GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 17: 1st May 2017 to 31st May 2017

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1st May 2017 to 31st May 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 has a special feature on the medium term natural gas supply situation 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 perennial low levels of LCO stocks at the Tema Power Enclave continued in May 2017. The Low LCO level at the Tema Power Enclave led to the inability of both TT1PP and CENIT plant to generate electricity in May 2017 even though they were available. This notwithstanding, the increase in generation of AKSA plant coupled with the coming online of TAPCo Power Plant and sustained high generation levels of Ameri Plant and Karpowership Plant in May 2017 ensured demand was met while at the same time reducing the level of generation from the hydro generation sources in an effort to slow down the drop rate of the water levels. The TAPCo Power Plant came online after being offline since February 2017 and generated 64.47 GWh at an average of 2.08GWh per day in May 2017. Ameri and Karpowership Power Plants also supplied an average of 4.64 GWh and 5.10 GWh per day in May 2017 respectively whiles AKSA Power Plant increased it generation from 3.1 GWh in April 2017 to 3.6 GWh in May 2017.

Supply from the Akosombo GS reduced by 17.2% to an average generation of 12.53 GWh per day in May 2017 from 15.13 GWh per day recorded in April 2017. The Kpong GS also reduced by 9.1% to an average generation of 2.2 GWh per day in May 2017 from 2.42 GWh per day in April 2017 whereas the Bui GS, on the other hand, increased by 10.1% to an average generation of 1.63 GWh per day in May 2017 from 1.48 GWh per day in April 2017. These reductions in electricity supply

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

	May 2017		April 2017	
	Projected	Actual Outturn	Projected	Actual Outturn
Total Supply (GWh)	1,346.0	1,226.2	1,338.0	1,221.8
Source by Power Plants (GWh)				
AKOSOMBO	285.0	388.5	307.0	454.02
KPONG	57.0	68.2	61.0	72.70
BUI	71.0	50.5	59.0	44.39
Sunon Asogli	183.0	74.0	191.0	75.26
TAPCO	95.0	64.5	88.0	-
TICO	190.0	115.1	184.0	114.83
TT1PP	-	-	-	24.40
CENIT	-	-	-	-
TT2PP	-	-	-	-
MRP	-	-	-	-
Karpowership	155.0	158.0	148.0	160.55
AMERI	145.0	145.0	140.0	156.26
KTPP	-	23.2	-	-
Trojan Power	-	8.0	-	8.57
AKSA	120.0	111.4	69.0	92.85
Total Generation (GWh)	1,301.0	1,206.2	1,247.0	1,203.8
Imports (GWh)	45.0	20.0	91.0	17.98
Total Supply (GWh)	1,346.0	1,226.2	1,338.00	1,221.80
Deficit (GWh)	-	(119.8)	-	(116.2)
Ghana Coincedent Peak Load (MW)	2,105.0	2,129.2	2,102.0	2,108.8
System Coincident Peak Load (MW)	2,238.0	2,158.2	2,235.0	2,160.8

from the Akosombo GS helped in reducing the rate of drop in their water levels. Akosombo GS water level dropped significantly by an average of 0.052 feet per day in May 2017, which was 27.7% lower than the average drop rate of 0.072 feet per day recorded in April 2017. Similarly, the Bui GS recorded a reduction in its water level drop rate by 12.2% from 0.082 feet per day in April 2017 to 0.072 feet per day in May 2017 despite the increase in generation.

There was a further reduction in the System Marginal Cost (SMC) of electricity in May 2017 due to the coming online of the TAPCo Power Plant which was offline since February 2017 which resulted in the shut down of less efficient power plants. The SMC reduced by 2.96% in May 2017 compared to the SMC recorded in April 2017.

There was a partial system collapse on May 3rd, 2017 which affected most parts of the country. This partial collapse was due to the tripping of all six units of the Akosombo GS. Power was restored to most of the affected areas in Ghana within hours of the event.

Electricity Demand and Supply

Electricity Demand

The System Peak Load (Ghana Peak Load plus Import) decreased marginally to 2,158.20 MW in May 2017 from 2,160.8 MW recorded in April 2017. The Ghana Peak Load (Domestic Peak Load including VALCo minus Export), however, increased to 2,129.20 MW in May 2017 from 2,108.8 MW in April 2017. The System Peak Load in May 2017 was lower (3.6%) than the projected System Peak load of 2,238 MW under the 2017 ESP, while the Ghana Peak Load was 1.4% higher than the projected Ghana Peak Load of 2,105 MW for May 2017 under the 2017 ESP.

Electricity supply

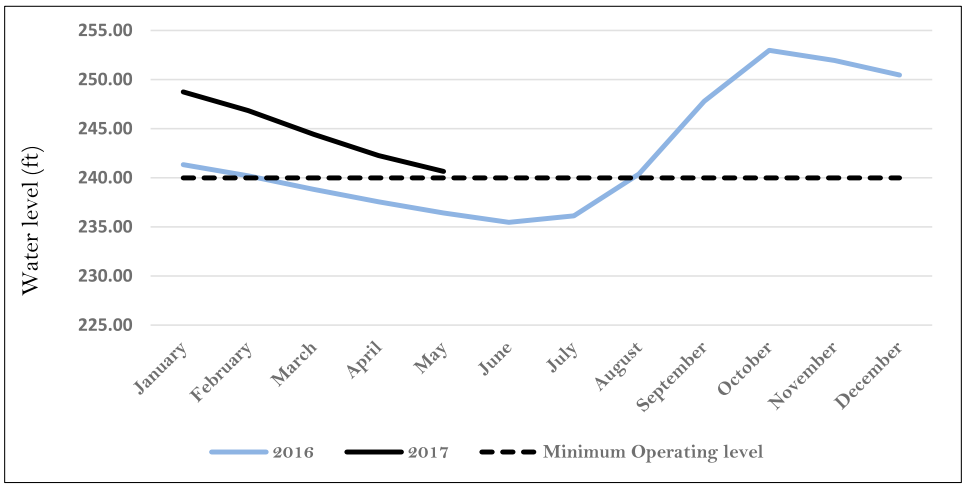
The average daily electricity supplied to meet Ghana's requirement decreased marginally to 39.55 GWh per day in May 2017 from 40.7 GWh per day recorded in April 2017. The total electricity supply in May 2017 was 1,226.23 GWh consisting of 1,206.23 GWh from domestic generation and 20 GWh of imports from La Cote D'Ivoire. The total supply of electricity in May 2017 was 119.87 GWh lower than the 1,346.1 GWh projected under the Electricity Supply Plan (ESP) developed for the year 2017. This represented a 8.9% deviation between the outturn and the projection.

Hydro Dam Levels

Akosombo Dam Water Level dropped in May 2017 but at a reduced rate

The rate of drop in the water level of the Akosombo dam reduced further to 0.052 feet per day in May 2017 from 0.072 feet per day in April 2017. The reduced drop rate was due to a reduction in generation from the Akosombo GS as a result of adequate generation from thermal sources. The water level dropped by 1.61 feet in May 2017 from 242.27 feet at the beginning of the month to 240.66 feet at the end of the month. The water level at the end of May 2017 was higher than the level at the same time in May 2016 by about 4.23 feet and only 0.66 foot 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 May 2017.

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

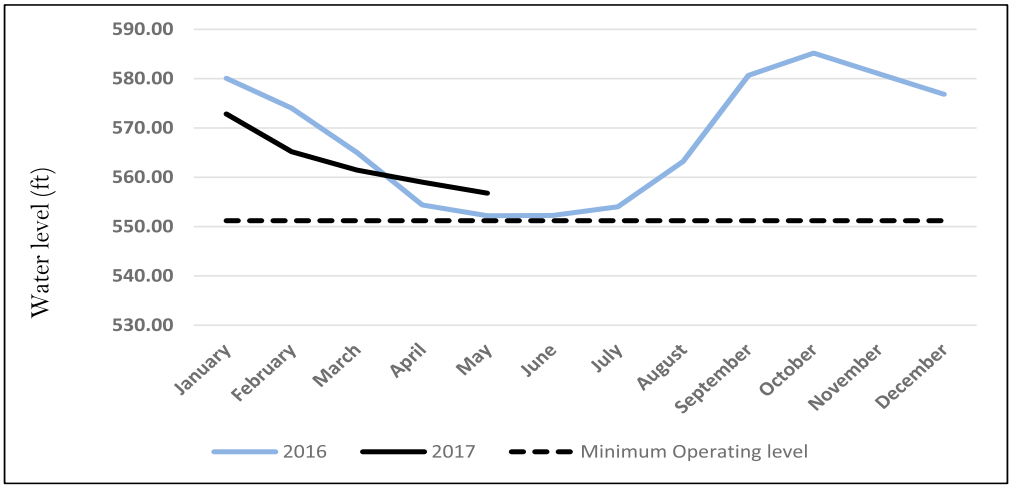


Bui Dam Water Level declines at a reduced rate

The Bui dam water level also witnessed a reduction in the rate of drop in May 2017 to 0.072 feet per day from 0.082 feet per day in April 2017. The reduction in the rate of drop was due to the reduction in generation from the Bui GS as a result of adequate available thermal power plant generation capacity to meet demand for the month. The water level dropped by 2.23 feet in May 2017 from 2.46

feet in April 2017. The water level dropped from 559.01 feet level at the beginning of the month to 556.78 feet at end of the month. The water level at the end of the month for Bui GS (556.78 feet) was, above the level of the dam at the same period in May 2016 (552.22 feet) by 4.56 feet due to the reduced generation from the Power Plant. Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2016 to May 2017.

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



Fuel Supply for Power Generation

Liquid fuel continued to dominate the fuel supply mix in May 2017 and its share in the fuel supply mix increased to 57% in May 2017 from 52% in April 2017 with natural gas accounting for the rest. The share of DFO increased to 6% in May 2017 from 2% in April 2017. Similarly, the share of LCO increased to 15% in May 2017 from 13% in April 2017. There was however a marginal fall in the share of HFO to 36% in May 2017 from 37% in April 2017 due to the reduction in generation from the Karpowership Power Plant.

On the individual fuel level, natural gas continued to dominate the fuel supply mix. Natural gas constituted 43% of the total fuel supply mix in May 2017, which was 5% higher than the 48% recorded in April 2017. Natural gas supply from the WAGPCo decreased marginally to 8.48% of the share of the total natural gas supply in May 2017 from 9.1% in April 2017. Correspondingly, natural gas supply from the AGPP also reduced to 34.85% in May 2017 from 39.1% in April 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

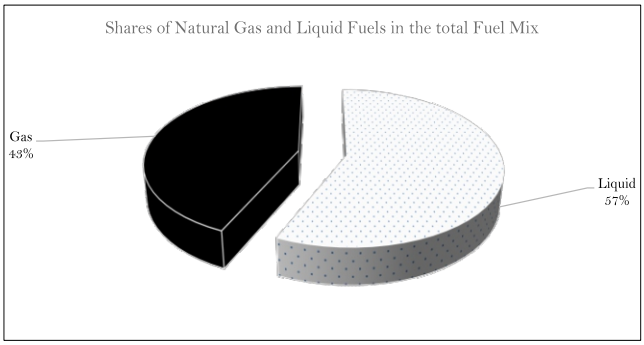
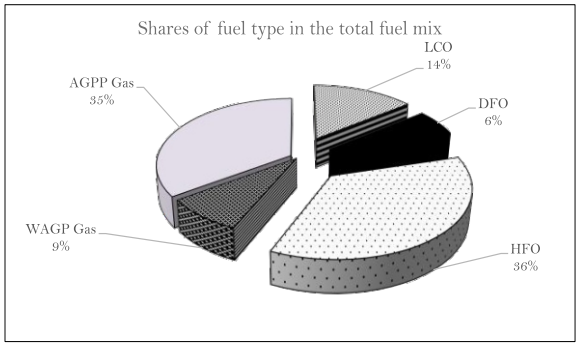


Figure 3b: Shares of fuel type in the generation fuel mix power generation



Natural gas supplies from WAGPCo decreased marginally

Natural gas flow rate from Nigeria through the WAGP to Tema and Kpone decreased marginally to 16.6 MMSCF per day in May 2017 from the 16.8 MMSCF per day recorded in April 2017. Total supply increased to 506 MMSCF (2.6%) in May 2017 from 484 MMSCF in April 2017. Natural gas supply from the WAGP accounted for 19.57% of the total natural gas supply in May 2017. As in April 2017, there was also a steady supply of natural gas from the WAGP for electricity generation by the Sunon Asogli Power Plant in May 2017.

Natural gas supply from GNCC decreased marginally

Natural gas flow rate from the AGPP to the Aboadze Power Enclave decreased marginally to 68.74 MMSCF per day in May 2017 from 69.87 MMSCF per day in April 2017. Total gas supply from the Atuabo Gas Processing plant to the Aboadze Power Enclave of 2,014.74 MMSCF in May 2017 was 5.7% higher than the 1,906.3 MMSCF supplied in April 2017. Natural gas supply from the AGPP accounted for 80.43% of the total natural gas supply in May 2017. Of the total natural gas supplied in May 2017, 68.2% was used by the Ameri Power Plant for electricity generation, 23.7% was used by the TICO power plant while the remaining 8.1% was used by the TAPCo Power plant.

Figure 4a: Contribution of Gas Supply by sources

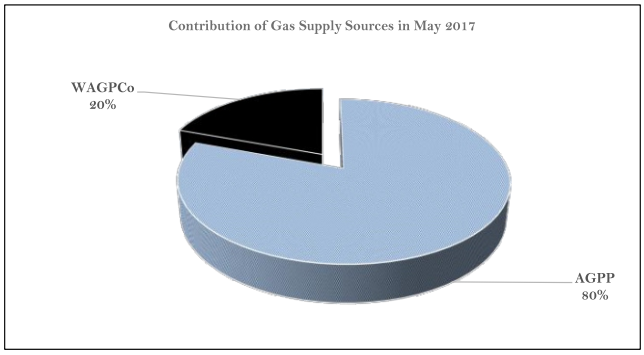
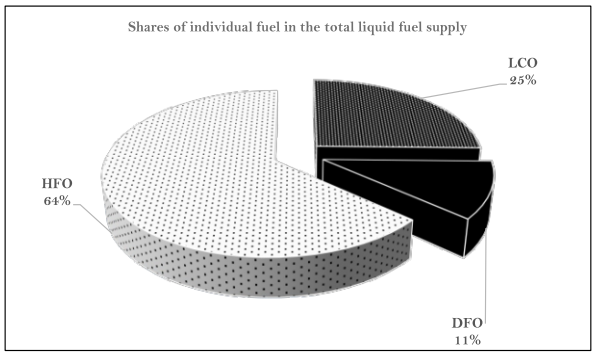


Figure 4b: Contribution of individual fuel in the liquid fuel supply



Liquid Fuel

A total of 611,277.89 barrels of liquid fuel was used by thermal power plants in May 2017. This total comprises of 25% LCO, 11% DFO and 64% of HFO. LCO slightly maintained its share in the liquid fuel supply mix. It only added 1% to its share of 24% in April to 25% in May 2017. HFO is currently dominating the liquid fuel supply mix although its share dropped marginally to 64% in May 2017 from 72% in April 2017. The dominance of HFO in the liquid fuel supply mix was attributed to the full commercial operation of the AKSA Power Plant in April 2017. The share of DFO in the total liquid fuel supply mix increased to 11% in May 2017 from 4% in April 2017.

A total of 168,442.35 barrels of LCO was used for electricity generation in May 2017, which was 26.3% higher than the 133,319 barrels used in April 2017. Of this total, 11.2% was used by power plants in Tema and Kpone whiles 88.8% was used in the Aboadze Power Enclave.

DFO consumption increased significantly in May 2017 by over 3 folds to 72,557.03 barrels from 23,550 barrels in April 2017, primarily due to the coming online of KTPP. In the month of May 2017, KTPP generated for 14 days. Of the total of 72,557.03 barrels of DFO was used in May 2017, 68% was used by KTPP while 31.7% was used by Trojan Power Plants in Tema and Kumasi and the remaining 0.3% was used by both TAPCo and TICO plants for the starting and stopping of their plants.

HFO consumption increased further in May 2017 by 8.1% to 370,278.51 barrels from 342,513 barrels in April 2017. Of this total, 57.7% was used by the Karpowership power plant while 42.3% was used by the AKSA power plant.

Plant by Plant Highlights

Electricity Generation at the Akosombo Generation Station (GS) dropped further in May 2017

The Akosombo GS operated for the entire month of May 2017, generating 388.52 GWh of electricity which was 65.5 GWh lower than what it generated in April 2017 of 454.02 GWh. Average generation from the Akosombo GS decreased to 12.53 GWh per day in May 2017 from 15.13 GWh per day in April 2017 due to increase in the supply of electricity from thermal sources. The Akosombo GS share of the total electricity supply continued to decline in May 2017 to 31.68% from 37.2% in April 2017. A drop in the share of Akosombo GS in the total supply mix was anticipated in the 2017 Electricity Supply Plan (ESP), however, the drop was less than anticipated. The 2017 ESP projected supply from the Akosombo GS to drop to 285 GWh. There was however a significant difference between the projection and the actual turnout as the turnout of 388.52 GWh was 36% higher than the projection.

The Akosombo GS contributed 822 MW (38.09%) to meet the System Peak Load of 2,158.20 MW which is marginally lower than the 854 MW (39.7%) it contributed in April 2017. Similarly, the Akosombo GS contributed 822 MW (38.61%) to the Ghana Peak Load of 2,129.20 MW in May 2017, lower than the 854.5 MW (40.5%) recorded in April 2017.

Electricity supply by Kpong Generation Station (GS) continued to decline

The Kpong GS generated a total of 68.16 GWh in May 2017 lower than the 72.70 GWh it generated in April 2017. The Kpong GS generated an average of 2.20 GWh per day in May 2017 which was 9.0% lower than in April 2017. The generation from the Kpong GS was 19.6% higher than the 57 GWh projected for May 2017 under the 2017 ESP.

The Kpong GS contributed 106 MW (4.91%) to meet System Peak Load in May 2017, lower than the 114 MW (5.28%) recorded in April 2017. Similarly, the Kpong GS contributed 106 MW (4.98%) to the Ghana Peak Load in May 2017, which was lower than the 110.1 MW (5.2%) recorded in April 2017.

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

Electricity production from the Bui Power Plant increased marginally in May 2017 to 50.49 GWh (1.63 GWh per day) from 44.39 GWh (1.48 GWh per day) in April 2017. This represents an increase of 15% between April 2017 and May 2017 based on the daily average production of the months. The Bui GS supplied 4.1% of the total electricity supplied in May 2017, higher than the 3.6% supplied in April 2017. The total electricity generated in May 2017 from the Bui Power Plant was 28.9% lower than the 71 GWh projected to be generated under the 2017 Electricity Supply Plan (ESP).

The Bui power plant contributed 197 MW to both the System Peak (2,158.20 MW) and Ghana Peak Loads (2,129.20 MW), which represents 9.13% and 9.25% respectively.

HIGHLIGHTS OF THE MONTH

Generation by the Sunon Asogli Power Plant (SAPP) continued to decline

The Sunon Asogli Power Plant (SAPP) operated for the whole of May 2017 and generated a total of 73.97 GWh of electricity (2.39 GWh per day), a marginal drop from the 75.26 GWh (2.51GWh per day) generated in April 2017. The Power Plant contributed 6.03% of the total electricity supplied in May 2017, which was marginally lower than the amount contributed in April 2017 and significantly lower (59.58%) than the 183 GWh projected under the 2017 ESP for May 2017.

The SAPP contributed 152 MW (7.04%) to meet the System Peak Load of 2,158.20 MW which was higher than the 139 MW (6.5%) contributed in April 2017. Likewise, the SAPP contributed 152 MW (7.14%) to Ghana Peak Load of 2,129.20 MW which was also higher than the 94.8 MW (4.5%) contributed in April 2017. The SAPP consumed a total of 506.03 MMSCF of natural gas and 18,815.75 barrels of LCO at an estimated heat rate of 8,460.79 Btu/kWh, a marginal drop in fuel efficiency as compared to 8,327.75 Btu/KWh recorded in April 2017.

CENIT Power Plant did not operate in May 2017

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

Ameri Energy Power Plant generation decreased in May 2017

Electricity generation from the Ameri Energy Power Plant decreased in May 2017 to 144.95 GWh with an average of 4.68GWh per day from 156.26 GWh, averaging 5.21 GWh per day generated in April 2017. The Ameri Power Plant generated almost the same amount of 145 GWh projected under the 2017 ESP. The total electricity generated by Ameri Power Plant in May 2017 represented 11.82% of total electricity supplied in the month which was lower than the 12.8% recorded in April 2017. The Ameri Power Plant contributed 236.70 MW (10.97%) to the System Peak Load in May 2017 which was higher than the 233.1 MW (10.8%) recorded in April 2017. Similarly, the Ameri Power Plant contributed 236.7 MW (11.2%) to the Ghana Peak Load in May 2017 which was higher than the 228.4 MW (10.8%) recorded in April 2017. The Ameri Power Plant consumed 1,373.36 MMSCF of natural gas to generate the 144.95 GWh of electricity at an average heat rate of 10,174.18 Btu/kWh, a marginal reduction from the 10,234.72 Btu/kWh recorded in April 2017.

Kpone Thermal Power Plant (KTPP) came back online in May 2017

The Kpone Thermal Power Plant (KTPP) came online for 14 days and generated 23.16 GWh in May 2017, averaging 1.65 GWh per day. The generation from KTPP accounted for only 1.98% of the total electricity generated in May 2017. KTPP was however projected to be offline in the 2017 ESP. The KTPP made no contribution to either the System Peak Load or Ghana Peak Load. The 23.16 GWh of electricity generated in May 2017 was achieved with a consumption of 49,316.67 barrels of DFO resulting in an average heat rate of 11,458.89 Btu/KWh.

Karpowership Power Plant generation reduced marginally

The Karpowership Power Plant generated every day of the month of May 2017, generating 157.98 GWh, at an average of 5.10 GWh per day which was lower than the 160.55 GWh generated in April 2017, averaging 5.35 GWh per day. The 157.98 GWh generated in May 2017 was 1.9% higher than the 155 GWh projected under the 2017 ESP. The Power Plant contributed 12.88% of the total electricity supplied in May 2017, which was marginally lower than its contribution of 13.1% in April 2017.

The Karpowership contributed 220 MW (10.2%) and 220 MW (10.3%) to the System and Ghana Peak Loads respectively in May 2017 compared to the 10.1% and 10.8% of the System and Ghana Peak Loads respectively in April 2017. The Karpowership Power Plant consumed 213,553.99 barrels of Heavy Fuel oil (HFO) to generate the 157.98 GWh in May 2017 at an average heat rate of 8,164.58 Btu/kWh.

AKSA Power Plant's generation increased in May 2017

The generation of AKSA power plant increased in May 2017 to 111.42 GWh, averaging 3.59 GWh per day from 92.85 GWh at an average of 3.09 GWh per day in April 2017. It however missed the projected figure of 120 GWh under the 2017 ESP by 7.15%. The Power Plant supplied 9.09% of the total electricity generated in May 2017, which is higher than the 7.6% contributed in April 2017. The Power Plant contributed 160 MW (7.43%) to System Peak Load and 160.40 MW (7.53%) to the Ghana Peak Load in May 2017. A total of 156,724.52 barrels of HFO was consumed by the AKSA Power Plant at an average heat rate of 8,496.08 Btu/kW almost the same as the heat rate of 8,496.58 Btu/kWh recorded in April 2017.

Takoradi International Company (TICO) increased its generation marginally

The TICO Power plant operated throughout the month of May 2017 and increased its generation of electricity marginally to 115.09 GWh (at an average of 3.71 GWh per day) from a total of 114.83 GWh of electricity (average of 3.83 GWh per day) generated in April 2017. The supply from the TICO Power plant constituted 9.4% of the total supply of electricity in May 2017. The Power Plant generated at half capacity due to technical challenges to one of its gas turbines.

The TICO Power Plant in May 2017 contributed 160 MW (7.4%) and 160 MW (7.5%) to meet the System Peak Load and Ghana Peak Load respectively. The Power Plant operated on both light crude oil (LCO) and natural gas consuming about 78,092.98 barrels of LCO and 477.95 MMSCF of natural gas to produce the 115.09 GWh of electricity at an estimated average heat rate of 8,049.72 Btu/kWh, an improvement over the 8,107.22 Btu/kWh recorded in April 2017.

Takoradi Power Company (TAPCO) Plant generated partially in May 2017

The TAPCo Power Plant operated for 23 days in May 2017 and generated 64.47 GWh (at an average of 2.80 GWh per day). The supply from the TAPCo power plant constituted 5.26% of the total supply of electricity in May 2017. TAPCo could not generate at full capacity in May 2017 because one of its units (unit 2) was down for major inspection. Due to this, the power plant missed its projection under the 2017 ESP of 95 GWh by 32%.

The TAPCO power plant contributed 104 MW (4.82%) and the same 104 MW (4.88) to the System Peak and Ghana Peak Loads respectively. The power plant operated on both light crude oil (LCO) and natural gas consuming 71,533.62 barrels of LCO and 163.43 MMSCF of natural gas to generate the 64.47 GWh of electricity at an estimated average heat rate of 8,591.96 Btu/KWh.

Tema Thermal 1 Power Plant (TT1PP) was offline in May 2017

The Tema Thermal 1 Power Plant (TT1PP) was offline for the whole of May 2017 due to low levels of Light Crude Oil (LCO) stocks to power the plant. The Power Plant was correctly projected to be offline in May 2017 under the 2017 ESP.

Trojan Power Plant generation dropped marginally

The Trojan Power Plant generated a total of 8.03 GWh (an average of 0.26 GWh per day) of electricity in May 2017, which was 6.3% lower than the 8.57 GWh of electricity it generated in April 2017. Of Trojan's total generation of 8.03 GWh, Trojan Tema generated 5.54 GWh (69%) whereas Trojan Kumasi generated the remaining 2.49 GWh (31%). The power plant's generation of 8.03 GWh constituted 0.65% of the total supply of electricity for the month. The Power Plant was however projected to be offline under the 2017 ESP.

A total of 23,021.40 barrels of DFO was used to generate the 8.03 GWh at an estimated average heat rate of 15,406.23 Btu/KWh.

Trojan plant in Tema consumed 16,983 barrels of DFO to generate 5.54 GWh of electricity at an average heat rate of 16,473.53 Btu/KWh in May 2017 while the Trojan plant in Kumasi consumed 6,038.40 barrels of DFO at an average heat rate of 14,752.58 Btu/KWh to generate 2.49 GWh of electricity.

Electricity Exchange – Imports increased further while exports continued to decrease making Ghana a net importer in May 2017

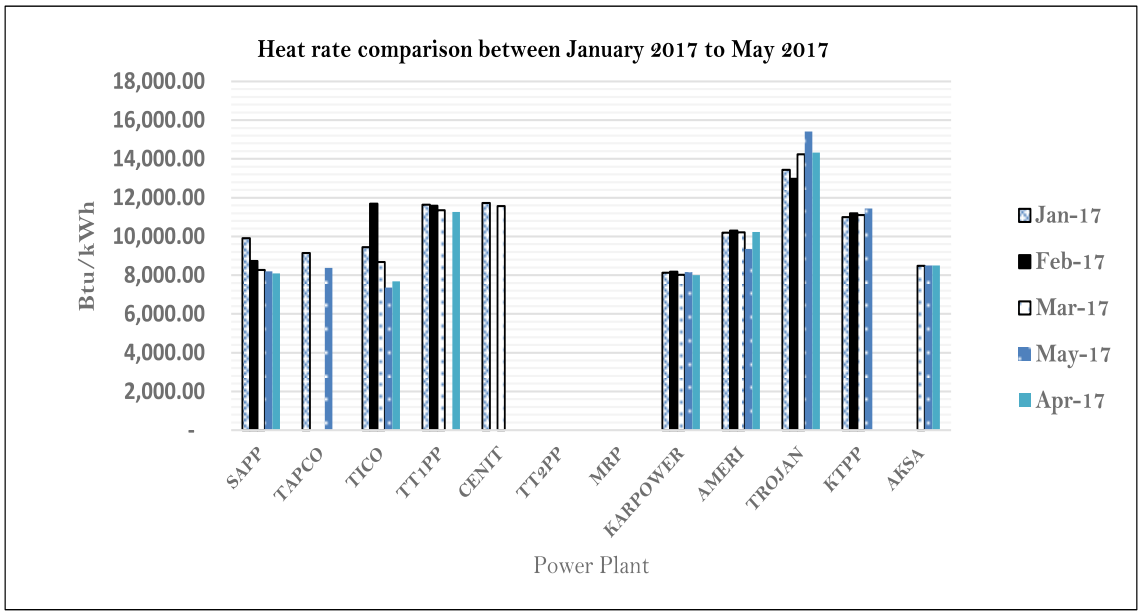
Electricity imports from La Cote D'Ivoire increased further to 20 GWh (0.65 GWh per day) in May 2017 from 17.98 GWh (0.6 GWh per day) in April 2017. Total import in May 2017 was, however, significantly lower than the 45 GWh projected under the 2017 ESP. Electricity import contributed 1.63% of the total electricity supplied in May 2017. Imports in May 2017, however, did not contribute to either the System Peak or Ghana Peak Loads.

Electricity export to CEB continued to decrease to 11.90 GWh (0.38 GWh per day) in May 2017 from 19.10 GWh (0.64 GWh per day) in April 2017 and was significantly lower than the 80 GWh projected under 2017 ESP. Ghana was a net importer of electricity in May 2017 unlike in March and April 2017 when Ghana was a net exporter.

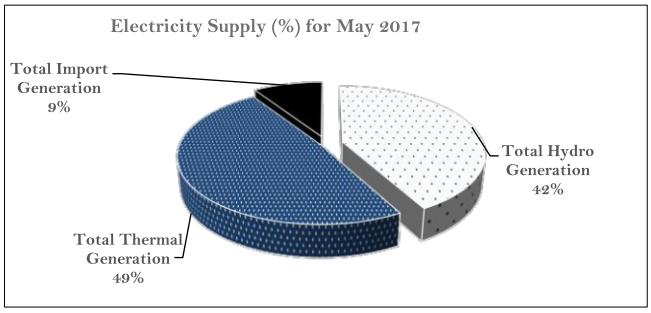
OPERATIONAL FACT SHEET

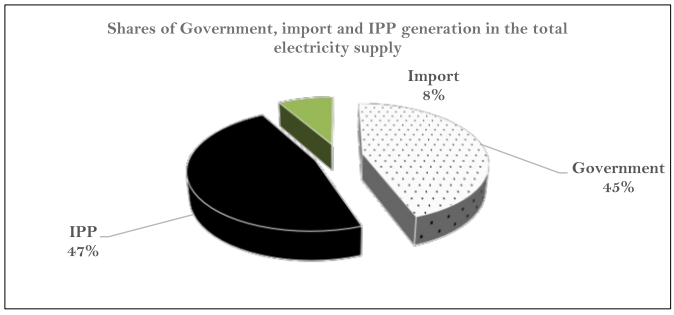
Peak Electricity Supply – May 2017			
Source of Supply	Generation at System Peak Load of May 2017 (MW)	Generation at Ghana Peak Load of May 2017 (MW)	Eleectricity Supply (GWh)
AKOSOMBO	822.00	822.00	388.52
KPONG	106.00	106.00	68.16
BUI	197.00	197.00	50.49
SAPP	152.00	152.00	73.97
TAPCO	104.00	104.00	64.47
TICO	160.00	160.00	115.09
TT1PP	–	–	–
CENIT	–	–	–
TT2PP	–	–	–
MRP	–	–	–
KARPOWER	220.10	220.10	157.98
AMERI	236.70	236.70	144.95
KTPP	–	–	23.16
Trojan Power	–	–	8.03
CENPOWER	–	–	–
AKSA	160.40	160.40	111.42
IMPORT	–	–	20.00
Export		29.00	11.90
System Coincident Peak Load	2,158.20	–	–
Ghana Coincedent Peak Load	–	2,129.20	–
Total Supply	–	–	1,226.23
Total Supply without export	–	–	1,214.33

Ghana Electricity Demand		
		May-17
Maximum System Peak Load	MW	2,158.2
Minimum System Peak Load	MW	1,751.4
Average Peak Generation	MW	1,979.4
System Base Load	MW	1,155.1
Total Electricity	GWh	1,226.2
Load Factor (LF)	%	76.4



OPERATIONAL FACT SHEET





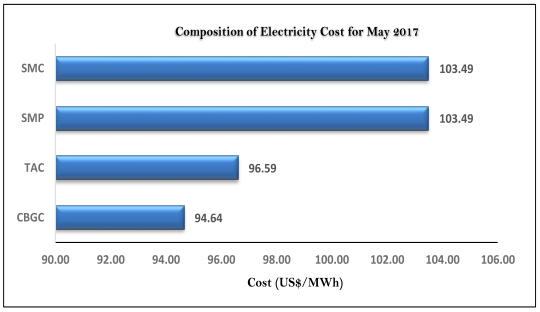
Power Plant Data for May 2017							
	Dependable Capacity (MW)	Plant Utilization (%)	Electricity Generation (GWh)	Gas Consumption (MMBtu)	LCO Consumption (MMBtu)	DFO Consumption (MMBtu)	HFO Consumption (MMBtu)
Akosombo	900.00	58.02	388.52	-	-	-	-
Kpong	140.00	65.44	68.16	-	-	-	-
Bui	340.00	19.96	50.49	-	-	-	-
SEAP	500.00	19.88	73.97	507,459.91	99,553.13	-	-
TAPCO	300.00	28.88	64.47	161,453.77	378,480.13	-	-
TICO	300.00	51.56	115.09	472,174.22	413,185.18	-	-
TT1PP	110.00	-	-	-	-	-	-
CENIT	110.00	-	-	-	-	-	-
TT2PP	45.00	-	-	-	-	-	-
MRP	70.00	-	-	-	-	-	-
KARPOWER	225.00	94.37	157.98	-	-	-	1,289,811.79
AMERI	230.00	84.71	144.95	1,474,758.21	-	-	-
TROJAN	56.00	19.27	8.03	-	-	123,708.00	-
KTPP	200.00	15.56	23.16	-	-	265,008.56	-
AKSA	160.00	93.60	111.42	-	-	-	946,576.32
Total	**3,686.00**	41.25	**1,094.82**	**2,615,846.11**	**891,218.43**	**388,716.56**	**1,289,811.79**

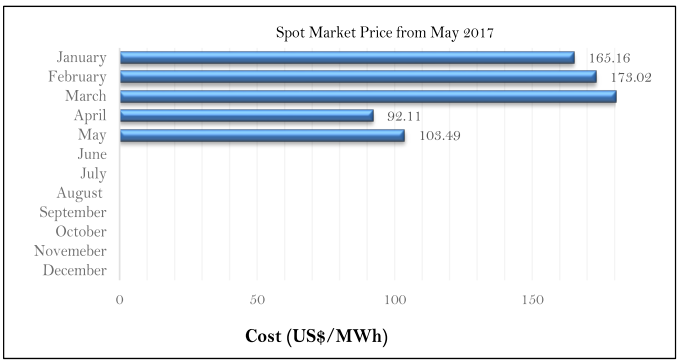
	Average Gas Flow (MMScfd) - May 2017				
Location	Week 1	Week 2	Week 3	Week 4	Monthly Average
Etoki	23.34	21.44	20.63	26.19	**23.22**
Tema	11.90	18.87	18.49	17.05	**16.62**
Aboadze	79.45	94.84	63.87	46.38	**68.74**

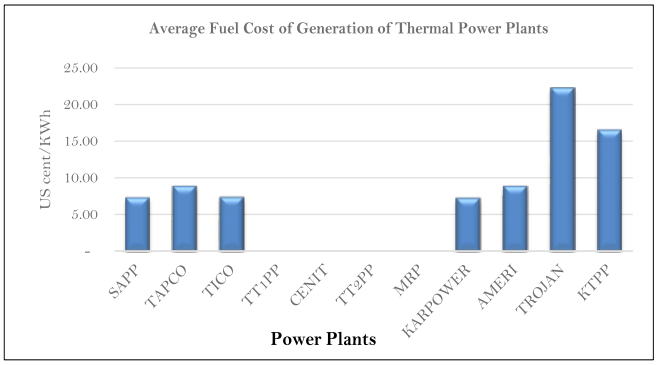
	Water Level (ft) - May 2017				Change in water level
Hydro Dam	Week 1	Week 2	Week 3	Week 4	(feet)
Akosombo	242.27	241.87	241.46	240.66	-1.61
Bui	559.01	558.45	557.73	556.78	-2.23

ECONOMIC FACT SHEET

		May-17	Apr-17	Change
Average Market Energy Cost	US$/MWh	74.58	62.73	11.85
Average Market Capacity Charge (AMCC)	US$/MWh	22.01	22.96	(0.95)
Total Average Market Cost (TAC)	US$/MWh	96.59	85.69	10.90
System Marginal Cost (SMC)	US$/MWh	103.49	92.11	11.38
System Marginal Capacity Charge (SMCC)	US$/MWh	-	-	-
Spot Market Price (SMP)	US$/MWh	103.49	92.11	11.38
Composite Bulk Generation Charge (CBGC)	US$/MWh	94.64	94.64	-
Deviation of TAC from CBGC	US$/MWh	(1.95)	8.95	(10.90)
Deviation of SMP from CBGC	US$/MWh	(8.85)	2.53	(11.38)

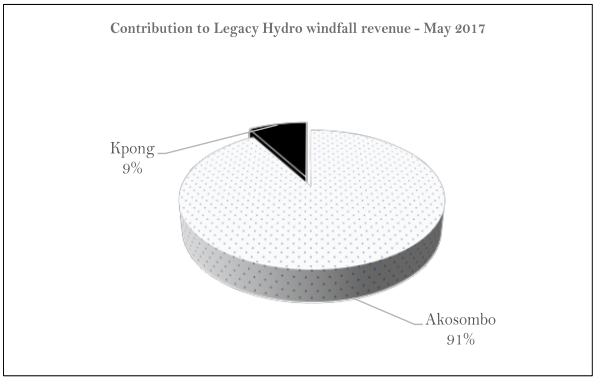






Jun-17				
	Average Cost	Average SMP	Difference	Windfall Revenue
Power Plant	US$/MWh	US$/MWh	US$/MWh	US$/MWh
Akosombo	33.10	103.49	70.39	20,018,130.33
Kpong	59.20	103.49	44.29	2,615,398.30
Total	92.30	-	-	22,633,528.63

Average Fuel Prices		
		May-17
Fuel Type	Unit	Delivered Cost
Natural Gas	US$/MMBtu	8.60
LCO	US$/BBL	63.00
HFO (Karpowership)	US$/Tonne	343.23
HFO (Tema)	US$/Tonne	363.23
DFO	US$/Tonne	576.10



1.0 Medium Term Gas Demand and Supply Situation in Ghana

Natural gas is an important fuel in Ghana's fuel supply for electricity generation. It is relatively cheaper than some of the liquid fuels and has a relatively stable price than the liquid fuels. It has an added advantage of reducing the number of maintenance needed by the power plant if liquid fuel is used and a cleaner source of fuel than the liquid fuels. The indigenous source of natural gas provide a source of fuel supply security for the country which makes planning much more easier. With the exception of the AKSA Power Plant, all the other thermal power plants could operate on natural gas. In January 2017, gas contributed 34% to the fuel supply mix, 15% in February 2017, 45% in March, 48% in April 2017 and 43% in May 2017. On the average, natural gas has accounted for 37% of the fuel supply mix from January 2017 to May 2017.

Natural gas supply to Ghana is from two sources; Nigeria through the West African Gas Pipeline (WAGP) which delivers gas largely to the Eastern corridor of the country and the Atuabo Gas Processing Plant located in the Western corridor of the country. Gas supplied from the Western corridor feeds power plants in the Aboadze Power Enclave. The WAGP supplies natural gas to power plants in the Aboadze Power Enclave and power plants in Tema and Kpone. The AGPP processes indigenous gas from the Jubilee fields and the TEN fields for power plants in the Aboadze Power Enclave.

This section of the bulletin analysis the total gas demand and supply situation of power plants located at the Eastern and Western corridors and ways of meeting gas demands at both corridors.

1.1 Current Demand & Supply Situation

Table 1.1: Current Demand and Supply Situation

	Installed Capacity (MW)	Current Natural Gas Demand (MMSCFD)
	Western	
TAPCO	330.0	60.0
TICO	360.0	60.0
AMERI	250.0	50.0
Sub-total	***940.0***	***170.0***
	Eastern	
SAPP	560.0	112.0
TT1PP	126.0	30.0
CENIT	126.0	30.0
TT2PP	80.0	24.0
KARPOWER	450.0	129.0
KTPP	220.0	60.0
Trojan Power	80.0	24.0
Cenpower	330.0	66.0
Sub-total	***1,972.0***	***475.0***
Grand-total	**2,912.0**	**645.0**

The total current natural gas demand for the country is about 645 MMSCF per day comprising 170 MMSCF per day from the Aboadze Power Enclave and 475 MMSCF per day from power plants in Tema and Kpone. Table 1.1 shows our current gas demand according to location.

The daily supply of natural gas from the WAGP reached a maximum of 28.5 MMSCF per day for the first five months of 2017 whiles the maximum gas supply from the AGPP reached a maximum of 107.4 MMSCF per day. The supply from the WAGP was sufficient for only SAPP phase I whiles the supply from the AGPP was enough for all the available generation units in the Aboadze Power Enclave which include one (1) Gas turbine (GT) of TAPCO, two (2) GT of TICO and Ten (10) units of Ameri Power Plant. Demand from the Eastern corridor fell short by over 430 MMSCF per day. This implies that the other thermal power plants had to rely on liquid fuel when they were needed to operate.

1.2 Medium term Demand & Supply Outlook (2018 to 2022)

Table 1.2 Medium Term Natural Gas Demand and Supply Outlook

	Peak Natural Gas Demand and Supply in the medium term (MMSCFD)				
	2018	2019	2020	2021	2022
	WESTERN CORRIDOR				
TAPCO	60.0	60.0	60.0	60.0	60.0
TICO	60.0	60.0	60.0	60.0	60.0
AMERI	50.0	50.0	50.0	50.0	50.0
Amandi	-	-	36.0	36.0	36.0
Jacobsen	-	-	-	72.0	72.0
Sub-total	***170.0***	***170.0***	***206.0***	***278.0***	***278.0***
Supply					
AGPP	150.0	150.0	150.0	150.0	150.0
ENI	180.0	180.0	180.0	180.0	180.0
Total	***330.0***	***330.0***	***330.0***	***330.0***	***330.0***
Surplus/Deficit	***160.0***	***160.0***	***124.0***	***52.0***	***52.0***
	EASTERN CORRIDOR				
SEAP	112.0	112.0	112.0	112.0	112.0
TT1PP	30.0	30.0	30.0	30.0	30.0
CENIT	30.0	30.0	30.0	30.0	30.0
TT2PP	24.0	24.0	24.0	24.0	24.0
KTPP	60.0	60.0	60.0	60.0	60.0
Karpowership	129.0	129.0	129.0	129.0	129.0
Trojan Power	24.0	24.0	24.0	24.0	24.0
Cenpower	66.0	66.0	66.0	66.0	66.0
Sub-total	***475.0***	***475.0***	***475.0***	***475.0***	***475.0***
Supply					
WAGP	45.0	45.0	45.0	45.0	45.0
LNG Continental	80.0	80.0	80.0	80.0	80.0
LNG Others	-	-	250.0	250.0	250.0
Sub-total supply	**125.0**	**125.0**	**375.0**	**375.0**	**375.0**
Supply/Deficit	(350.0)	(350.0)	(100.0)	(100.0)	(100.0)
Grand-total Supply	**455.0**	**455.0**	**705.0**	**705.0**	**705.0**
Total Demand	**645.0**	**645.0**	**681.0**	**753.0**	**753.0**
Supply/Deficit	(190.0)	(190.0)	**24.0**	(48.0)	(48.0)

1.2.1 Demand Outlook

The maximum total demand for natural gas is projected to increase from the current 638 MMSCF per day to 753 MMSCF per day in the medium term for all the available thermal power plant capable of operating on natural gas. Demand from the Aboadze Power Enclave is projected to increase from 170 MMSCF per day to 278 MMSCF per day in the medium term whiles demand from the Tema and Kpone remains the same at 475 MMSCF per day. The projected increase in demand at the Aboadze Power Enclave is due to the projected operation of two new power plants; Amandi and Jacobsen Power Plants with natural gas demand of 36 MMSCF per day and 72 MMSCF per day respectively.

1.2.2 Supply Outlook

Supply of natural gas from the Western corridor is projected to increase to a maximum 330 MMSCF per day with the coming online of the ENI gas in 2018. This supply include 150 MMSCF per day from AGPP and 180 MMSCF per day from the ENI. In the Eastern corridor, supply is projected to increase to a maximum of 375 MMSCF per day with the introduction of LNG to the natural gas supply. The West African Gas Pipeline (WAGP) is projected to supply 45 MMSCF per day and 330 MMSCF per day from LNG. The LNG supply include the proposed 80 MMSCF per day from Continental fuel (capacity of the onshore regasification plants at the SAPP and Trojan Power Plants sites) and 250 MMSCF per day from other sources such as Quantum, Tema LNG, WAGL and any other supplier.

Table 1.3 Average Demand and Supply Balance in the Medium term

	Minimum Demand & Supply Projections				
	2018	2019	2020	2021	2022
TAPCO	60.0	60.0	60.0	60.0	60.0
TICO	60.0	60.0	60.0	60.0	60.0
AMERI	-	-	-	50.0	50.0
TT1PP	-	-	-	-	30.0
Amandi	-	-	36.0	36.0	36.0
Jacobsen	-	-	-	72.0	72.0
Karpowership	129.0	129.0	129.0	129.0	129.0
CENIT	-	-	-	-	-
KTPP	-	-	-	-	30.0
SAPP I	-	36.0	36.0	-	-
SAPP II	72.0	72.0	72.0	72.0	72.0
AKSA	-	-	-	-	-
CenPower	66.0	66.0	66.0	66.0	66.0
Trojan I	-	-	-	-	-
Trojan II	15.0	15.0	15.0	15.0	15.0
Total	402.0	438.0	474.0	560.0	620.0
Western Corridor	120.0	120.0	156.0	278.0	278.0
Eastern Corridor	282.0	318.0	318.0	282.0	342.0
Total	402.0	438.0	474.0	560.0	620.0
Supply Western Corridor	280.0	280.0	280.0	280.0	280.0
Surplus/Deficit - Western	160.0	160.0	124.0	2.0	2.0
Supply Eastern Corridor	125.0	125.0	355.0	355.0	355.0
Surplus/Deficit - Eastern	(157.0)	(193.0)	37.0	73.0	13.0

1.2.3 Demand & Supply Balance

Generally, at the maximum demand of all the available gas fired power plants, there would be a deficit in supply in the medium term as seen in table 1.2. There would not be enough natural gas to meet our demand in the medium term looking at our general demand and supply situation. Even though there is excess gas supply in the Western corridor, this excess supply is not enough to cover all the deficit in the Eastern corridor. In the Western corridor, there is projected excess supply of 160 MMSCF per day in 2018 and 2019, 124 MMSCF per day in 2020 and 52 MMSCF per day in 2021 and 2022. The Eastern corridor, Tema and Kpone, will continue to have deficits to the tune of 350 MMSCF per day in 2018 and 2019 and 100 MMSCF per day thereafter in the medium term. To reduce the deficit in the Eastern corridor, natural gas must be transported from the West to the East or new power plants should be situated in the West to utilize the excess supply.

Also, considering our minimum natural gas demand, (natural gas needed to meet our projected electricity demand) natural gas surplus is projected to be witnessed in 2018, 2020, 2021 and 2022 ranging between 15 MMSCF per day to 161 MMSCF per day. As presented in table 1.3, the Western corridor is projected to have supply surplus in the medium term. This is contrary to the Eastern corridor where deficit is project in the short term., 2018 and 2019, but there is a projected surplus from 2020 to 2022. This deficit established in 2018 and 2019 at the Eastern corridor in the short term needs to be supplied, otherwise some power plants must operate on expensive liquid fuels. The question now is that by what means can the excess supply of gas at the Western corridor be utilized to augment the supply from the eastern corridor? In attempting to utilize the excess supply of gas from the western corridor, the following scenarios could be used;

i. Reverse flow from West to East

The West African Gas Pipeline (WAGP) is to supply natural gas from Nigeria (Lagos) through Benin and Togo to Ghana (Takoradi). In Ghana, the gas pipeline extend from the East (Tema) to the West (Takoradi) with the gas flowing from the East to the West. To be able to send natural gas from the West to the East through the WAGP, there is the need for a reverse flow mechanism that could aid the natural gas to flow opposite the designed direction of flow. This reverse flow mechanism will ensure that gas is always available at any part of the two corridors when needed. The downside to this is that any problem with the pipeline regardless of where it occurs will affect the flow of gas in the pipeline. The reverse flow will be very helpful but does not guarantee security hence the need for processes that could provide security.

ii. The 470 MW Karpowership sent to the West

The 225 MW Karpowership situated in the Tema Fishing Harbour in the Gretaer Accra Region will be replace by a 450 MW barge inSeptember 2017. The new barge will significantly augment our electricity demand and provide an avenue to supply cheap source of electricity. From the demand and supply projection provided in table 1.2 and table 1.3, in 2018 and 2019, there was a significant natural gas surplus in the Western corridor. One of the logical things to do in utilizing the surplus gas when the two power plants Amandi and Jacobsen are not operational is to send the Karpowership to the West since it is the only movable plant available. In 2018 and 2019, there would be a projected 160 MMSCF per day of surplus natural gas in the west which could be utilized by Karpowership which could potentially reduce the deficit in the East by 129 MMSCF per day. This remedy however, could create a deficit in the West from 2021 of about 77 MMSCF per day and excess in the East by 2021. Excess gas in the East could however be sent to West through the WAGP and reduce the deficit in the Aboadze Power Enclave. Therefore sending Karpowership to the West will in the short term help utilize the gas surplus in the West and reduce the deficit in the East.

iii. Construction of new gas pipeline from the West to the East

This present the long term sustainable solution to balance the gas supply and demand in the country. In the medium term, this solution is probably not feasible but provide the most secured, reliable and sustainable solution in the long term. The downside to this scenario is the cost of the project and difficulty in having a secured pipeline and to secure the right of way for the pipeline.

1.4 Conclusion

Natural gas remains an important source of fuel for electricity generation in the medium to long term. There is a projected deficit in natural gas supply in the medium term as more and more power plant comes online. There is the need for the natural gas supply from the WAGP improve beyond the projected 45 MMSCF per day. In the short term, the reverse gas flow will be vital to help reduce the gas deficit at the Eastern corridor. The challenge with this scenario is the fact that any problem with the WAGP anywhere will affect the gas flow. In the interim, the Karpowership could be sent to the Western corridor to help reduce the gas deficit in the West and utilize the gas surplus in the West. In this scenario however, the reverse gas flow will be needed to be able to send any excess gas in the West to the East. Finally a more secured, reliable and sustainable solution is the construction of a new gas pipeline from the West to the East. The challenge with this scenario is the cost involve, security of the pipeline and obtaining the right of way for the pipeline.

2.0 Performance Indicators of Power Plants

2.1 Capacity Utilization Factor (CUF)

The Karpowership plant maintained a high CUF while the AKSA Power Plant also came in with a high CUF in May 2017 above 90%. The CUF of the Karpowership depreciated marginally to 94.37% in May 2017 from 99.10% in April 2017 while that of AKSA increased to 93.6% in May 2017 from 80.60% in April 2017. These two power plants had a relatively stable supply of fuel throughout the month. Both the Akosombo and the Kpong GS had a reduction in their CUF due to the increased supply of electricity from the thermal sources in May 2017

compared to April 2017. The CUF of Akosombo Hydro Plant reduced to 58.02% in May 2017 from 70.07% in April 2017 whereas that of Kpong reduced to 65.44% in May 2017 from 72.12% in April 2017. The CUF of Bui GS, however, increased marginally to 19.96% in May 2017 from 18.13% in April 2017 but is still lower than it designed CUF of 25%.

The Plant utilisation factors of the various plants is contained in table 2.1.1

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	58.02	-	-
Kpong	65.44	-	-
Bui	19.96	-	-
SEAP	19.88	8,206.21	73.29
TAPCO	28.88	8,374.96	88.73
TICO	51.56	7,364.54	73.86
TT1PP	-	-	-
CENIT	-	-	-
TT2PP	-	-	-
MRP	-	-	-
KARPOWER	94.37	8,164.40	72.69
AMERI	84.71	10,174.25	88.92
TROJAN	19.27	15,405.73	221.88
KTPP	15.56	11,442.51	164.80
AKSA	93.60	8,495.57	80.04

The CUF of the Ameri plant reduced to 84.71% in May 2017 from the 94.36% recorded in April 2017. This was due to low natural gas consumption of Ameri owing to the coming online of the TAPCO plant which shared in the consumption of natural gas at the Aboadze enclave. Also, Trojan Power Plant had a marginal reduction in its CUF to 19.27% in May 2017 from 24.4% to 21.3% in April 2017. The SAPP had a relatively stable CUF of 19.88% in April 2017 and 20.5% in May 2017.

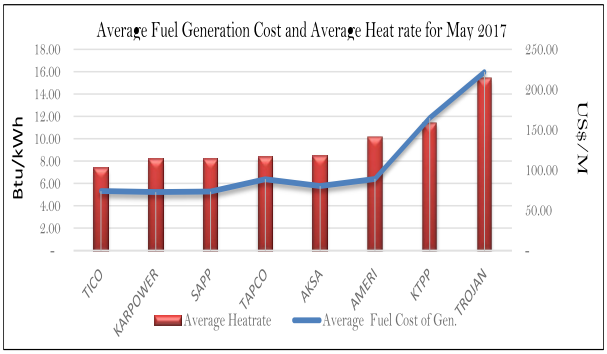
The System Load Factor (LF) reached its maximum since the beginning of 2017 in March 2017 at 80.9%. Load factor in May 2017 was 76.4%, marginally higher than the 76% recorded in April 2017.

2.2 Heat Rate (Fuel Efficiency)

TICO Power Plant maintained its high efficiency to be the most efficient power plant in May 2017.TICO Power Plant had a heat rate of 7,364.54 Btu/kWh in May 2017, an improvement over the heat rate of 7,679.62 Btu/kWh recorded in April 2017, as it generated predominantly on combined cycle mode. Karpowership had a heat rate of 8,164.40 Btu/kWh and was the second most fuel efficient power plant in May 2017. The Trojan Plant had a heat rate of 15,405.73 Btu/kWh and was the least efficient power plant in May 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

Trojan Power Plant which had the highest heat rate in May 2017 recorded the highest fuel cost of generation. Aside it being the least fuel efficient power plant in May 2017, it also operated on the most expensive fuel, DFO, for electricity generation. DFO cost in May 2017 was relatively higher than all the other fuel types used.

Karpowership and AKSA which were the second and fourth most efficient power plant respectively in May 2017 due to the relative higher cost of generation by TICO (US$ 11.39/MMBtu) compared to HFO (US$ 8.9/MMBtu) for Karpowership and cost of fuel for AKSA (US$ 9.42/MMBtu)

Acronyms

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

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