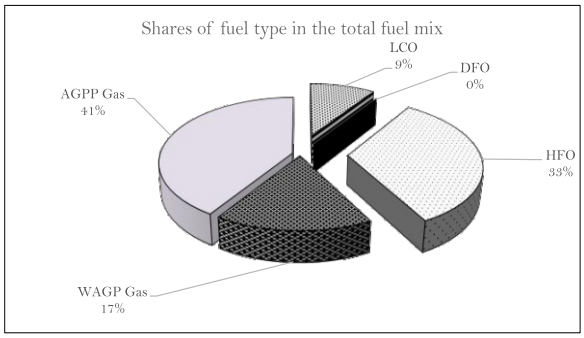


Figure 3b: Shares of fuel type in the generation fuel mix power generation



Natural gas supplies from WAGPCo increased

Natural gas flow rate from Nigeria through the WAGP to Tema and Kpone increased to 32.96 MMSCF per day in July 2017 from 24.87 MMSCF per day recorded in June 2017. Total supply increased to 982.49 MMSCF in July 2017 from 752.6 MMSCF in June 2017. Natural gas supply from the WAGP accounted for 29% of the total natural gas supply in July 2017. Despite the increase in supply, there was no continues supply of natural gas from the WAGP for electricity generation by the Sunon Asogli Power Plant in July 2017.

Natural gas supply from GNCC increased significantly

Natural gas flow rate from the AGPP to the Aboadze Power Enclave increased significantly to 76.39 MMSCF from 68.48 MMSCF per day in June 2017. Total gas supply from the Atuabo Gas Processing plant to the Aboadze Power Enclave of 2,281.37 MMSCF in July 2017 was 21% higher than the 1,885.17 MMSCF supplied in June 2017. Natural gas supply from the AGPP accounted for 71% of the total natural gas supply in July 2017. Of the total natural gas supplied in July 2017, 32.7% was used by the Ameri Power Plant for electricity generation, 57.3% was used by TICO Power Plant whiles the remaining 10.03% was used by the TAPCO Power plant.

Figure 4a: Contribution of Gas Supply by sources

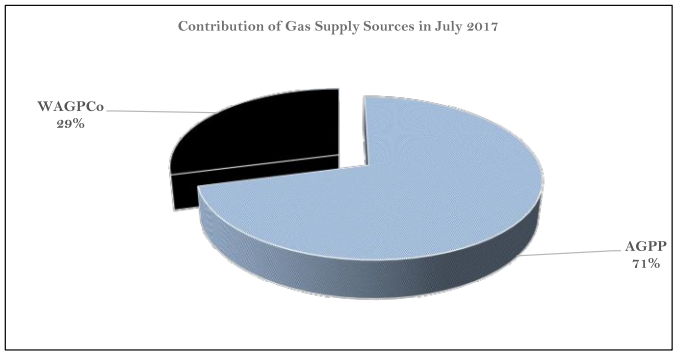
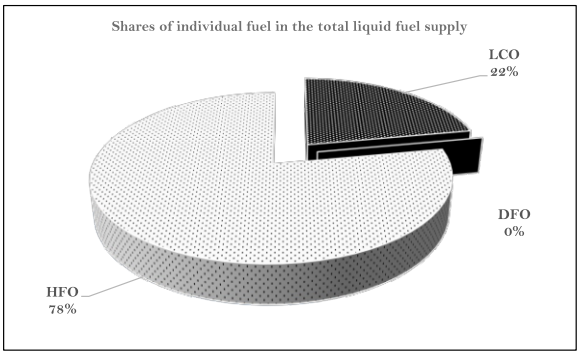


Figure 4b: Contribution of individual fuel in the liquid fuel supply



Liquid Fuel

A total of 440,233 barrels of liquid fuel was used by thermal power plants in July 2017. This total comprised of 24% LCO, 0% DFO and 76% of HFO. LCO continue to lose its dominance in the liquid fuel supply mix and its share of the total liquid fuel supply decreased to 22% in July 2017 from 43% in June 2017. Share of HFO in the Liquid fuel supply mix increased to 78% in July from 64% in June 2017. Share of DFO in the total liquid fuel supply mix dropped further to 0% in July 2017 from 2% in June 2017.

A total of 107,271 barrels of LCO was used for electricity generation in July 2017, which was 62.4% higher than the 285,099 barrels used in June 2017. Of this total, 40.1% was used by power plants in the Tema and Kpone whiles 59.9% was used in the Aboadze Power Enclave.

DFO was only used by TICO power plants and TT1PP to start and stop their plants. Its consumption decreased significantly in July 2017 by 99.8% to 19.97 barrels from 11,130 barrels in June 2017, primarily due to no generation from KTPP and Trojan Power Plant as a result of the availability of cheaper alternative sources of electricity. Of the total of 19.97 barrels of DFO used in July 2017, 71% was used by TT1PP.

HFO consumption increased in July 2017 by 5.96% to 332,939 barrels from 314,201 barrels in June 2017. Of this total, 63.7% was used by the Karpowership power plant and 36.3% was used by the AKSA power plant.

Plant by Plant Highlights

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

The Akosombo GS operated for the entire month of July 2017, generating 290.18 GWh of electricity which was 5.73 GWh higher than 284.4 GWh it generated in June 2017. Average generation from the Akosombo GS increased marginally to 9.67 GWh per day in July 2017 from 9.48 GWh per day in June 2017. The Akosombo GS share of the total electricity supply also increased marginally in July 2017 to 25.5% from 24.7% in June 2017. The low share of Akosombo GS in the total supply mix was well anticipated in the 2017 Electricity Supply Plan (ESP) but the actual percentage outturn differed from the projection. The 2017 ESP projected supply from the Akosombo GS to 22.8% in July 2017. The Akosombo GS generated 0.76% higher than the 288 GWh projected under the 2017 ESP. The Akosombo GS contributed 556 MW (27.2%) to meet the System Peak Load which is marginally lower than the 569MW (27.3%) it contributed in June 2017. Similarly, the Akosombo GS contributed 556 MW (27.4%) to the Ghana Peak Load in July 2017.

Electricity supply by Kpong Generation Station (GS) increased marginally

The Kpong GS generated a total of 61.04 GWh in July 2017, marginally higher than the 59.1 GWh it generated in June 2017. The Kpong GS generated an average of 2.0 GWh per day in July 2017 which was 3.3% lower than in June 2017. Generation from the Kpong GS accounted for 5.4% of the total electricity supplied in July 2017. The generation from the Kpong GS was 7.1% higher than the 57 GWh projected for July 2017 under the 2017 ESP. The Kpong GS contributed 108 MW (5.29%) to meet System Peak Load in July 2017, which was lower than the 81 MW (3.7%) recorded in June 2017. Similarly, the Kpong GS contributed 108 MW to the Ghana Peak Load in July 2017, which was higher than the 81 MW (3.9%) recorded in June 2017.

Electricity supply by the Bui Generation Station (GS) increased marginally

Electricity production from the Bui Power Plant increased marginally in July 2017 to 28.52 GWh (0.95 GWh per day) from 28 GWh (0.93 GWh per day) in June 2017. This represents an increase of 2.2% between July 2017 and June 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 July 2017. The Bui GS supplied 2.5% of the total electricity supplied in July 2017, marginally higher than the 2.4% supplied in June 2017. The total electricity generated in July 2017 from the Bui Power Plant was 59.8% lower than the 71 GWh projected to be generated under the 2017 Electricity Supply Plan (ESP). The Bui power plant contributed 99 MW to meet both the System Peak (4.85%) and Ghana Peak Loads (4.89%).

Generation by the Sunon Asogli Power Plant (SAPP) decreased significantly in July 2017

The Sunon Asogli Power Plant (SAPP) operated for the whole of June 2017 and generated a total of 132.71 GWh of electricity (4.42 GWh per day) a significant decrease from the 171.2 GWh of electricity (5.71 GWh per day) generated in June 2017. The Power Plant contributed 11.7% of the total electricity supplied in July 2017, a significant increase from the 14.6% recorded in June 2017. The SAPP contributed 91 MW to meet both the System Peak Load (4.85%) and Ghana Peak Load (4.89%) in July 2017. The SAPP consumed a total of 740.14 MMSCF of natural gas and 43,667.19 barrels of LCO at an estimated heat rate of 7,540.80 Btu/kWh, a marginal increase in fuel efficiency as compared to 7,761.18 Btu/KWh recorded in June 2017.

HIGHLIGHTS OF THE MONTH

CENIT Power Plant did not operate in July 2017

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

Ameri Energy Power Plant generation continued decline in July 2017

Electricity generation from the Ameri Energy Power Plant declined to 2.79 GWh per day from 4.01 GWh per day in June 2017. The total electricity generation of 88.83 GWh was also lower than the 120.3 GWh supplied in June 2017 owing to the increased generation of TAPCO and TICO on natural gas compared June 2017. The Ameri Power Plant generated 39.6% lower than the 147 GWh projected under the 2017 ESP. The total electricity generated by Ameri Power Plant in July 2017 represented 7.8% of total electricity supplied in the month which was lower than the 10.5% recorded in June 2017. The Ameri Power Plant consumed 726.36 MMSCF of natural gas to generate the 88.83 GWh of electricity at an estimated average heat rate of 10,059.38 Btu/kWh, a marginal improvement in fuel efficiency from the 10,129.61 Btu/kWh recorded in June 2017.The Ameri Power Plant contributed 197.9 MW (9.69%) to meet the System Peak Load and 197.90 MW (9.77%) to meet the Ghana Peak Load in July 2017.

Kpone Thermal Power Plant (KTPP) was offline in July 2017

The Kpone Thermal Power Plant (KTPP) was offline for the whole of July 2017 due to low levels of Light Crude Oil (LCO) stocks to power the plant. The Power Plant was also correctly projected to be offline in July 2017 under the 2017 ESP.

Karpowership Power Plant generation increased marginally

The Karpowership Power Plant generated every day in the month of July 2017, generating an average of 5.32 GWh per day which was marginally higher than the average generation of 5.03 GWh per day recorded in June 2017. Total electricity supplied by Karpowership in July 2017 was 159.56 GWh, which was 5.6% higher than the 151.08 GWh supplied in June 2017 and 2.9% higher than the 155 GWh projected under the 2017 ESP. The Power Plant contributed 14% of the total electricity supplied in June 2017, which is marginally higher than its contribution of 13.1% in June 2017. The Karpowership also contributed 227.80 MW (11.2%) to meet both the System Peak Load and Ghana Peak Loads (11.3%) in July 2017 2017. The Karpowership Power Plant consumed 211,963 barrels of Heavy Fuel oil (HFO) to generate the 159.56 GWh in July 2017 at an average heat rate 8,023.63 Btu/kWh which is a marginal improvement in fuel efficiency from the 8,143.42 Btu/kWh recorded in June 2017.

AKSA Power Plant generation increased marginally in July 2017

The AKSA Power Plant generated 85.74 GWh in July 2017, marginally higher than the 77.8 GWh generated in June 2017 but significantly lower than the 131 GWh projected under the 2017 ESP. The Power Plant supplied 7.5% of the total electricity supplied in July 2017, which is marginally higher than the 6.8% supplied in June 2017. The Power Plant contributed 164.8 MW to meet both the System Peak Load (8.1%) and the Ghana Peak Load (8.13%) in July 2017. A total of 120,976.26 barrels of HFO was consumed by the AKSA Power Plant at an average heat rate of 8,522.66 Btu/kWh, a marginal improvement from the 8,600.82 Btu/kWh recorded in June 2017.

Takoradi International Company (TICO) continued to increase its generation

The TICO Power plant operated throughout the month of July 2017 and generated a total of 192.52 GWh of electricity (average of 6.4 GWh per day) representing 16.9% of total electricity supplied in July 2017. The supply from the TICO Power Plant was 8.7% higher than it supplied in June 2017 and constituted the 16.9% of the total supply in June 2017. The TICO Power Plant had all of its units available in July 2017. The TICO Power Plant in July 2017 contributed 330 MW (16.1%) to meet the System Peak Load and similarly 330 MW (16.3%) to meet the Ghana Peak Load. The Power Plant operated on both light crude oil (LCO) and natural gas consuming about 10,269.61 barrels of LCO and 1,306.21 MMSCF of natural gas to produce the 192.52 GWh of electricity at an estimated average heat rate of 7,567.83 Btu/kWh, an improvement over the 7,850.69 Btu/kWh, recorded in June 2017.

Takoradi Power Company (TAPCO) Plant continued to operate with half of its capacity

The TAPCO Power plant operated for 24 days in the month of July 2017 due to technical challenges to the Power Plant and generated a total of 63.76 GWh of electricity, averaging 2.66 GWh per day which represented 5.6% of total electricity supplied in July 2017. The Power Plant was offline for 7 days due technical issues. The supply from the TAPCO Power Plant was 1.9% higher than it supplied in June 2017 and constituted the 5.6% of the total supply in July 2017. The TAPCO Power Plant had half of its capacity available in July 2017 due to the shutdown of the Gas turbine (Unit 2) for mandatory maintenance work since January 2017. The TAPCO Power Plant in July 2017 contributed 150 MW (7.4%) to meet both the System Peak Load and the Ghana Peak Load respectively. The Power Plant operated on both light crude oil (LCO) and natural gas consuming about 53,334.94 barrels of LCO and 229.37 MMSCF of natural gas to produce the 63.76 GWh of electricity at an estimated average heat rate of 8,287.91 Btu/kWh, a fall in the fuel efficiency compared to the 8,212.44 Btu/kWh recorded in June 2017.

Tema Thermal 1 Power Plant (TT1PP) generated in July 2017

The TT1PP was back online in July 2017 after going offline for the whole of June 2017 due to low levels of Light Crude Oil (LCO) stocks to power the plant. The power plant generated 20.06 GWh in July 2017, averaging 1.54 GWh per day. The power plant contributed 1.8% of the total electricity supplied in July 2017. TT1PP contributed 105 MW (5.1%) to meet both the System and Ghana Peak Loads. It consumed 236.87 MMSCF and 14 barrels of DFO to generate the 20.06 GWh in July 2017 at an estimated heat rate of 12,284.02 Btu/kWh.

Tema Thermal 2 Power Plant (TT2PP) generated briefly July 2017

The TT2PP came online briefly in July 2017 (4 day) to continue commission of the 36 MW TT2PP expansion power plant. The power plant generated 0.5 GWh of electricity consuming 5.48 MMSCF of natural gas at an average heat rate of 12,284.05 Btu/kWh.

Trojan Power Plant was offline in July 2017

The Trojan Power Plant was offline in July 2017 and did not generate any amount of electricity. This was due to unavailability of DFO at both the Tema and Kumasi Plant sites. This wasn't surprising as the Power Plant was correctly projected to be offline under the 2017 ESP.

HIGHLIGHTS OF THE MONTH

Electricity Exchange – Imports increased while export decreased and Ghana remained a net importer of electricity

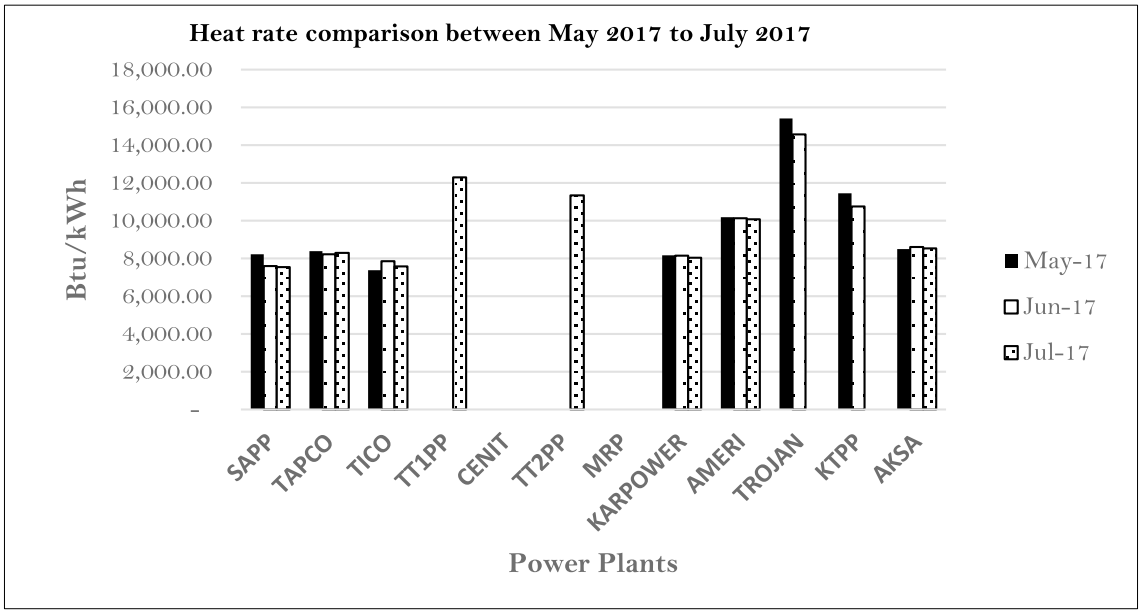
Electricity imports from La Cote D'Ivoire increased to 19.34 GWh (0.64 GWh per day) in July 2017 from 13.3 GWh (0.44 GWh per day) in June 2017. Total import in July 2017 was lower than the 33 GWh projected under the 2017 ESP. Electricity import contributed 1.7% of the total electricity supplied in July 2017. Daily peak import in June 2017 reached a maximum of 12 MW and contributed 0.6% of the System Peak Load and Ghana Peak Load in July 2017.

Electricity export to CEB decreased marginally to 5.50 GWh (0.17 GWh per day) in July 2017 from 5.76 GWh (0.19 GWh per day) in June 2017 and was significantly lower than the 80 GWh projected under 2017 ESP. Ghana was a net importer of electricity in July 2017 similar to June 2017.

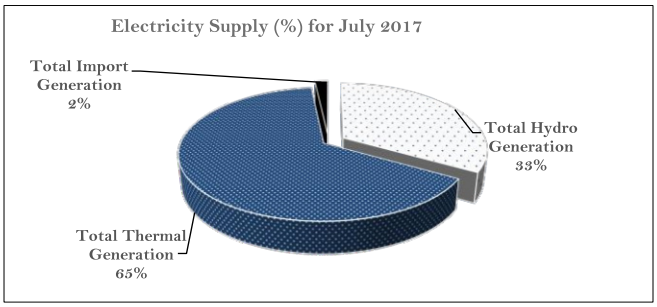
OPERATIONAL FACT SHEET

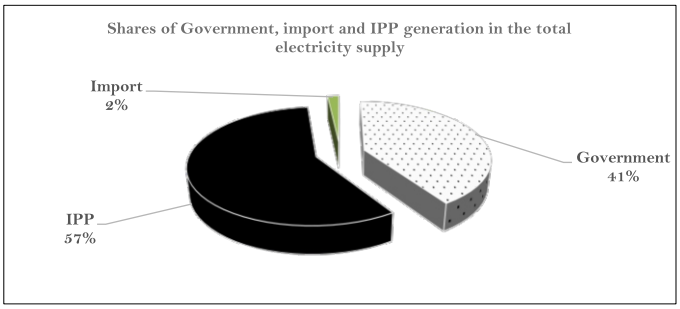
Peak Electricity Supply – July 2017			
Source of Supply	Generation at System Peak Load of July 2017 (MW)	Generation at Ghana Peak Load of July 2017 (MW)	Eleectricity Supply (GWh)
AKOSOMBO	556.00	556.00	290.18
KPONG	108.00	108.00	61.04
BUI	99.00	99.00	28.52
SAPP	91.70	91.70	132.71
TAPCO	150.00	150.00	63.76
TICO	330.00	330.00	192.52
TT1PP	105.00	105.00	20.06
CENIT	–	–	–
TT2PP	–	–	0.50
MRP	–	–	–
KARPOWER	227.80	227.80	159.56
AMERI	197.90	197.90	83.83
KTPP	–	–	–
Trojan Power	–	–	–
CENPOWER	–	–	–
AKSA	164.80	164.80	85.74
IMPORT	12.00	12.00	19.34
Export		16.00	5.50
System Coincident Peak Load	2,042.20	–	–
Ghana Coincedent Peak Load	–	2,026.20	–
Total Supply	–	–	1,137.75
Total Supply without export	–	–	1,132.26

Ghana Electricity Demand		
		Jul-17
Maximum System Peak Load	MW	2,042.2
Minimum System Peak Load	MW	1,435.2
Average Peak Generation	MW	1,853.1
System Base Load	MW	1,161.5
Total Electricity	GWh	1,137.8
Load Factor (LF)	%	74.9



OPERATIONAL FACT SHEET





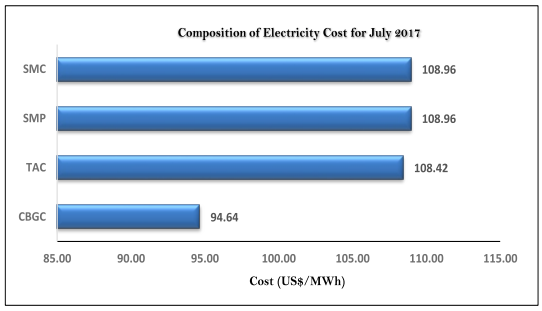
Power Plant Data for July 2017							
	Dependable Capacity (MW)	Plant Utilization (%)	Electricity Generation (GWh)	Gas Consumption (MMBtu)	LCO Consumption (MMBtu)	DFO Consumption (MMBtu)	HFO Consumption (MMBtu)
Akosombo	900.00	43.34	290.18	-	-	-	-
Kpong	140.00	58.60	61.04	-	-	-	-
Bui	340.00	11.27	28.52	-	-	-	-
SEAP	500.00	35.67	132.71	769,747.27	230,999.43	-	-
TAPCO	300.00	28.57	63.76	246,303.79	282,141.85	-	-
TICO	300.00	86.26	192.52	1,402,648.27	54,335.50	-	-
TT1PP	110.00	24.51	20.06	246,340.98	-	-	-
CENIT	110.00	-	-	-	-	-	-
TT2PP	45.00	1.50	0.50	5,697.74	-	-	-
MRP	70.00	-	-	-	-	-	-
KARPOWER	225.00	95.32	159.56	-	-	-	1,280,270.60
AMERI	230.00	48.99	83.83	843,247.65	-	-	-
TROJAN	56.00	-	-	-	-	-	-
KTPP	200.00	-	-	-	-	-	-
AKSA	160.00	72.02	85.74	-	-	-	730,696.62
Total	**3,686.00**	38.91	**1,032.68**	**3,513,985.70**	**567,476.78**		**1,280,270.60**

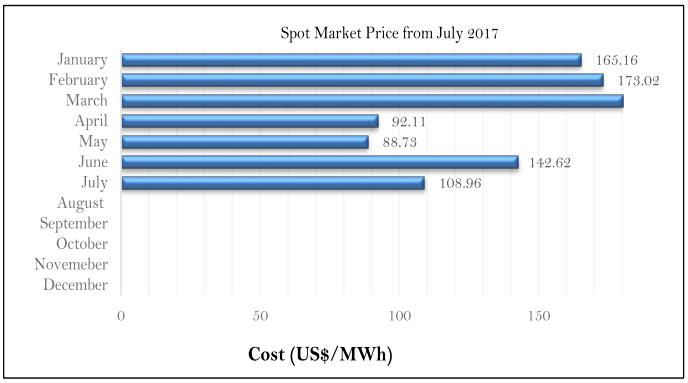
	Average Gas Flow (MMScfd) - July 2017				
Location	Week 1	Week 2	Week 3	Week 4	Monthly Average
Etoki	40.71	59.53	48.38	37.66	**45.71**
Tema	33.82	57.44	27.73	18.87	**32.96**
Aboadze	58.91	85.48	76.39	82.27	**76.39**

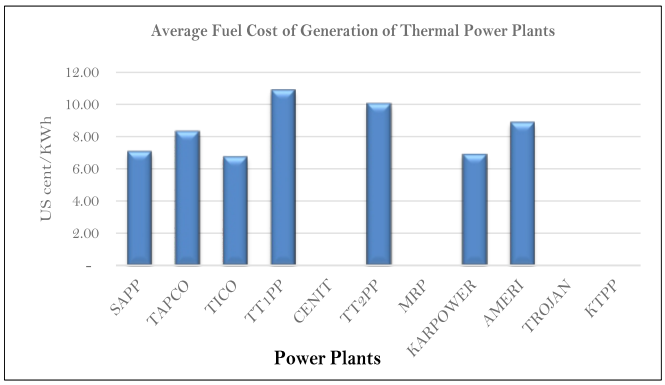
	Water Level (ft) - July 2017				Change in water level
Hydro Dam	Week 1	Week 2	Week 3	Week 4	(feet)
Akosombo	240.45	240.76	241.12	243.00	2.55
Bui	556.71	557.14	557.83	559.17	2.46

ECONOMIC FACT SHEET

		Jul-17	Jun-17	Change
Average Market Energy Cost	US$/MWh	85.58	85.76	(0.18)
Average Market Capacity Charge (AMCC)	US$/MWh	22.85	23.54	(0.70)
Total Average Market Cost (TAC)	US$/MWh	108.42	109.30	(0.88)
System Marginal Cost (SMC)	US$/MWh	108.96	103.49	5.47
System Marginal Capacity Charge (SMCC)	US$/MWh	-	-	-
Spot Market Price (SMP)	US$/MWh	108.96	103.49	5.47
Composite Bulk Generation Charge (CBGC)	US$/MWh	94.64	94.64	-
Deviation of TAC from CBGC	US$/MWh	(13.78)	(14.66)	0.88
Deviation of SMP from CBGC	US$/MWh	(14.32)	(8.85)	(5.47)

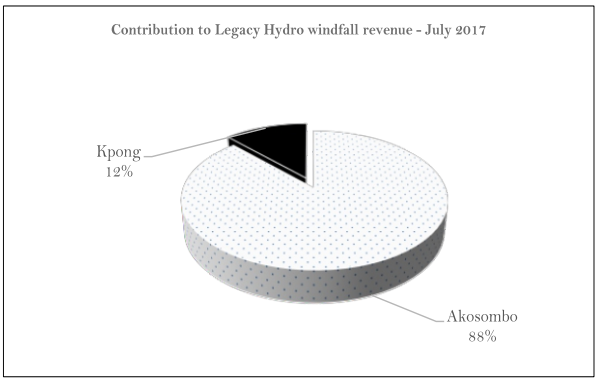






Jul-17				
	Average Cost	Average SMP	Difference	Windfall Revenue
Power Plant	US$/MWh	US$/MWh	US$/MWh	US$/MWh
Akosombo	33.10	108.96	75.86	22,012,164.83
Kpong	59.20	108.96	49.76	3,036,916.30
Total	92.30	-	-	25,049,081.13

Average Fuel Prices		
		Jul-17
Fuel Type	Unit	Delivered Cost
Natural Gas	US$/MMBtu	8.86
LCO	US$/BBL	58.69
HFO (Karpowership)	US$/Tonne	331.57
HFO (Tema)	US$/Tonne	351.57
DFO	US$/Tonne	674.50



1. Financially Sustainable Power Sector

The Wholesale Electricity Market (WEM) Bulletin will from this edition begin a series that will chronicle series of indicators which could be used in assessing the financial sustainability of Ghana's power sector based on a set of criteria developed by the International Institute for Sustainable Development (IISD). This chapter begins the series and looks at the reasons and definitions of the criteria and some indicators to be assessed. These indicators are sources from the International Institute for Sustainable Development's (IISD) report on "A Financially Sustainable Power Sector: Developing assessment methodologies" published in 2014.

The Power Sector in every country has an important role to play. Apart from providing the needed energy for the residencial sector and industries, they contribute significantly to GDP directly and indirectly. This sector also provide the means to speed up rural development especially SME's which could present a way of reducing rural-urban migration. It is for this reason and other equally important reasons that there is the need to have a financially sustainable power sector in Ghana.

According to the International Institute for Sustainable Development (IISD), a power sector is considered financially sustainable if it is able to provide sufficient electricity, make investments to meet changing future demands and generate adequate revenues to cover cost and operations in accordance with environmental and social norms. This brings in the four criteria proposed by IISD to measure this;

1. Ability to recover investment and operating cost
2. Ability to reliably meet demand
3. Ability to make investments; and
4. Ability to operate according to environmental and social norms.

The IISD, 2014 proposed several indicators for these assessment but this bulletin will sample a few. This bulletin will assess the following indicators under each criteria;

1. Ability to recover investment and operating cost
   - Electricity generation unit cost
2. Ability to reliably meet demand
   - Ratio of installed capacity to demand
   - Reserve margin
   - Capacity Factor
3. Ability to make investments
   - Capacity growth
   - Ratio of installed capacity to demand growth
4. Ability to operate according to environmental and social norms
   - Emission factor
   - Fossil fuel dependency
   - Proportion of renewable energy

1.1 Ability to recover investment and operating cost

The ability to recover investment and operating cost is the essence for the establishment of any profit making enterprise. A power sector that enable investors make reasonable investment and recover their investment will attract more investments. There are several indicators which alone or in combination with others could help estimate the extent to which this criteria is met. Some of these indicators include but not limited to; electricity generation unit cost, technical and non-technical losses, rental unit cost, financial ratio analysis such as current ratio, profit margins and debt ratio and opportunity cost. The WEM bulletin will be looking at the electricity generation unit cost as the indicator to measure this criteria.

1.1.1 Electricity generation unit cost

This indicator measures the ability to recover cost of generation from the Bulk Generation Tariff (BGT). For each unit of electricity produced, there should be a commensurate electricity tariff that will ensure the recovery of cost and promote increased investment. The indicator therefore assesses the adequacy of the Bulk Generation Tariff in meeting the cost of producing electricity. This indicator considers all the individual plant units cost in meeting the demand with respect to each contribution to meeting the demand. Electricity generation unit cost could further be developed to measure the retail unit cost by adding the transmission and distribution cost including taxes and levies.

1.2 Ability to reliably meet demand

Capacities are added to meet demand and obtain the necessary back up capacity to make electricity supply reliable. Electricity reliability is critical as a reliable electricity supply could help industries and consumer plan and make future investment decisions. Indicators such as; reliability index, power intensity, reserve margins, capacity factor, availability factor, operating ratio, net power import, number of outages and value of net power import is used in assessing this criteria. This bulletin and subsequent bulletin will assess this criteria based on; ratio of installed capacity, reserved margin and capacity factor.

1.2.1 Ratio of installed capacity to demand

To what extent is the installed capacity sufficient to meet system demand at any given time? This question is answered by the ratio of installed capacity to demand. The ratio of installed capacity to demand is typically greater than two (2). With suppress demand and other demand side management programmes on-going, actual demand might not be represented in this indicator. This notwithstanding, this indicator gives a general performance in our ability to meet demand with our installed capacity.

1.2.1 Reserve Margin

Reserve margin is one synthetic measurement often used to measure the reliability of a power system. There is sufficient evidence to asset that reliability increase with increase in reserve margin for a power system. Reserve margin is necessary to cater for any loss in generation capacity due to faults, planned and unplanned maintenance works. However, it is important to have an optimal amount of reserve as excess reserves turns to be costly to the power system as there are more idle plants than needed. There are varying literature on

the optimal reserve margin need for a power system. The IEA in its "Energy Market Reform edition" on the "Security of Supply in Electricity Market", 2002, estimated that the optimal reserve margin level range within 18% to 25% but reserve margins are particular to every system. Two variant of this indicator will be calculated; Constrained and Unconstraint reserve margin.
The Constraint Reserve Margin considers available power plants and fuel supply situation compared to system demand at each period of measurement. This measures our ability to meet demand with adequate reserve considering fuel constraints, planned and unplanned maintenance of the power plants. Unconstraint Reserve Margin compares the system demand and installed capacity at each period of measurement.

1.2.3 Capacity Factor
The Capacity Factor indicator show the extent to which the supply system is being utilized. This factor expresses the ratio between the actual generation and maximum possible generation at the installed capacity of the system. A high capacity factor indicates that the system is efficient whiles a low capacity factor indicates idle or non-operational plants.

1.3 Ability to make investments
A sustainable power sector should not only be able to meet current demand but should ensure that future demands are met. Investment in the power sector should be able to grow to correspond to growing demands. Ability to make investment can be evaluated based on the relative increase in capacity and expenditure. Analysis will however be made on only relative capacity increase. In measuring this criteria, two indicators will be used; capacity growth and ratio of installed capacity to demand growth.

1.3.1 Capacity Growth
The intent of this indicator is to measure the changes in the installed capacity over a period. An increase in the installed capacity signifies an increase in investment in the sector. A reduction in the installed capacity will signify the retirement or decommissioning of older power plants which need to trigger new investment in the sector.

1.3.2 Ratio of installed capacity to demand growth
This indicator measures the sufficiency of the capacity growth in meeting demand growth. This also gives an indication of the speed at which capacity is able to catch up with the electricity demand or needs of the country. This indicator will be assessed on a yearly bases.

1.4 Ability to operate according to environmental and social norms
The need to meet present and future demand, make investment and recover cost of investments should not override the need to achieve environmental and social norms. Conforming to environmental norms is in the best interest of the power sector, that is, if these norms are not conformed with, there will be more pressure from society and international bodies which could make the cost of generation increase. This segment will deal more with environmental indicators such as Emission factor, fossil fuel dependency, Proportion of renewable energy.

1.4.1 Emission Factor
This indicator measures how much greenhouse gases are emitted for every unit of electricity produced. This bulletin will focus on Carbone Dioxide (CO2) emission per every unit of electricity produced. This will be compared with average values obtained in other region. This indicator is measured as kgCO2/kWh using the simple OM emission factor approach.

1.4.2 Fossil fuel dependency
This is a simple ratio which measures share of fossil fuel in the electricity generation which indicates the countries dependency of fossil fuel. The lower the fossil fuel dependency ratio, the more environmental friendly power generation subsector.

The four criteria; ability to recover cost, ability to reliably meet demand, ability to make investments and ability to operate according to environmental and social norms are in no way been exhaustively judge by the above list of indicators. These indicators provide a snapshot of the power sector and could be used to track the progress of the power sector over time. It does not place a definite judgment on Ghana's power sector but seeks to compare our progress with other economies.

2.0 Performance Indicators of Power Plants

2.1 Capacity Utilization Factor (CUF)

The hydro power plants generally had a marginally reduced CUF in July 2017. The CUF of Akosombo Hydro Plant reduced marginally from 43.89% in June 2017 to 43.34% in June 2017 whiles the CUF of Bui GS reduced from 11.43% in June 2017 to 11.27% in July 2017 which is lower than it designed CUF of 25%. Kpong GS on the other hand, had a stable CUF of 58.59% in June 2017 and 58.60% in July 2017.

Like the hydro power plants, the TAPCO witnessed a marginal reduction in their CUF in July 2017 compared to June 2017. TAPCO power plants CUF reduced from 29% in June 2017 to 28.57% in July 2017 respectively. The Ameri power plant and SAPP had significant reductions in their CUF from 72.62% and 47.56% in June 2017 respectively to 48.99% and 35.67% in July 2017 respectively. The AKSA, Karpowership power plant and TT1PP were the only thermal power plants that had significant increase in the CUF in July 2017. The AKSA power plant CUF increased from 67.5% in June 2017 to 72.02% in July 2017. Likewise, the TT1PP CUF increased to 24.51% in July 2017 as it generated no electricity in June 2017. The Karpowership power plant also had an increase of 2.06% and its CUF in July 2017 compared to June 2017 from 93.26% to 95.32%.

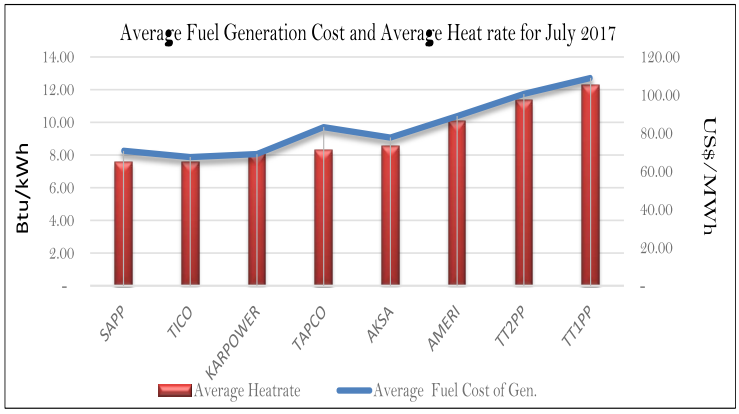
The System Load Factor (LF) reduced from 76.4% in June 2017 to 74.9% in July 2017.

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	43.34	-	-
Kpong	58.60	-	-
Bui	11.27	-	-
SEAP	35.67	7,540.80	70.77
TAPCO	28.57	8,287.91	83.23
TICO	86.26	7,567.83	67.54
TT1PP	24.51	12,280.21	108.96
CENIT	-	-	-
TT2PP	1.50	11,334.27	100.56
MRP	-	-	-
KARPOWER	95.32	8,023.63	69.01
AMERI	48.99	10,059.38	88.92
TROJAN	-	-	-
KTPP	-	-	-
AKSA	72.02	8,522.66	77.72

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



2.2 Heat Rate (Fuel Efficiency)

The SAPP continued to be the most efficient power plant in July 2017with it efficiency increasing from 7,762.17 Btu/kWh in June 2017 to 7,540.8 Btu/kWh in July 2017. Likewise, there were improvement in fuel efficiencies for TICO, Karpowership, Ameri and the AKSA power plants in July 2017 compared to June 2017. Efficiencies of these plants increased from 7,849.86Btu/kWh, 8,134.42 Btu/kWh, 10,129.61 Btu/kWh and 8,600.82 Btu/kWh for TICO, Karpowership, Ameri and AKSA power plants respectively in June 2017 to 7,567.83 Btu/kWh, 8,023.63 Btu/kWh, 10,059.38 Btu/kWh and 8,522.66 Btu/kWh respectively in July 2017. There was a marginal reduction in efficiency for the TAPCO power plant from 8,212.44 Btu/kWh in June 2017 to 8,287.91 Btu/kWh in July 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.

2.3 Average Fuel Cost of Electricity Generation

The TICO power plant had the lowest fuel cost of generation of US$67.54/MWh in July 2017 due to the fact that the power plant largely generated with natural gas and had an improved fuel efficiency. Cost of natural gas (US$8.84/MMBtu) was 20% cheaper in July than LCO (US$11.09/MMBtu). Natural gas constituted 96% of the total fuel used by the TICO power plant in July 2017. The SAPP which was the most efficient plant in July 2017 had a relatively higher cost of generation than TICO and Karpowership due to the relatively average cost of fuel used for electricity generation compared to the other 2 plants. Average fuel cost for SAPP was US$9.38/MMBtu compared to average fuel cost of US$8.92/MMBtu for TICO and US$8.6/MMBtu for Karpowership. Average thermal cost of generation improved from US$93.28/MWh in June 2017 to US$84.1/MWh in July 2017.

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 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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