GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 31 **1st July 2018 to 31st July 2018**

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1st July, 2018 to 31st July, 2018. 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 WEM bulletin explains one of the pertinent issues in the power sector, installed capacity utilization.

The Energy Commission (EC) would very much appreciate and welcome comments from readers on the Bulletin. Reasonable care has been taken to ensure the information contained in this Bulletin is accurate at the time of publication, nevertheless, any errors, omissions or inaccuracies therein are regretted.

OVERVIEW OF THE MONTH

The System Peak Load for July 2018 was 10 MW higher than the System Peak Load of 2,339 MW projected in the 2018 Electricity Supply Plan (ESP) for July 2018. Ghana Peak Load was also 36 MW higher than the Ghana Peak Load projected in the 2018 ESP. Average electricity demand for July 2018 was, likewise, 31.4 MW higher than the 1,794.35 MW projected in the 2018 ESP. Demand for export at peak reached a maximum of 210 MW at an average of 102.6 MW at peak. Demand by CEB reached a maximum of 111 MW, 109 by CIE and 70 MW by SONABEL. Average export demand for July 2017 of 77.6 MW was significantly lower than projected in the 2018 ESP of 133 MW.

Electricity consumption in July 2018 was marginally higher than projected in the 2018 ESP. electricity consumption of 1,383.35 GWh was 3.3% higher than the projected 1,339 GWh in the 2018 ESP. Likewise, domestic electricity consumption of 1,300.6 GWh was 3.3% higher than the projected 1,259 GWh in the 2018 ESP. Electricity exports was however lower than projected for July 2018. Total electricity export of 57.75 GWh was 24% lower than projected in the 2018 ESP.

There was a significant reduction in electricity supply from hydro sources from 38.4 % in June 2018 to 29.2 % in July 2018. Correspondingly, electricity supply from thermal sources increase from 58.1% of the total electricity supplied in June 2018 to 67.2% in July 2018 to make up for the shortfall in hydro generation. The hydro water levels begun to rise in July 2018. The Akosombo dam water level had a net inflows of 1.94 ft in July 2018 whiles the Bui Dam had a net inflow of 3.65 ft.

Table 1. Projected and Actual Outturn of electricity demand and supply in June 2018 and July 2018.

	July 2018		June 2018	
	Projected	Actual Outturn	Projected	Actual Outturn
Total Supply (GWh)	1,336.8	1,358.3	1,327.4	1,316.4
Source by Power Plants (GWh)				
AKOSOMBO	269.0	305.2	305.0	392.9
KPONG	51.0	63.8	49.0	73.4
BUI	71.0	27.2	56.0	38.5
Sunon Asogli	118.0	211.4	118.0	98.9
TAPCO	179.0	34.5	86.0	17.8
TICO	202.0	227.5	196.0	218.6
TT1PP	60.0	75.1	-	0.5
CENIT	46.0	-	45.0	-
TT2PP	-	-	-	-
MRP	-	-	-	-
Karpowership	138.0	251.6	218.0	269.7
AMERI	76.0	74.8	73.0	43.6
KTPP	-	3.2	61.0	50.5
Trojan Power	-	-	-	-
CENPOWER	108.0	3.0	104.0	2.1
AKSA	14.0	31.3	14.0	63.0
BXC Solar	2.2	2.0	2.1	2.1
VRA Solar	0.4	0.2	0.3	0.2
Genser		37.2	-	36.8
MEINERGY	2.2			
Total Generation (GWh)	1,336.8	1,348.1	1,327.4	1,308.5
Imports (GWh)	-	10.2	-	7.8
Total Supply (GWh)	1,336.8	1,358.3	1,327.4	1,316.4
Deficit (GWh)	-	21.5	-	(11.0)
Ghana Coincedent Peak Load (MW)	2,211.0	2,242.0	2,333.0	2,210.4
System Coincident Peak Load (MW)	2,384.0	2,349.0	2,416.0	2,292.3

HIGHLIGHTS OF THE MONTH

Consumption of liquid fuel in the total fuel mix reduced in July 2018 from 41.5% in June 2018 to 29.2% in July 2018 with HFO consumption accounting for 97.4% of the total liquid fuel consumed in July 2018. Correspondingly, natural gas supply in the total fuel mix increased from 52.4% in June 2018 to 65.7% in July 2018. This is attributable to the significant increase in supply from the West African Gas Pipeline (WAGP) from 19.5% in June 2018 to 31% in July 2018. Natural gas supply from the Atuabo Gas Processing Plant (AGPP) continue to dominate the natural gas supply but at a reduced share from 62.8% in June 2018 to 52.8% in July 2018.

ELECTRICITY DEMAND AND SUPPLY

Electricity Demand

The System Peak Load increased marginally in July 2018 from 2,292.3 MW in June 2018 to 2,349 MW in July 2018. Likewise, the Ghana Peak Load reduced marginally by 1.4% from 2,210.4 MW in June 2018 to 2,242 MW in July 2018. However, average system demand reduced marginally from 1,828.3 MW in June 2018 to 1,825.7 MW in July 2018. The System Peak Load and the Ghana Peak Load was 0.4% and 3.8% respectively, higher than the projected in the 2018 Electricity Supply Plan (ESP). Hydro generation accounted 42.1% of the both the System Peak Load and the Ghana Peak Load in July 2018, lower than the 52% recorded in June 2018. Average electricity export to CEB reduced marginally from 47.1 MW in June 2018 to 36.5 MW in July 2018. Average electricity export to SONABEL for July 2018 was 35.6 MW.

Electricity supply

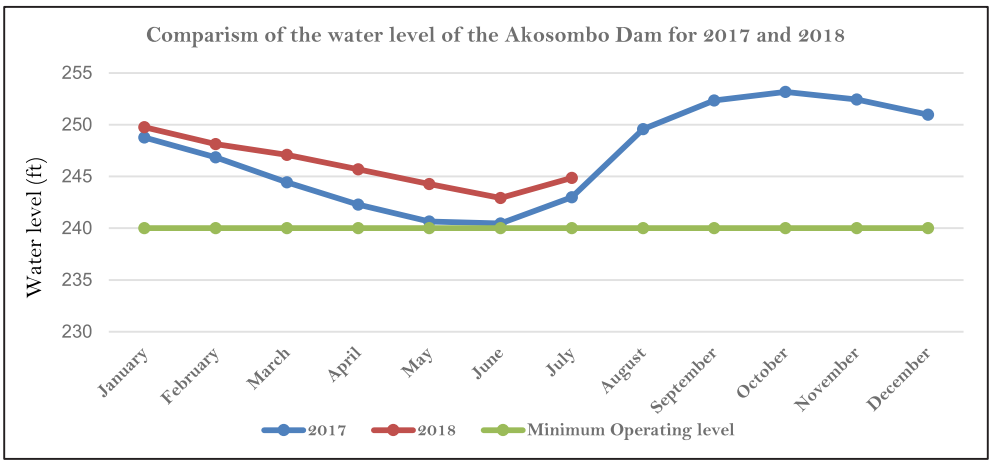
Average electricity supplied in July 2018 reduced marginally from 43.88 GWh per day in June 2018 to 43.82 GWh per day due to the marginal reduction in demand. However, the total electricity supplied increased from 1,316.36 GWh in June 2018 to 1,358.35 GWh in July due to the higher number of days in July than in June. Of the total 1,358.35 GWh of electricity supplied, 1,348.17 GWh was generated from domestic sources and 10.19 GWh imported from CIE. The total electricity supplied in June 2018 was 22.75 GWh higher than the 1,335.6 GWh projected under the 2018 ESP. The contribution of hydro power plant in the total electricity supplied reduced from 38.4% in June 2018 to 29.2% in July 2018.

HYDRO DAM LEVELS

Akosombo Dam Water Level begun to rise in July 2018

The water level for the Akosombo GS started to rise on the 12th July 2018. The water level rose by 1.94 feet in July 2018 from 242.93 feet at the beginning of the month to 244.87 feet at the end of the month. With this inflows, the water level of the Akosombo dam at the end of July 2018 was 4.87 feet higher than the minimum operating level of 240 feet and 1.87 feet higher than the water recorded for the same period in 2017.

Figure 1: Month-End Water Level for Akosombo Dam from January 2017 to July 2018

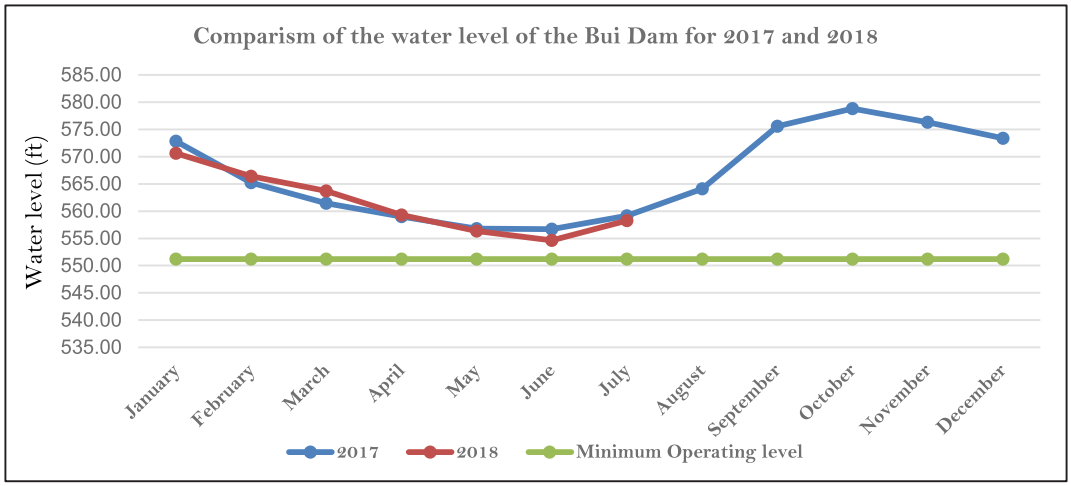


Bui Dam Water Level begun to rise in July 2018

The Bui dam begun to rise on 3rd July 2018. The water level rose by 3.64 feet from 554.65 feet at the beginning of the month of July 2018 to 558.29 feet by the end of the month. Despite the rise in the water level by 3.64 feet in July 2018, the water level for the Bui dam was 0.88 feet lower than the water level recorded for the same period in 2017. However, the water level at the end of July 2018 was higher than the minimum operating level of 551.18 feet by 7.11 feet.

Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2017 to July 2018.

Figure 2: Month-End Water Level for Bui Dam from January 2017 to July 2018



FUEL SUPPLY FOR POWER GENERATION

Natural gas flow rate from WAGPCo increase significantly in July 2018

The natural gas flow rate from WAGP to Tema and Kpone increased by 82.9% in July 2018, from 43.76 MMSCFD in June 2018 to 80.02 MMSCFD in July 2018. Correspondingly, total natural gas consumption from the WAGP increased from 1,333.19 MMSCF in June 2018 to 2,520.5 MMSCF in July 2018. The share of natural gas from the WAGP in the total natural gas supplied increased from 37.2% in June 2018 to 47.2% in July 2018.

Natural gas flow rate from GNGC increased marginally in July 2018.

The flow rate of natural gas from AGPP to the Aboadze Power Enclave increased by 20.9% in July 2018 from 76.71 MMSCFD in June 2018 to 92.73 MMSCFD in July 2018 as natural gas flow picked up after the turret remediation work which lasted from 28th May 2018 to 24th June 2018. Natural gas consumption at the Aboadze Power Enclave increased by 24.5% in July 2018 from 2,084.49 MMSCF in June 2018 to 2,594.27 MMSCF. Despite the increase in natural gas supply from the AGPP, it shares in the total natural gas supplied reduced from 62.8% in June 2018 to 52.8% in July 2018.

Liquid Fuel

Liquid fuel consumption in July 2018 declined by 18.8% from 464,822 barrels in June 2018 to 377,384 barrels in July 2018. This was primarily due to decrease in electricity generation from AKSA and Karpowership power plants in July 2018. The shares of HFO in the total liquid fuel consumed however increased from 96.7% in June 2018 to 97.4% in July 2018 due to reduced consumption of LCO and DFO to 2.4% and 0.2% respectively in July 2018 from 0.7% and 0% respectively in June 2018.

OPERATIONAL POWER PLANTS

Electricity Generation at the Akosombo Generation Station (GS) decreased in July 2018

Average electricity supply from the Akosombo GS decreased significantly from 13.1 GWh per day in June 2018 to 9.84 GWh per day in July 2018. This represent a decrease of 24.9% in average electricity generation from Akosombo GS. Similarly, the total electricity supplied by the power plant decreased by 22.3%, from 392.91 GWh in June 2018 to 305.17 GWh in July 2018. The power plant however, generated 13.4% higher than the projected electricity generation under the 2018 ESP. The total electricity generation from the Akosombo GS constituted 22.5% of the total electricity supplied in July 2018. The Akosombo GS contributed 704.9 MW to both the System Peak Load and the Ghana Peak Load constituting 30% of both the System Peak Load and Ghana Peak Load.

Electricity supply by Kpong Generation Station (GS) decreased in July 2018

The Kpong GS witnessed a decrease in the average electricity supplied by 15.9% from 2.45 GWh per day in June 2018 to 2.06 GWh per day in July 2018. Similarly, the total electricity supplied by the power plant in July 2018 decreased by 13.1%, from 73.42 GWh in June 2018 to 63.83 GWh in July 2018. The total electricity generated by Kpong GS was, however, lower than projected in the 2018 ESP for July 2018 by 25.2%. The total electricity generated by the power plant constituted 4.7% to the total electricity supplied in July 2018. Kpong GS contributed 121 MW to both the System Peak Load and Ghana Peak Load in July 2018, representing 3.5% of the System Peak Load and Ghana Peak Load.

Electricity supply by the Bui Generation Station (GS) reduced significantly in July 2018

Electricity generation from the Bui GS decreased significantly in July 2018 by 31.3% to 0.88 GWh per day from 1.28 GWh per day in June 2018. Likewise, the total electricity supplied by Bui GS reduced by 29.4% to 27.19 GWh in July 2018 from 38.51 GWh in June 2018. Bui GS' total electricity generation constituted 2.0% of the total electricity supplied in July 2018 and was over 1.6 folds higher than the 71 GWh projected under the 2018 ESP. The power plant contributed 205.5 MW to both the System Peak Load and Ghana Peak Load, representing 8.6% of the System Peak Load and Ghana Peak Load.

HIGHLIGHTS OF THE MONTH

Generation by the Sunon Asogli Power Plant's (SAPP) increased significantly in July 2018

Average electricity generation from the Sunon Asogli Power Plant (SAPP) increased significantly over 1.06 folds in July 2018, from 3.3 GWh per day in June 2018 to 6.82 GWh per day in July 2018. The SAPP generated a total of 211.39 GWh in July 2018 which was 79.1% higher than the projected 118 GWh projected under the 2018 ESP for July 2018. The power plant contributed 15.6% of the total electricity supplied in July 2018. SAPP contributed 281.2 MW to both the System Peak Load and the Ghana Peak Load in July 2018. These contributions constituted 12% to both the System Pak Load and the Ghana Peak Load. The power plant consumed a total of 1,711.8 MMSCF of natural gas in generating the 211.39 GWh of electricity in July 2018. The heat rate of the SAPP increased in July 2018 to 7,976.39 Btu/kWh from 7,818.81 Btu/kWh in June 2018.

Ameri Energy Power Plant's generation increased significantly in July 2018

The Ameri power plant recorded a significant increase in average electricity generation by 66.2% in July 2018 from 1.45 GWh per day in June 2018 to 2.41 GWh per day in July 2018. Likewise, the total electricity supplied by the power plant in July 2018 increased by 71.8%, from 43.55 GWh in June 2018 to 74.81 GWh. The total electricity generated by the Ameri power plant constituted 5.5% of the total electricity supplied and was 1.6% higher than the 76 GWh projected for July 2018 under the 2018 ESP. Ameri power plant contributed 25 MW to both the System Peak Load and the Ghana Peak Load, representing 1.1% of both the System Peak Load and the Ghana Peak Load. The power plant consumed a total of 650.95 MMSCF of natural gas with an estimated heat of 10,102.09 Btu/kWh in July 2018, marginally lower than the heat rate recorded in June 2018 of 10,191.96 Btu/kWh.

Kpong Thermal Power Plant's (KTPP) was shut down in July 2018

The KTPP was shut down for most of the period in July 2018 but generated 3.21 GWh for a period of two days. The power plant was shut down to make natural available for electricity generation by TT1PP.

The Karpowership Power Plant's generation reduced marginally in July 2018

Average electricity generation from Karpowership reduced marginally by 9.7% to 8.12 GWh per day from 8.99 GWh per day in July 2018. Karpowership's total electricity generated reduced from 269.74 GWh in June 2018 to 251.58 GWh in July 2018. The total electricity generated by the power plant constituted 18.5% of the total electricity supplied in July 2018 and was 82.3% higher than the 138 GWh projected under the 2018 ESP. The Karpowership contributed 435 MW to both the System Peak Load and the Ghana Peak Load, representing 18.5% of both the System Peak Load and the Ghana Peak Load. The power plant consumed a total of 338,304 barrels of HFO, at an estimated heat rate of 8,135.65 Btu/kWh in July 2018. The heat rate recorded in July 2018 was marginally higher than 8,116.44 Btu/kWh in June 2018.

AKSA Power Plant's generation reduced significantly in July 2018

The average electricity generation from the AKSA power plant increased significantly by 51.9% in July 2018 to 1.01 GWh from 2.1 GWh per day in June 2018 due to low HFO stocks limiting the generation of the AKSA power plant to an average of 43 MW1/. Consequently, the total electricity generated by the power plant increased by 50.3%, from 63.02 GWh in June 2018 to 31.29 GWh in July 2018. AKSA's total electricity generated contributed 2.3% to the total electricity supplied in July 2018. The power plant however generated 17.29 GWh more than projected under the 2018 ESP. AKSA power plant contributed 47.5 MW to both the System Peak Load and the Ghana Peak Load, representing 2.0% of the System Peak Load and the Ghana Peak Load. The power plant consumed a total of 42,344 barrels of HFO at an improvement in heat rate of 8,188.44 Btu/kWh in July 2018 from 8,200.39 Btu/kWh in June 2018.

Takoradi International Company (TICO) generation increased marginally in July 2018

The average electricity generation from the TICO power plant increased by 0.7% in July 2018, from 7.29 GWh per day in June 2018 to 7.34 GWh per day June. This notwithstanding, the total electricity supplied by the power plant increased by 4.1%, from 218.56 GWh in June 2018 to 227.49 GWh in July 2018. The total electricity generated by the power plant constituted 16.8% of the total electricity supplied in July 2018 and was 16.1% higher than the 196 GWh projected under the 2018 ESP. TICO contributed 336 MW to both the System Peak Load and the Ghana Peak Load, representing 14.3% of the System Peak Load and the Ghana Peak Load. A total of 1,593.1 MMSCF of natural gas was consumed by the power plant at an estimated average heat rate of 7,304.03 Btu/kWh in July 2018 marginally lower than the 7,451.71 Btu/kWh in June 2018.

Takoradi Power Company (TAPCO) Plant's generation increased in July 2018

The TAPCO power plant average generation increased from 0.59 GWh per day in June 2018 to 1.11 GWh per day in July 2018. The total electricity supplied by the power plant increased by 94%, from 17.8 GWh in June 2018 to 34.54 GWh in July 2018. The total electricity generation from the power plant was significantly lower than the 179 GWh projected under the 2018 ESP. The total electricity generated by TAPCO constituted 2.5% of the total electricity supplied in July 2018. TAPCO contributed 109 MW to both the System Peak Load and the Ghana Peak Load in June 2018, representing 4.6% of both the System Peak Load and Ghana Peak Load. The power plant consumed a total of 350.23 MMSCF of natural gas at an increased heat rate of 10,575.46 Btu/kWh, significantly higher than the 10,872.63 Btu/kWh recorded in June 2018.

Tema Thermal 1 Power Plant's (TT1PP) decreased in June 2018

TT1PP came online in July 2018 and generated a total of 75.14 GWh which constituted 5.5% of the total electricity supply and was 15.14 GWh higher than the projected 60 GWh under the 2018 ESP. A total of 824.31 MMSCF of natural gas was consumed at an estimated heat rate of 10,805.81 Btu/kWh.

Embedded Generation

Genser Power Plant's generation increased marginally in July 2018

The average electricity generation from the Genser power plant increased marginally in July 2018 by 0.01 GWh. Average electricity generation increased from 1.23 GWh in June 2018 to 1.24 GWh in July 2018. Total electricity generation also increased from 36.76 GWh in June 2018 to 37.17 GWh in June 2018. The total electricity generated by the power plant constituted 2.7% of the total

electricity supplied in July 2018. The power plant consumed a total of 9,679.08 tonnes of LPG at an increased heat rate from 11,087.65 Btu/kWh in June 2018 to 11,106.54 Btu/kWh in July 2018.

BXC Solar generation reduced marginally July 2018

The BXC solar power's average electricity generation reduced marginally from 0.07 GWh per day in June 2018 to 0.068 GWh per day in July 2018. The total electricity generated by the power in July 2018 decreased from 2.13 GWh in June 2018 to 2.12 GWh in July 2018. The solar power plant's total electricity generated constituted 0.2% of the total electricity supplied in July 2018.

VRA Navrongo Solar generation decreased marginally in July 2018

The total electricity supplied by VRA Navrongo Solar decreased marginally by 4.5% from 0.22 GWh in June 2018 to 0.21 GWh in July 2018. The power plant's total electricity generated constituted 0.02% of the total supplied in July 2018. The solar plant's total electricity generated was 47.5% lower than the 0.4 GWh projected under the 2018 ESP.

Electricity Exchange

Electricity Exports increased significantly in July 2018

Average electricity import from La Cote D'Iviore increased by 26.9%, from 0.26 GWh per day in June 2018 to 0.33 GWh per day in June 2018. A total of 10.19 GWh of electricity was imported in July 2018 which was 30.3% higher than the 7.82 GWh in June 2018. The total electricity imported constituted 0.75% of the total electricity supplied in June 2018. Electricity import contributed 17 MW to both the System Peak Load and the Ghana Peak Load, representing 0.72% of both the System Peak Load and the Ghana Peak Load. Average import in July 2018 was 13.7 MW.

The average electricity export increased from an average of 1.39 GWh per day in June 2018 to 1.86 GWh per day in July 2018 as export to SONABEL increased. A total of 41.76 GWh of electricity was exported in June 2018 compared to 57.75 GWh. Of the total export, 47% was to CEB, 7.2% to CIE and 45.8% to SONABEL. Average export demand likewise increased from 58 MW in June 2018 to 77.6 MW in July 2018. Export at peak reached a maximum of 141 MW. Ghana continues to be a net exporter of electricity in July 2018.

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

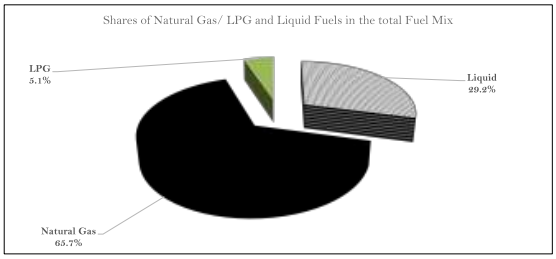


Figure 3b: Shares of fuel type in the generation fuel mix power generation

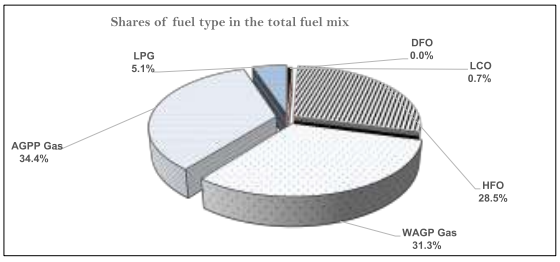


Figure 4a: Contribution of Natural Gas Supply by sources

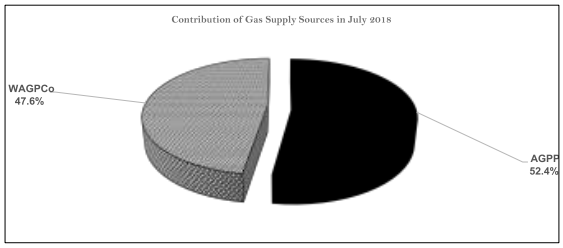
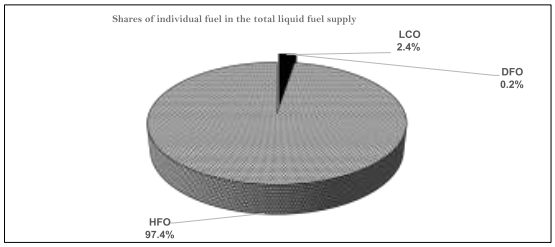


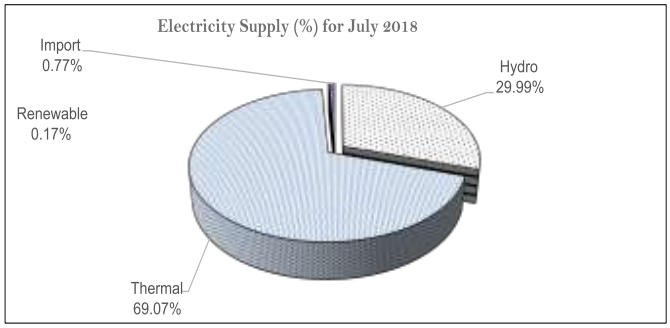
Figure 4b: Contribution of individual fuel in the liquid fuel supply

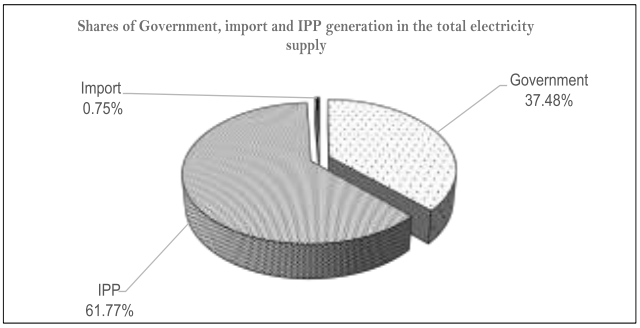


Peak Electricity Supply - July 2018			
Source of Supply	Generation at System Peak Load for July 2018 (MW)	Generation at Ghana Peak Load for July 2018 (MW)	Electricity Supply (GWh)
AKOSOMBO	704.90	704.90	305.17
KPONG	81.00	81.00	63.83
BUI	202.40	202.40	27.19
SAPP	281.20	281.20	211.39
TAPCO	109.00	109.00	34.54
TICO	336.00	336.00	227.49
TT1PP	110.00	110.00	75.14
CENIT	-	-	-
TT2PP	-	-	-
MRP	-	-	-
KARPOWER	435.00	435.00	251.58
AMERI	25.00	25.00	74.81
KTPP	-	-	3.21
Trojan Power	-	-	-
CENPOWER	-	-	3.04
AKSA	47.50	47.50	31.29
BXC Solar	-	-	2.03
Safisana	-	-	-
VRA Solar	-	-	0.21
Genser	-	-	37.17
IMPORT	17.00	17.00	10.19
Export to CEB	-	-	27.13
Export to CIE	59.00	59.00	4.16
Export to SONABEL	48.00	48.00	26.46
System Coincident Peak Load	**2,349.00**	-	-
Ghana Coincedent Peak Load	-	**2,290.00**	-
Total Supply	-	-	**1,358.26**
Total Supply without export	-	-	**1,326.97**

Ghana Electricity Demand & Supply		
		Jul-18
Maximum System Peak Load	MW	2,349.0
Minimum System Peak Load	MW	2,003.7
Average Peak Generation	MW	2,193.1
System Base Load	MW	1,330.2
Total Electricity	GWh	1,358.3
Load Factor (LF)	%	75.5

OPERATIONAL FACT SHEET





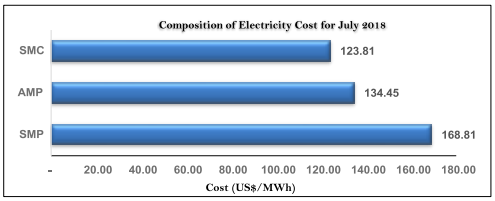
Power Plant Data for July 2018								
	Installed Capacity (MW)	Plant Capacity Utilization (%)	Heat Rate (Btu/kWh)	Natural Gas Consumption (MMBtu)	LCO Consumption (MMBtu)	DFO Consumption (MMBtu)	HFO Consumption (MMBtu)	LPG Consumption (MMBtu)
Akosombo	1,020.00	40.21	-	-	-	-	-	-
Kpong	160.00	53.62	-	-	-	-	-	-
Bui	400.00	9.14	-	-	-	-	-	-
SEAP	560.00	50.74	7,976.39	1,686,137.12	-	-	-	-
TAPCO	330.00	14.07	10,575.46	365,286.96	-	-	-	-
TICO	340.00	89.93	7,304.03	1,661,601.79	-	-	-	-
TT1PP	126.00	80.15	10,805.81	811,948.78	-	-	-	-
CENIT	126.00	-	-	-	-	-	-	-
TT2PP	49.50	-	-	-	-	-	-	-
MRP	-	-	-	-	-	-	-	-
KARPOWER	470.00	71.94	8,135.65	-	-	-	2,046,736.61	-
AMERI	250.00	40.22	10,102.09	755,686.61	-	-	-	-
TROJAN	56.00	-	-	-	-	-	-	-
Cenpower	0.00	-	-	-	56,363.01	3,937.33	-	-
KTPP	220.00	1.96	10,464.10	33,557.74	-	-	-	-
AKSA	320.00	13.14	8,188.44	-	-	-	256,182.64	-
Genser	95.00	52.59	11,106.54	-	-	-	-	412,830.02
Total	**4,522.50**	40.00		**5,314,218.99**	**56,363.01**	**3,937.33**	**2,302,919.26**	**412,830.02**

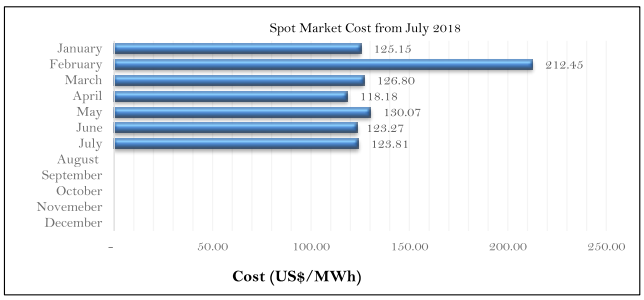
Natural gas flow rate (MMSCF/D)	
Location	**Monthly Average**
Etoki	**92.65**
Tema WAGPCo	**80.02**
Aboadze WAGPCo	**0.00**
Aboadze GNGC	**92.73**

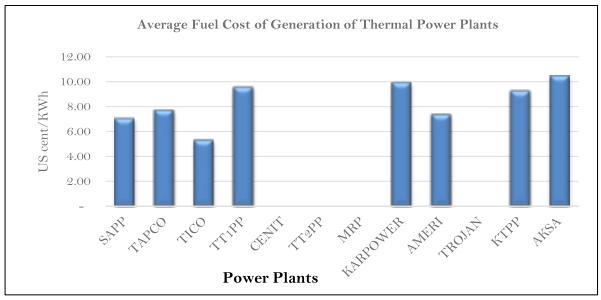
Jul-18			
	Beginning month (ft)	**End month (ft)**	**Change in water level**
Hydro Dam			(feet)
Akosombo	242.93	244.87	1.94
Bui	554.65	558.29	3.64

ECONOMIC FACT SHEET

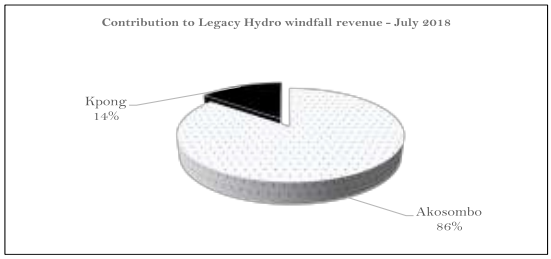
		Jul-18	Jun-18	Change
Average Market Price	US$/MWh	134.45	133.55	0.90
System Marginal Cost (SMC)	US$/MWh	123.81	123.27	0.54
System Marginal Capacity Charge	US$/MWh	45.00	45.00	
System Marginal Price (SMP)	US$/MWh	168.81	168.27	0.54



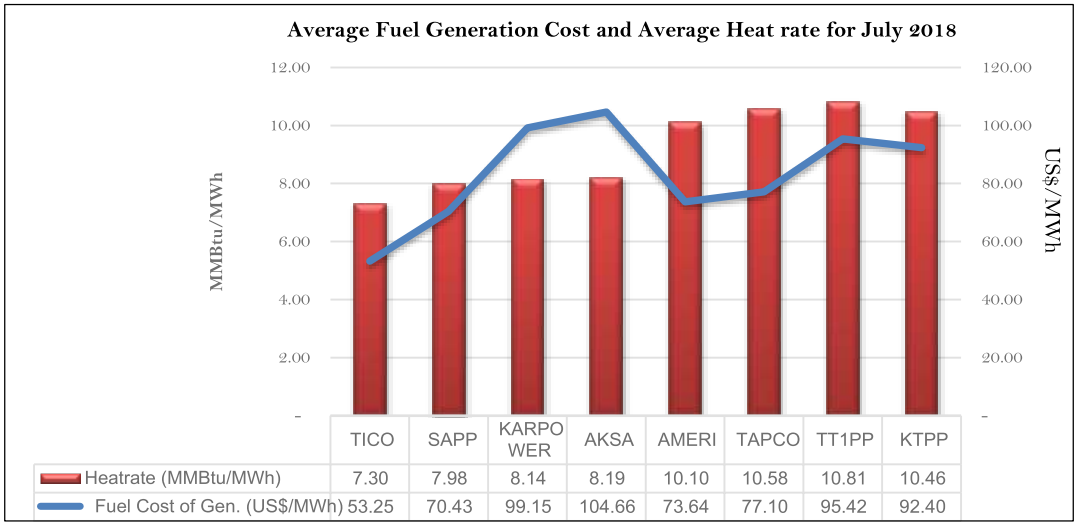


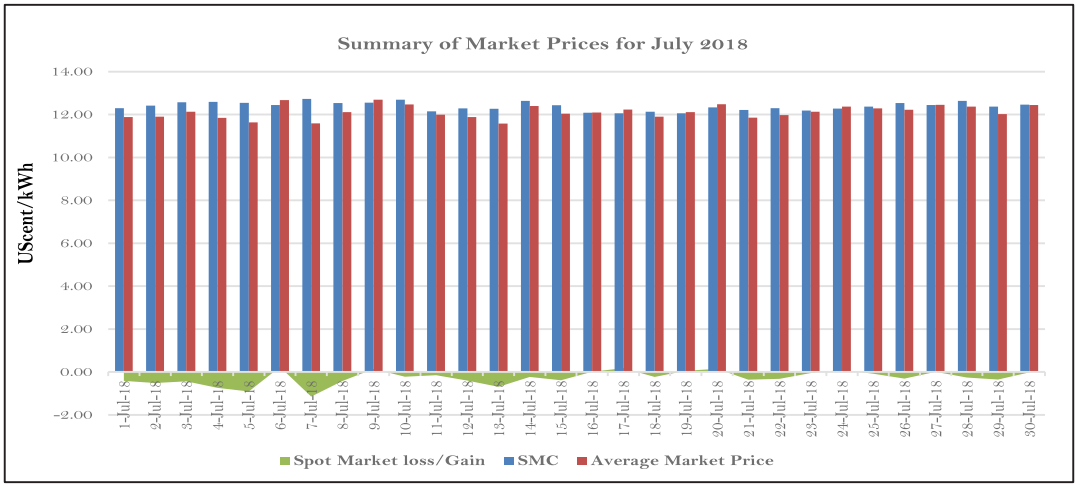


Average Fuel Prices		
		Jul-18
Fuel Type	Unit	Delivered Cost
Natural Gas	US$/MMBtu	8.10
LCO	US$/BBL	84.26
HFO	US$/Tonne	440.18
DFO	US$/Tonne	795.79



	FUEL PRICES (US$/MMBTU)		
	Natural Gas	HFO	LCO
July 2018	8.1	12.25	15.93





1.0 INSTALLED CAPACITY UTILIZATION IN GHANA'S POWER SECTOR

This paper examines the utilization of Ghana's installed capacity, from the year 2000 to 2017. It also provides possible reasons for any underutilization of the installed capacity and aims at providing an insight into some of the teething problems confronting the power sector and their impact on the continue supply of power.

Ghana's grid installed capacity has grown over the years by an average of 9% per year from 1,620 MW in the year 2000 to 4,095.5 MW in 2017. Likewise, electricity demand has increased at an annual rate of 5.2% from 1,161 MW in 2000 to 2,192 MW in 2017. Arguably, Ghana has had higher growth in installed capacity over demand. The ratio of the Installed Capacity Growth to Demand growth has average 1.7 from 2000 to 2017. This ratio is significantly higher than the averages recorded for the other economic classes as seen in table 1.0.

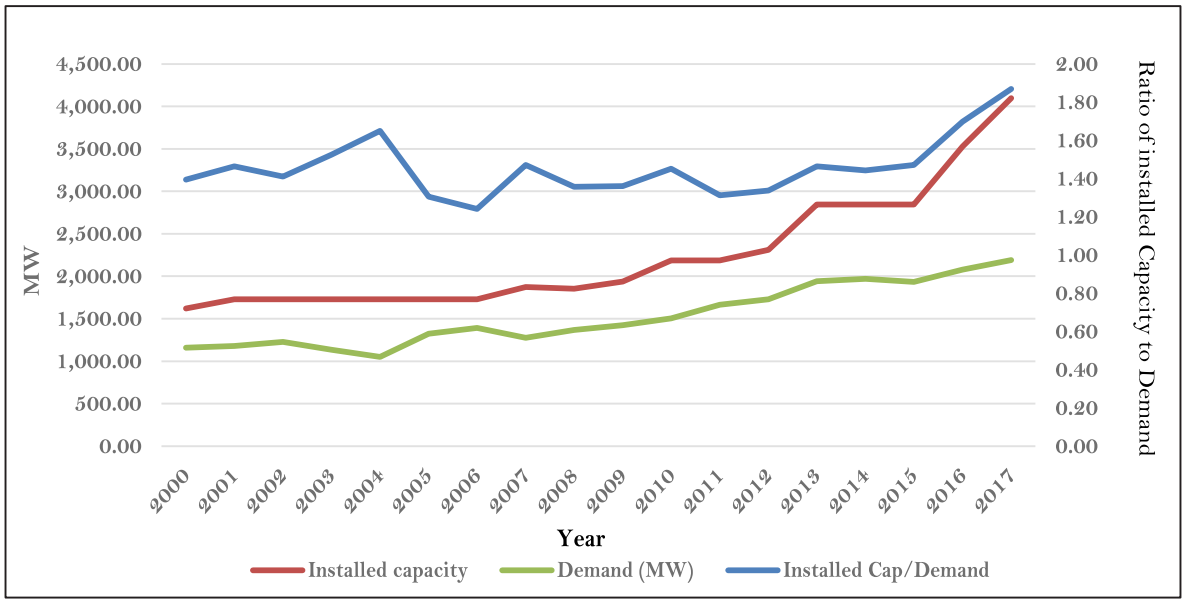
Table 1.0: Comparison of Ratio of installed capacity growth to demand growth

Ratio of Installed Capacity Growth to Demand Growth			
High Income	Upper middle Income	Lower Middle Income	Low Income
0.6	0.7	0.3	0.02

Source: IISD, 2014

With an interval of five years and a two year period, Ghana's installed capacity grew by 4.4% from 2000 to 2005, 5% from 2005 to 2010, 13.7% from 2010 to 2015 and 10% from 2015 to 2017. Likewise, on five years and a two year horizon, demand for electricity grew by 2.8% from 2000 to 2005, 1.6% from 2005 to 2010, 3.2% from 2010 to 2015 and 6.7% from 2015 to 2017. Figure 1 shows a graph of the installed capacity, demand and the ratio of installed capacity to demand from the year 2000 to 2017.

Figure 1.0: A graph of the Ghana's installed capacity, demand and ratio of installed capacity to demand from 2000 to 2017

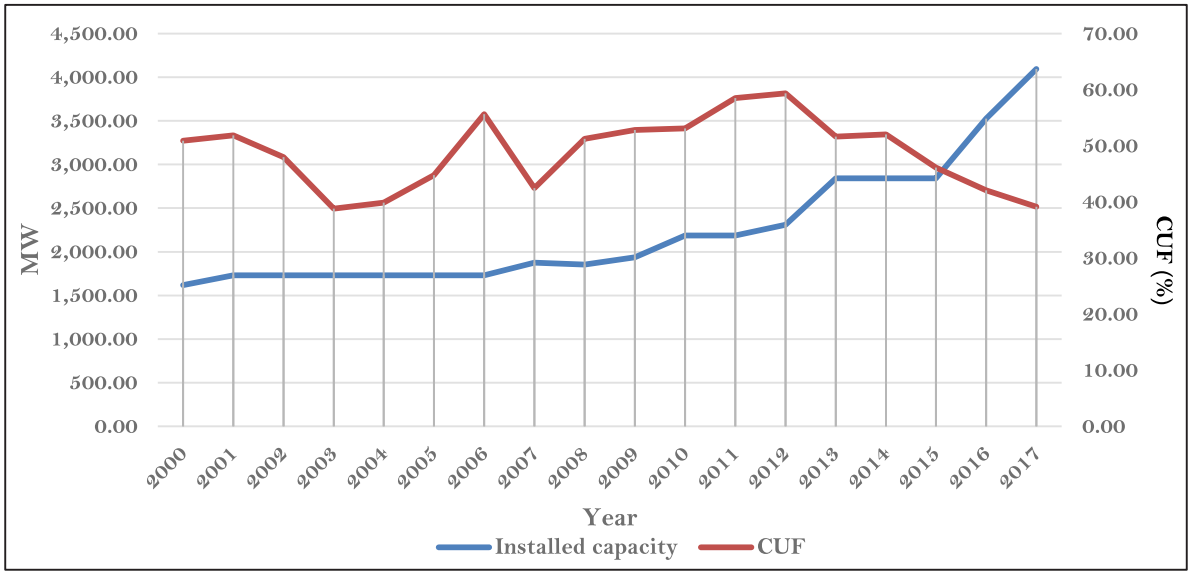


The ratio of installed capacity to demand as a measure of Ghana's ability to meet demand has consistently been over an average of 1.3, from the year 2000 to 2017. This implies that, Ghana's installed capacity has been used to meet demand reliably with a minimum of 30% reserve margin.

Ghana's installed capacity would mean less, if the average growth of 5.9% in installed capacity is not being used to meet demand. Despite these growth in installed capacity, Ghana still experienced some periods of mild load shedding in 2003, a severe load shedding in 2007, 2012 to 2015. This implies that, a growth in installed capacity does not always lead to sufficiency in electricity supply.

In other to quantify the utilization of the installed capacity of Ghana, the Capacity Utilization Factor (CUF) was measured. Figure 2.0 shows a graph of the installed capacity and the Capacity Utilization Factor (CUF) from 2000 to 2017.

Figure 2.0: A graph of the installed capacity and the Capacity Utilization Factor (CUF) from 2000 to 2017

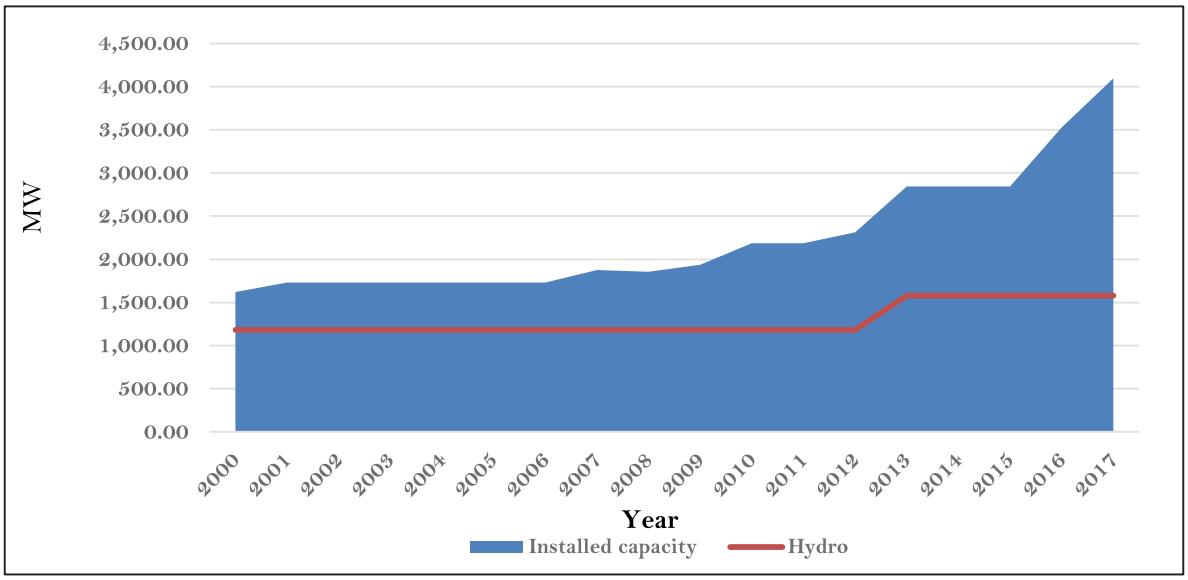


Capacity Utilization depends on the technical availability of the power plants and fuel available (for hydro water) for electricity generation. Capacity Utilization has consistently been below 60% and has averaged around 49% from the year 2000 to 2017 despite the increase in the thermal generating capacity. This may have occurred due to the following reasons:

a. Low inflows into the hydroelectric dams

Hydro electricity generation has been an integral part of Ghana's electricity generation from 2000 to 2017. Its share in the installed capacity has however dropped from 73% in 2000 to 39% in 2017 and 36% in 2018. Figure 3.0 shows the shares of hydro installed capacity in the total capacity.

Figure 3.0 Shares of hydro installed capacity in the total installed capacity from 2000 to 2017



With hydro contributing an average of 60% of the total installed capacity, low inflows into the hydro dams could result in low capacity utilization of the installed capacity. This low inflows were witnessed in 2003 and 2007 which caused severe load shedding in these years. The CUF for the Akosombo GS for 2003 and 2007 was 36% and 35% due to low inflows into the dam. Despite the relatively low inflows into the Akosombo Dam from 2012 to 2013 compared to the previous years in 2010 and 2011, capacity utilization for the Akosombo Generation Station (GS) was 78%, 75%, 73% and 47% for 2012, 2013, 2014 and 2015 respectively. This indicates the over reliance and over draughting of the hydro dam during those period.

b. Thermal Power Plant fuel supply inadequacies

Thermal power plant installed capacity has increased significantly from 37% in the year 2000 to 61% in 2017 and 64% in 2018. The increase in thermal capacity should however be accompanied by increase in either liquid fuel or natural gas. Inadequate supply of

these fuel contributes to the low utilization of the thermal capacities and the subsequent over drafting of the hydro dams as witnessed from 2012 to 2014. There has been several interruptions to natural supply from the West African Gas Pipeline (WAGP) the most severe been in 2012. Average natural gas supply from the WAGP averaged below 50 MMSCFD lower than the average demand of about 120 MMSCFD. Interruptions to natural gas supply from the West African Pipeline especially in 2012 and the inability of plants managers to procure liquid fuel due to financial challenges has limited the utilization of the thermal capacity.

c. Excess Capacity

Excess capacity means the capacity available is over and above our demand and reserve margins necessary to keep the grid stable. Excess capacity therefore exist if demand for electricity are met (no load shedding) with adequate reserves but capacity utilization of installed capacity keeps declining. Therefore, the optimal capacity needed for a power system is the demand plus a reserve margin of 18% to 25%. In calculating the optimal capacity needed for the power system reveal that Ghana has witnessed varying degrees of excess capacities with the maximum occurring in 2016 and 2017 at 26% and 33% respectively. The only period that Ghana experienced capacity deficit was in 2006 at 0.7%. In fact, from the year 2000 to 2015, an average excess capacity of 11% were realized. Excess capacity caused decline in CUF from 2016 to 2017 when there were no severe load shedding but CUF dropped from 46% in 2015, 42% in 2016 to 39% in 2017. Installed capacity to demand also increased from 1.47 in 2015, 1.74 in 2016 and 1.87 in 2017.

Despite the obvious excess capacity from 2016 to 2017, operationally, this is not the case as fuel supply challenges has not help us to fully realize the operationalization of these capacities. Table 2.0 shows the reserve margin for 2017 indicating operable reserve margin and reserve margin due to technical and fuel supply challenges.

Table 2.0 Reserve margin for 2017

	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
Operable reserve margin (%)	3.4	1.18	6.57	3.71	2.92	4.01	2.00	15.02	28.34	24.75	25.95	26.91
Offline due to technical & fuel (%)	40.37	45.57	40.59	43.25	44.11	44.99	47.31	38.13	22.59	26.35	25.35	24.5
Total reserve margin (%)	43.77	46.75	47.16	46.96	47.03	49	49.31	53.15	50.93	51.1	51.3	51.41

Operable reserve margin increased gradually from 3.4% in January 2017 to 26.9% in December 2017 mainly due to improvement in volumes and consistent supply of natural gas.

Conclusion

There is clearly a disjoint between planning and operation. Capacity addition should be planned to coincide with increase in demand to reduce over capacity and payment for unused capacity. It therefore holds on the Energy Commission to issue license to prospective IPPs to meet projected increase in demand.

There is also the need to improve the liquidity in the WEM and improve the efficiency of the market. It is therefore incumbent on the GRIDCo and EMOP to operationalize the WEM by enacting the needed market rules that will ensure efficiency and improve the liquidity of the WEM. The EMOP should also ensure the judicious and proper use of the hydro resources in the country especially the Akosombo Dam to obtain the best out of these plants by the plant.

Even though natural gas supply has improved, there is the need to improve further these supply (especially to the Tema and Kpone) in other to reduce liquid fuel consumption and improve power plant availability which will eventually increase CUF.

2. PLANNING IN THE WHOLESALE ELECTRICITY MARKET (WEM)

Planning is the basic management function involving formulation of one or more detailed plans to achieve optimum balance of needs or demands with the available resources. Planning forms integral part of any organized system as it gives a clear indication to everybody the future and prospect of the system. The Ghana Wholesale Electricity Market (GWEM) would not be different as proper planning is needed by all interested parties in the market in order to ensure that the market runs smoothly and efficiently as envisaged.

One important underlining property of planning is that it takes it source of information from forecasted demand and resource availability. This could either be through a census or a survey. Either way, accurate data is critical for planning. In the power sector, there are several levels of planning done by various institution in undertaking their function. Regulators, distribution utilities, Bulk customers, NITS asset owners and the transmission utility undertake several forms of planning in achieving their function which lack coordination. How each of these institution plan and implement their plans will have an effect on the WEM.

The Energy Commission (EC) is mandate by the Energy Commission Act, 1997 Act 541 to among other things prepare, review and update periodically indicative national plans to ensure that reasonable demands for energy are met. In fulfilling this update, the EC in 2006 published the Strategic National Energy Plan (SNEP) which covered the period from 2006 to 2020. This document provided the demand outlook for Ghana from 2006 to 2020 and assessed the resources needed to meet these demand. The EC had also from 2010 been publishing the National Energy Outlook for Ghana which provide the short to medium term outlook for energy including Electricity in Ghana. These two document gives the broad indicative demand for the country. The EC is in the process of reviewing

the SNEP and present energy demand projections from 2015 to 2035. The L.I. 1937 mandates the Ghana Grid Company (GRIDCo) to plan and operate the National Interconnected Transmission System (NITS) in a safe, reliable and transparent manner. The Ghana Grid Code published by the Energy Commission provides the roles and responsibility of each grid participant in the planning of the NITS infrastructure in Ghana. The grid operator and asset owner are to plan for the upgrade and maintenance of the NITS in order to provide a congestion free NITS and to overcome constraints in the system.

The WEM as envisage for Ghana, the broad forecast of demand will be sources from the demand forecast from the indicative plans prepared by the Energy Commission. Projections made in the 2016 SNEP is currently under review and a new document will be prepared. This will serve as a guild to the administrator of the market, transmission asset owners and market participants. This plans will assist the transmission asset owner to plan grid expansion and fortification to prevent congestion. The long term demand forecast could also help bulk customers and distribution utilities plan their long term power needs by the competitive procuring of the needed capacity through a Power Purchase Agreement (PPA).

The administrator of the market is mandated to prepare short to medium plans for the market. Short term include one day, one week, a month and up to a year forecast. Medium term plans looks as forecast for up to 5 years. The short to medium forecast will help assist the bulk customers and distribution companies plan their short term capacity needs which the capacity market would play an important role. These forecast would also help potential investors in power production to make the necessary investment in the capacity market.

For the WEM to function efficiently, there need to be greater cooperation between the Energy Commission, market administrator and the market participant in producing demand and supply forecast that are accurate and acceptable to all. It is therefore of great importance that the Electricity Supply Plan prepared by GRIDCo include institutions such as Energy Commission, Volta River Authority (VRA), Electricity Company of Ghana (ECG) and Bui Power Authority (BPA). Planning in the WEM will be as accurate as possible in order to prevent excessive losses to market participants due to inaccurate forecast.

3.0 Ghana continues to be a net exporter of electricity

Ghana in the first half of 2018 was a net export of electricity, exporting a total of about 244 GWh of electricity and importing 80.4 GWh. This is in line with government policy of making Ghana a net exporter of electricity as stated in the power sector goal outlined in the national energy policy published in 2010 which is currently under review. The policy document sated that the goal of the power sector of Ghana is to be a major export of power in the sub-region by 2015. This was envisaged to be achieved through capacity addition, modernization of transmission and distribution infrastructure. Ghana became a net exporter in 2015 and 2017 with a net export of 328.54 GWh and 21.33 GWh respectively. Ghana was however a net importer of electricity in 2016 with a net import of 299.57 GWh.

From 2017 to mid-2018, Ghana has been a net exporter of electricity as envisaged in the policy statement. Government should continue with its measures put in place to make Ghana a net exporter of electricity and to rig in the needed foreign exchange earnings.

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
TT2PP = 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

For any enquiries please contact the:
EMOP Secretariat, Energy Commission, Accra.
Tel: 0302 813756/7/9 **E-mail:** emop@energycom.gov.gh