



# GHANA WHOLESALE ELECTRICITY MARKET BULLETIN

## MARKET WATCH

Monthly Market Data Analysis

ISSUE NO. 14: 1<sup>st</sup> February 2017 to 28<sup>th</sup> February 2017

This Bulletin covers major developments in the Wholesale Electricity Market (WEM) of Ghana from 1<sup>st</sup> February 2017 to 28<sup>th</sup> February 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.

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 slump in electricity generation recorded by some major plants including TICO, TAPCO and Ameri Power Plants in January 2017 intensified in the month of February 2017. In February 2017, the TICO and Ameri Power Plants together dropped additional combined generation of 140.8 GWh (average of 5.03 GWh per day) over that of January 2017. Of the total drop in generation, TICO accounted for 43.9 GWh as a result of the shutdown of the Gas Turbine Unit 2 for mandatory maintenance in addition to the Steam Turbine which was taken out in January 2017 while Ameri Energy Power Plant accounted for 96.9 GWh and was due to the tie-in of the Tweneboa, Enyenra, Ntomme (TEN) gas pipeline to the gas export pipeline of the FPSO Kwame Nkrumah which curtailed gas supply for the continuous operation of the Plant. The further drop in generation by TICO and Ameri Power Plants in February 2017 was compounded by the inability of the alternatives relied upon in January 2017 (increased imports and generation from more expensive sources such as TT1PP and Cenit as well as increased hydro generation) to make up for the deficit. Indeed, the 2017 Electricity Supply Plan (ESP) projected a deficit in supply if imports were not adequate in February 2017. Imports decreased by 9.4 GWh (15.3%) in February 2017 as compared to 61.5 GWh imported in January 2017 and was 80.9 GWh lower than projected. The Cenit power plant did not generate at all, and TT1PP decreased generation by 30 GWh (50%) because of unavailability of fuel (LCO) at the Tema Power Enclave. The TAPCO Unit 2 which was taken out in January, 2017 remained offline in February 2017.

Akosombo was able to increase its generation by 45.7 GWh (10.1%) over that of January 2017, Bui also came in with an increased generation of 1.85 GWh per day (81.36%) and KTRPP increased generation by 1.78 GWh per day (over 3 folds increase) even though they operated for 28 days in February 2017 as compared to 31 days in January 2017. The mitigation measures were not adequate to balance the demand and supply

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

|                                  | February 2017 |                | January 2017 |                |
|----------------------------------|---------------|----------------|--------------|----------------|
|                                  | Projected     | Actual Outturn | Projected    | Actual Outturn |
| Total Supply (GWh)               | 1,157.0       | 1,125.7        | 1,294.0      | 1,244.1        |
| Source by Power Plants (GWh)     |               |                |              |                |
| AKOSOMBO                         | 362.0         | 496.9          | 388.0        | 451.2          |
| KPONG                            | 72.0          | 71.5           | 72.0         | 71.0           |
| BUI                              | 74.0          | 115.4          | 72.0         | 70.4           |
| Sunon Asogli                     | 62.0          | 49.8           | 55.0         | 54.3           |
| TAPCO                            | -             | -              | 25.0         | 27.0           |
| TICO                             | 94.0          | 61.9           | 104.0        | 105.8          |
| TT1PP                            | 58.0          | 29.9           | 60.0         | 59.9           |
| CENIT                            | 55.0          | -              | 60.0         | 35.2           |
| TT2PP                            | -             | -              | -            | -              |
| MRP                              | -             | -              | -            | -              |
| Karpowership                     | 140.0         | 150.9          | 152.0        | 165.0          |
| AMERI                            | 40.0          | 18.0           | 148.0        | 114.9          |
| KTRPP                            | 62.0          | 65.4           | -            | 17.2           |
| Trojan Power                     | 5.0           | 13.9           | 7.0          | 10.7           |
| Total Generation (GWh)           | 1,024.0       | 1,073.6        | 1,144.0      | 1,182.6        |
| Imports (GWh)                    | 133.0         | 52.1           | 147.0        | 61.5           |
| Total Supply (GWh)               | 1,157.0       | 1,125.7        | 1,291.0      | 1,244.1        |
| Deficit (GWh)                    | -             | (81.3)         | -            | (46.9)         |
| Reduction in Consumption         |               | 3%             |              | 4%             |
| Ghana Coincident Peak Load (MW)  | 1,973.0       | 2,038.3        | 1,973.0      | 2,049.6        |
| System Coincident Peak Load (MW) | 2,134.0       | 2,084.3        | 2,106.0      | 2,099.8        |

## HIGHLIGHTS OF THE MONTH

leading to load shedding of up to 200MW at off peak and 230MW at peak for some periods in February 2017. The net effect of the measures put in place to meet demand from available generation sources was an accelerated drop rate of the hydro dam levels and a further increase in System Marginal Cost (SMC) by 25.6%. Table 1 shows a comparison of the projected and actual electricity demand and supply for February 2017 and January 2017.

### Electricity Demand and Supply

#### Electricity Demand at peak declined marginally

The System Peak Load (Ghana Peak Load plus Import) in February 2017 was 2,084.3 MW, marginally lower than the 2,099.8 MW recorded in January 2017. Also, the Ghana coincident peak load (Domestic Peak Load including Valco minus Export) recorded a marginal dip of 11.3 MW in February 2017 from 2,049.6 MW recorded in January 2017 to 2,038.3 MW. Just as in January 2017, the total System Peak Load was marginally lower (2.3%) than the projected System Peak load of 2,134 MW under the 2017 ESP, while the Ghana Peak Load was marginally higher (1.9%) than the projected Ghana Peak Load of 2001 MW for February 2017 under the 2017 ESP.

#### Electricity supply increased marginally

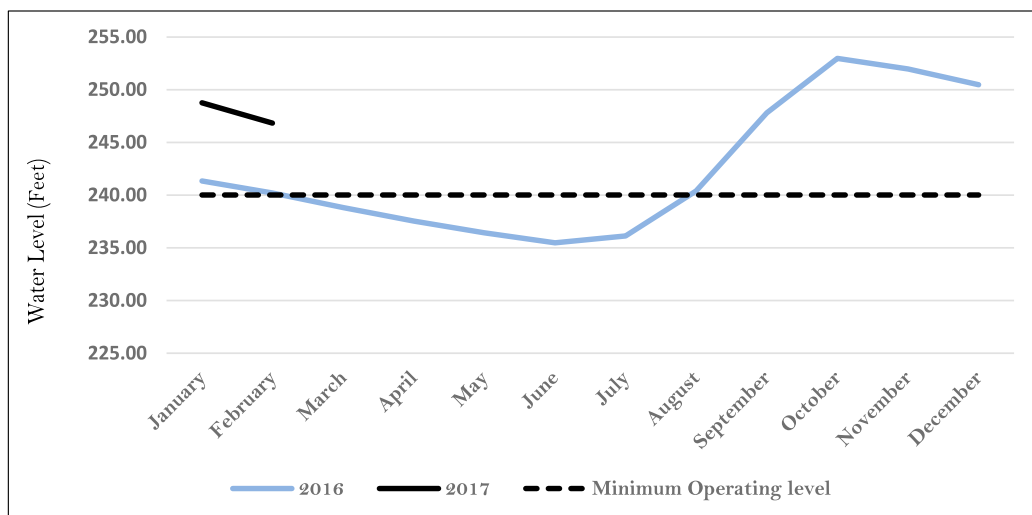
The average daily electricity supplied to meet Ghana's requirement increased marginally to 40.2 GWh per day in February 2017 from 40.1 GWh per day recorded in January 2017. The total electricity supply in February 2017 was 1,125.7 GWh consisting of 1,073.62 GWh from domestic generation and 52.08 GWh of imports from La Cote D'Ivoire. The total electricity supply in February 2017 was lower than that of January 2017. However, the average electricity supply per day was higher in February 2017 (40.2 GWh/day) than January 2017 (40.1 GWh/day) due to the fewer number of days in February than January which effectively signifies increased demand in February 2017. The total supply of electricity in February 2017 was 31.3 GWh lower than the 1,157 GWh projected in the 2017 Electricity Supply Plan (ESP). This represents a 2.7% deviation between the outturn and projection. The deviation was due to the lower than expected imports from CIE, inability of CENIT to come online due to low LCO stocks and lower than projected generation from Ameri Power Plant and the TT1PP.

### Hydro Dam Levels

#### Akosombo Dam Water Level Continued its decline in February, 2017

The water level in the Akosombo dam dropped by a further 1.92 feet in February 2017 to move from 248.76 feet at the beginning of the month to 246.84 feet at end of the month despite the fewer number of days of operation in February 2017. This was due to increased generation from the Akosombo GS to make up for short fall in supply resulting from decreased imports and unavailability of some thermal power plants. This notwithstanding, the water level at the end of February 2017 was higher than the level at the same time in February 2016 by about 1.15 feet and was also 8.76 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 February 2017.

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

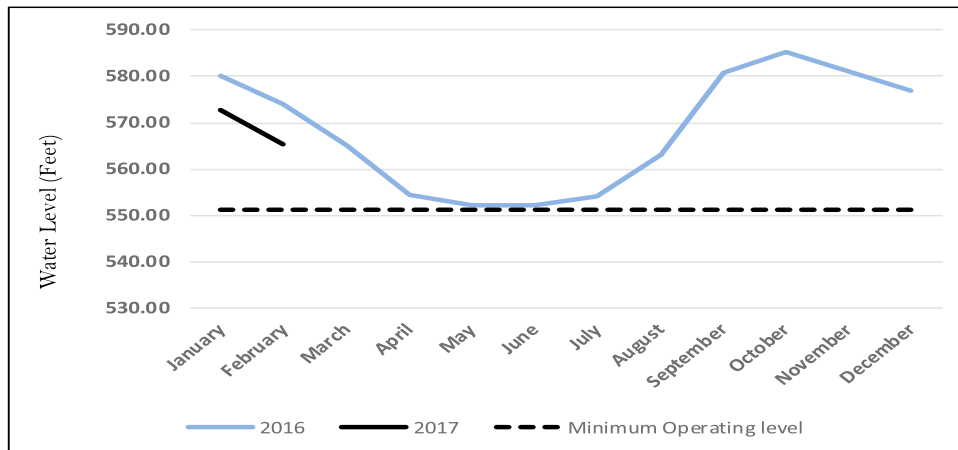


#### Bui Dam Water Level declined at an elevated rate

The Bui dam water level dropped by 7.61 feet in February 2017 to move from 572.82 feet level at the beginning of the month to 565.21 feet at end of the month. The drop rate was 88.9% higher than the drop in January 2017 even though it ran for fewer days in February 2017 than in January 2017. The dip in the water level points to an increase in drafting of the dam to fill the electricity generation gap left by increased unavailability of thermal generation sources. Even though the water level remained above the minimum design operating level of 551.04 feet, the water level at the end of February 2017, unlike the Akosombo Dam, was lower than the level at the same time in February 2016 by about 12.89 feet. Figure 2 shows comparative end of month trajectory of the level of water in the Bui dam from January 2016 to February 2017.

## HIGHLIGHTS OF THE MONTH

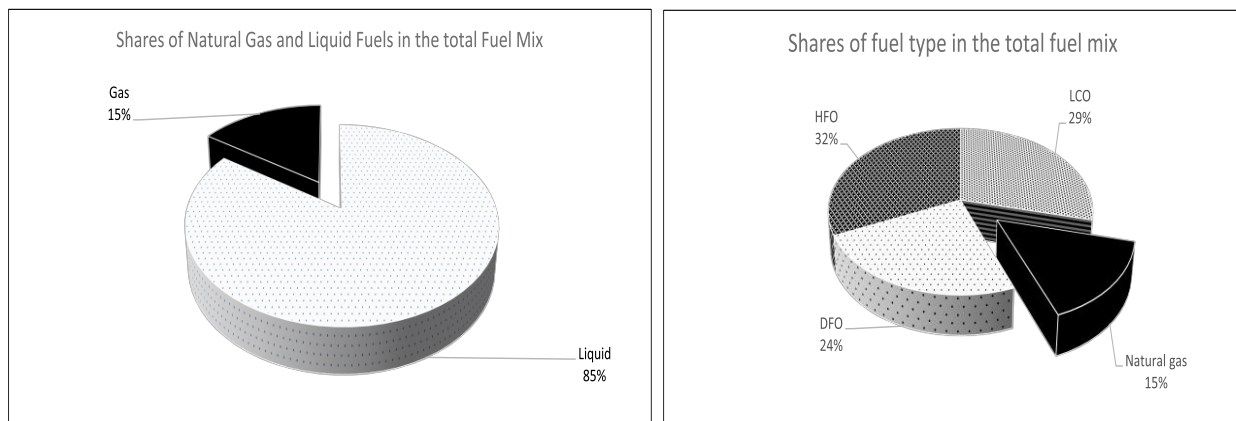
Figure 2: Month-End Water Level for Bui Dam from January 2016 to February 2017



### Fuel Supply

Liquid fuel continued to dominate the fuel supply mix in February 2017. Shares of natural gas in the fuel supply mix reduced from 34% in January 2017 to 15% in January 2017 with liquid fuels constituting 85% of the fuel mix in February 2017. Of the total liquid fuel supply, Light Crude Oil (LCO) shares dropped from 37% in January 2017 to 29% in February 2017, HFO shares increased from 23% in January 2017 to 32% in February 2017 and DFO shares increased from 6% in January 2017 to 24% in February 2017. It is therefore not surprising that the SMP for February 2017 was higher than that of January 2017. Gas supply from the West African Gas Pipeline Company (WAGPCo) increased from 27.5% of the total gas supply to 68% while gas supply from the Atuabo Gas Processing Plant (AGPP) reduced from 72.5% in January 2017 to 32% in February 2017. The reduction in the gas supply from the AGPP was due to the curtailment of gas exports from the FPSO Kwame Nkrumah to Aboadze Power Enclave (APE) to allow for the tie-in of the TEN oil field gas pipeline to the gas export pipeline of the FPSO Kwame Nkrumah. Figure 3 shows the shares of sources of fuel and fuel type in the generation fuel mix

Figure 3 Shares of sources of fuel and fuel type in the generation fuel mix



### Natural gas supply from WAGPCo continued to decline

Total gas supply from Nigeria through the West African Gas Pipeline (WAGP) to Tema and Kpone averaged 13.6 MMSCF per day which was 18.8% lower than the average supply of 16.2 MMSCF per day in January 2017. This supply was only adequate to feed part of phase I of Sunon Asogli power plant which relies solely on natural gas for electricity generation. The inadequate gas supply compelled the other power plants in Tema and Kpone to run on LCO and DFO, which increased the shares of liquid fuel in the fuel supply mix.

### Natural gas supply from GNCC to the Aboadze Power Enclave dipped significantly in February 2017

Total gas supply from the Atuabo Gas Processing plant to the Aboadze Power Enclave for February 2017 was 160.04 MMSCF which was woefully inadequate for the enclave. It was only consumed by the Ameri Energy Power Plant to generate electricity for 7 days. The resulting average gas supply for the month of February 2017 was 5.72 MMSCF per day, an 85% reduction on the average of 39.38 MMSCF per day for January 2017.

### Liquid Fuel

A total of 169,936 bbls of LCO was used for electricity generation in February 2017. Of this total, 52% was used by power plants in the Tema and Kpone Power Enclaves while 48% was used in the Aboadze Power Enclave. For the first time, the SAPP phase II consumed LCO for electricity

## HIGHLIGHTS OF THE MONTH

generation after it was commissioned on LCO in February 2017. DFO consumption increased significantly from 61,934 bbls in January 2017 to 136,225 bbls in February 2017. About 19.8% of the DFO was used in the Tema power enclave while the remaining 80.2% was used in the Kpone Power Enclave.

Karpowership Power Plant which was the only HFO fired power plant in operation in February 2017 utilized a total of 200,957 bbls of HFO for electricity generation.

### Plant by Plant Highlights

#### Electricity Generation at the Akosombo Generation Station (GS) increased further in February 2017

The Akosombo GS operated for the entire 28 days of February 2017, increasing its electricity generation by a further 45.64 GWh to 496.86 GWh (17.74 GWh per day) in February 2017 from 451.22 GWh (14.55 GWh per day) in January 2017 despite the fewer number of days in operation in February 2017 than in January 2017. The 496.86 GWh generated by Akosombo GS in February 2017 was also 37.3% higher than the 362 GWh projected to be generated under the 2017 ESP. The Akosombo GS generated 46.3% of total electricity supplied in February 2017 up from 36.3% of total electricity supplied in January 2017. The power plant contributed 903 MW (43.3%) to meet total System Peak Load of 2084.30 MW in February 2017 compared to 878 MW (41.8%) in January 2017 to meet System Peak Load of 2,099.8 MW. The Akosombo GS contributed the same elevated amount of 903.0 MW (44.3%) to meet the Ghana Peak Load of 2,038.30 MW in February 2017.

#### Kpone Generation Station (GS) continued to increase generation in February 2017

Kpone generation station operated for the entire 28 days of February 2017 and generated a total of 71.53 GWh an average of 2.6 GWh per day which was 11.5% higher than in January 2017 and 5% higher than in December 2016. The Kpone GS generated marginally higher (2.53 GWh) than the projected 69 GWh in the 2017 ESP. The Kpone GS contributed 110 MW to both System Peak Load and Ghana Peak Load in February 2017 representing 5.3% and 5.4% of the System Peak Load and Ghana Peak load respectively.

#### Bui Generation Station (GS) increased generation significantly

Electricity production from the Bui GS increased significantly in February 2017 to 115.36 GWh (4.12 GWh per day) from 79.11 GWh (2.55 GWh per day) in January 2017. This represents an increase of 61.5%, based on the daily average production in the two months. The daily average generation suggests that the Bui GS run one unit at base load and three units at peak contrary to its design specification as a peaking plant. The total electricity generated in February 2017 from the Bui GS was also higher than the 74 GWh projected to be generated under the 2017 Electricity Supply Plan (ESP). The Bui power plant contributed 334 MW to both the System Peak (2,084.30 MW) and Ghana Peak Loads (2,038.30 MW), which represents 16% and 16.4% respectively.

#### Electricity Generation by the Sunon Asogli Power Plant increased marginally

The Sunon Asogli Power Plant (SAPP) operated for 26 days out of the 28 days in February 2017 and generated a total of 49.8 GWh of electricity (an average of 1.9 GWh per day), a marginal increase over the 1.75 GWh a day generated in January 2017. The plant was shut down for 2 days in February 2017 due to unavailability of natural gas supply from Nigeria through the WAGP. The SAPP for the first time commissioned and run some part of phase II (Sunon Asogli Expansion) on LCO consuming a total of about 5,700 bbls of LCO. In February 2017, the Sunon Asogli Power Plant contributed 152.9 MW to meet both the System Peak Load of 2,084.30 MW and Ghana Peak Load of 2,038.30 MW. This represented 7.3% and 7.5% of System Peak Load and Ghana Peak Load respectively. The SAPP consumed a total of 381.62 MMSCF and about 5,700 bbls of LCO at an estimated heat rate of 8,739.41 Btu/kWh, an improvement in fuel efficiency as compared to January 2017.

#### CENIT Power Plant did not operate in February 2017

CENIT Power Plant was offline for the whole of February 2017 due to low levels of Light Crude Oil (LCO) stocks to power the plant.

#### Ameri Energy Power Plant generation slumped further

Electricity generation from the Ameri Energy Power Plant slumped in February 2017. The tie-in of the TEN gas pipeline to the FPSO Kwame Nkrumah export pipeline limited the run time of the Ameri power plant operation to 7 days out of the 28 days in February 2017, generating 18 GWh instead of the projected 40 GWh under the 2017 ESP due to gas supply curtailment to the Aboadze Power Enclave for the rest of the month. The 18 GWh of electricity generated by Ameri in February 2017 represented only 1.6% of total electricity supplied in the month and was achieved with total gas consumption of 160.04 MMSCF resulting in an estimated average heat rate of 10,297.40 Btu/kWh. The Ameri Energy Power Plant made no contribution to meet either the System Peak Load or the Ghana Peak Load.

#### Kpone Thermal Power Plant (KTPP) increased generation

For the first time since June 2016, the KTPP operated continuously for the entire month in February 2017. Electricity generated from the KTPP in February 2017 increased to 65.44 GWh (average of 2.34 GWh per day) from 17.16 GWh (1.56 GWh per day) in January 2017. The February 2017 generation of 65.44 GWh by the KTPP was 5.5% higher than the 62 GWh it was projected to generate under the 2017 ESP. The increase in generation was to make up for the short fall in generation due to the shutdown of the other thermal power plants. The KTPP contributed 188 MW to meet both the System (2,084.30) and Ghana (2,038.30) Peak Loads. This represented 9% and 9.2% of System and Ghana Peak loads respectively. The 65.44 GWh of electricity generated in February 2017 by KTPP represented 5.8% of total electricity supplied in the month and was achieved with a consumption of 136,225.21 barrels of DFO resulting in an average heat rate of 11,186.42 Btu/kWh.

## HIGHLIGHTS OF THE MONTH

### **Karpowership Power Plant maintained its high level of electricity generation**

The Karpowership Power Plant operated every day in the month of February 2017, generating a total of 150.90 GWh in February 2017 (an average of 5.4 GWh per day). The power plant contributed 13.4% of total electricity supplied in February 2017 similar to the 13.5% contributed in January 2017. It also contributed 10.9% and 11.2% of the System and Ghana Peak Loads respectively in February 2017 and 10.8% and 11.2% of the System and Ghana Peak Loads respectively in January 2017. The electricity generated in February 2017 was also higher than the projected generation of 140 GWh forecasted under the 2017 ESP. The Karpowership plant consumed 200,957 barrels of Heavy Fuel oil (HFO) to generate the 150.90 GWh in February 2017 at an average heat rate of 8,172.41 Btu/kWh.

### **Takoradi International Company (TICO) generated with only one Gas turbine in February 2017**

The TICO Power plant operated throughout the month of February 2017 with only one gas turbine and generated a total of 61.91 GWh of electricity (average of 2.2 GWh/day) representing 5.5% of total electricity supplied in the month. The steam turbine and the other gas turbine had been taken offline for warranty inspection and major inspection respectively. The TICO power plant in February 2017 contributed 96 MW to meet both the System Peak Load and Ghana Peak Load, representing 4.6% and 4.7% respectively. It operated solely on light crude oil (LCO) consuming about 136,877 barrels of the fuel to produce the 61.91 GWh of electricity at an estimated average heat rate (fuel efficiency) of 11,697.61 Btu/kWh.

### **Takoradi Power Company (TAPCO) remained offline**

The TAPCO Power Plant was offline throughout the month of February 2017 and therefore generated no electricity. The power plant was offline in February 2017 because of works on Gas Turbine 1 (rotor ground fault) and major inspection on Gas Turbine 2.

### **Tema Thermal 1 Power Plant (TT1PP) generated for half of the period in February 2017**

The Tema Thermal 1 Power Plant, (TT1PP) generated 29.88 GWh of electricity in February 2017 operating for 14 day in the month as it run out of LCO stock to continue operation for the rest of the month. Consequently, the February 2017 generation of 29.88 GWh by the TT1PP which represented 2.7% of total electricity supplied for the month and was lower than the 58 GWh projected for the month of February 2017 under the 2017 ESP. The TT1PP made no contribution to meet either the System or Ghana Peak Loads. The power plant operated solely on LCO consuming about 65,436.82 barrels of LCO to generate 29.88 GWh of electricity at an average heat rate of 11,587 Btu/kWh.

### **Trojan Power Plant increased generation marginally**

Trojan Power Plant operated throughout February 2017 and generated a total of 13.93 GWh of electricity (an average of 0.5 GWh per day as against 0.35 GWh per day generated in January 2017). Of the total 13.93 GWh generated, Trojan power plant in Kumasi accounted for 27.7% while Trojan Power Plant in Tema accounted for 72.3%. Of the 33,620 bbls of DFO used by Trojan power plant for electricity generation, 23,399 bbls was used in the Tema power enclave to generate 10.1 GWh of electricity at an average heat rate of 12,491.08 Btu/kWh and 10,221 bbls was used to generate 3.87 GWh of electricity at Kumasi at an average heat rate of 14,203.14 Btu/kWh. The power plant generated 8.93 GWh higher than the projected 5 GWh projected in the 2017 ESP.

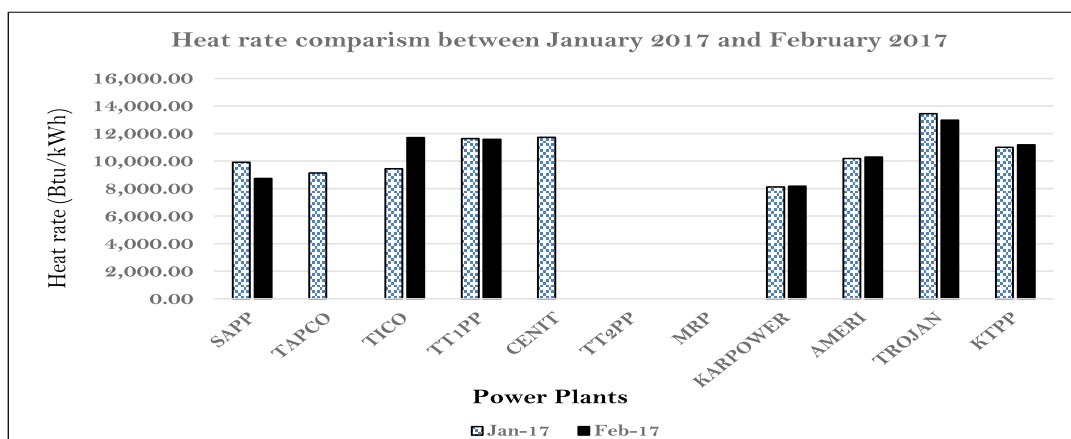
## **Electricity Exchange**

Electricity imports from La Cote D'Ivoire decreased to 52.1 GWh (an average of 1.8 GWh per day) in February 2017 from 61.5 GWh (1.98 GWh per day) in January 2017. Total import was also 1.6 times lower than the projected 133 GWh projected under the 2017 supply plan. The lower than projected import in February 2017 contributed to the demand supply deficit in the month. Electricity export also decreased from 45.33 GWh in January 2017 to 27.82 GWh in February 2017 and was also lower than the projected 72 GWh projected under the 2017 ESP. Daily peak import in February 2017 ranged between 14 MW and 137 MW and contributed 3.5% and 3.6% to meet the System Peak Load and Ghana Peak Load respectively in February 2017. Ghana was a net importer of electricity in February, 2017.

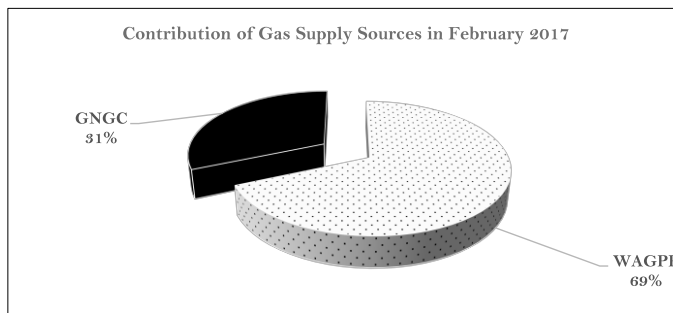
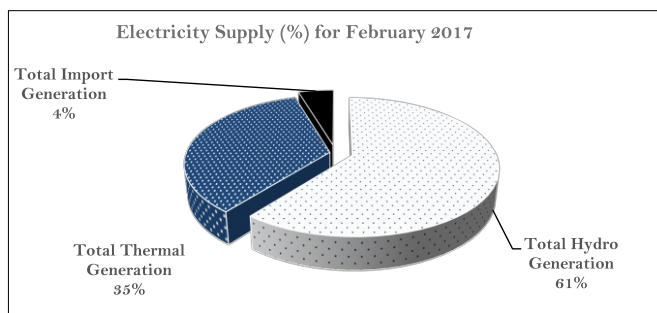
## OPERATIONAL FACT SHEET

| Peak Electricity Supply - February 2017 |   |  |                          |
|---|---|--|--------------------------|
| Source of Supply                        | Generation at System Coincident Peak Load of February 2017 (MW) | Generation at Ghana Coincident Peak Load of February 2017 (MW) | Electricity Supply (GWh) |
| AKOSOMBO                                | 903.00  | 903.00   | 496.86                   |
| KPONG                                   | 110.00  | 110.00   | 71.53                    |
| BUI                                     | 334.00  | 334.00   | 115.36                   |
| SAPP                                    | 152.90  | 152.90   | 49.78                    |
| TAPCO                                   | -   | -  | -                        |
| TICO                                    | 96.00   | 96.00  | 61.91                    |
| TT1PP                                   | -   | -  | 29.88                    |
| CENIT                                   | -   | -  | -                        |
| TT2PP                                   | -   | -  | -                        |
| MRP                                     | -   | -  | -                        |
| KARPOWER                                | 227.40  | 227.40   | 150.90                   |
| AMERI                                   | -   | -  | 18.04                    |
| KTPP                                    | 188.00  | 188.00   | 65.44                    |
| Trojan Power                            | -   | -  | 13.93                    |
| IMPORT                                  | 73.00   | 73.00  | 52.08                    |
| Export                                  | -   | 46.00  | 27.82                    |
| <b>System Coincident Peak Load</b>      | <b>2,084.30</b>   | -  | -                        |
| <b>Ghana Coincident Peak Load</b>       | -   | <b>2,038.30</b>  | -                        |
| <b>Total Supply</b>                     | -   | -  | <b>1,125.70</b>          |
| <b>Total Supply without export</b>      | -   | -  | <b>1,097.88</b>          |

| Ghana Electricity Demand      |     |         |
|-------------------------------|-----|---------|
|                               |     | Feb-17  |
| Maximum System Peak Load      | MW  | 2,084.3 |
| Minimum System Peak Load      | MW  | 1,607.1 |
| Average Peak Generation       | MW  | 1,956.1 |
| System Base Load              | MW  | 1,360.6 |
| Total Electricity Consumption | GWh | 1,125.7 |
| Total Energy Imported         | GWh | 52.1    |
| Load Factor (LF)              | %   | 72.6    |



# OPERATIONAL FACT SHEET



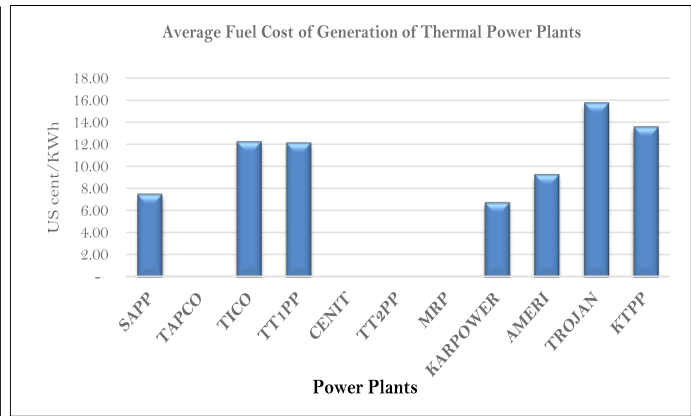
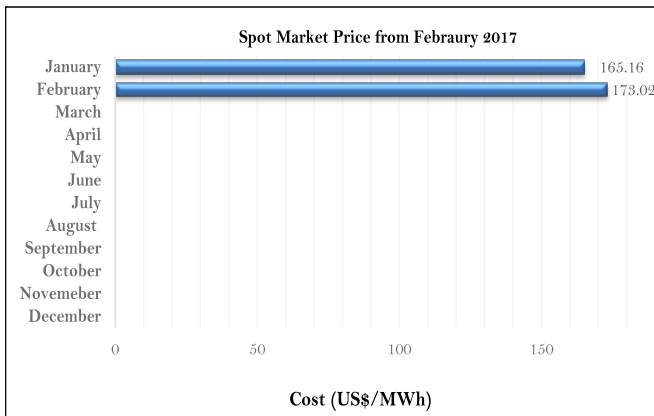
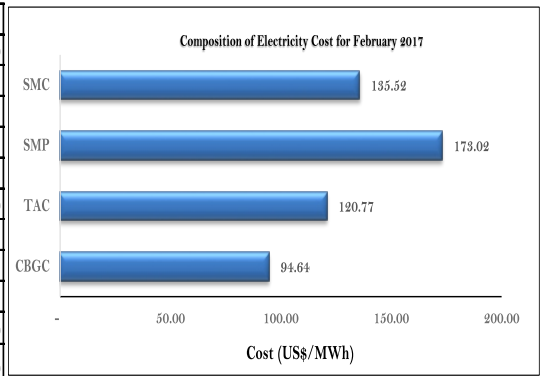
| Power Plant Data for February 2017 |                          |                       |                              |                         |                         |                         |                         |
|------------------------------------|--------------------------|-----------------------|------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                    | Dependable Capacity (MW) | Plant Utilization (%) | Electricity Generation (GWh) | Gas Consumption (MMBtu) | LCO Consumption (MMBtu) | DFO Consumption (MMBtu) | HFO Consumption (MMBtu) |
| Akosombo                           | 900.00                   | 74.20                 | 496.86                       | -                       | -                       | -                       | -                       |
| Kpong                              | 140.00                   | 68.67                 | 71.53                        | -                       | -                       | -                       | -                       |
| Bui                                | 340.00                   | 45.60                 | 115.36                       | -                       | -                       | -                       | -                       |
| SEAP                               | 500.00                   | 13.38                 | 49.78                        | 390,052.29              | 30,502.45               | -                       | -                       |
| TAPCO                              | 300.00                   | -                     | -                            | -                       | -                       | -                       | -                       |
| TICO                               | 300.00                   | 27.74                 | 61.91                        | -                       | 724,204.42              | -                       | -                       |
| TT1PP                              | 110.00                   | 36.51                 | 29.88                        | -                       | 346,222.16              | -                       | -                       |
| CENIT                              | 110.00                   | -                     | -                            | -                       | -                       | -                       | -                       |
| TT2PP                              | 45.00                    | -                     | -                            | -                       | -                       | -                       | -                       |
| MRP                                | 70.00                    | -                     | -                            | -                       | -                       | -                       | -                       |
| KARPOWER                           | 225.00                   | 90.14                 | 150.90                       | -                       | -                       | -                       | 1,233,217.89            |
| AMERI                              | 230.00                   | 10.54                 | 18.04                        | 185,796.05              | -                       | -                       | -                       |
| TROJAN                             | 56.00                    | 33.44                 | 13.93                        | -                       | -                       | 180,661.00              | -                       |
| KTPP                               | 200.00                   | 43.98                 | 65.44                        | -                       | -                       | 732,021.13              | -                       |
| AKSA                               | -                        | -                     | -                            | -                       | -                       | -                       | -                       |
| <b>Total</b>                       | <b>3,526.00</b>          | <b>40.93</b>          | <b>1,073.62</b>              | <b>575,848.34</b>       | <b>1,100,929.02</b>     |                         | <b>1,233,217.89</b>     |

| Location | Average Gas Flow (MMScfd) - February 2017 |        |        |        |                 |
|----------|---|--------|--------|--------|-----------------|
|          | Week 1                                    | Week 2 | Week 3 | Week 4 | Monthly Average |
| Etoki    | 5.52                                      | 14.21  | 22.34  | 9.51   | <b>12.89</b>    |
| Tema     | 14.60                                     | 9.80   | 22.28  | 11.43  | <b>14.53</b>    |
| Aboadze  | 18.55                                     | 0.00   | 0.00   | 6.87   | <b>6.35</b>     |

| Hydro Dam | Water Level (ft) - February 2017 |        |        |        | Change in water level (feet) |
|-----------|----------------------------------|--------|--------|--------|------------------------------|
|           | Week 1                           | Week 2 | Week 3 | Week 4 |                              |
| Akosombo  | 248.76                           | 248.32 | 247.83 | 246.84 | -1.92                        |
| Bui       | 572.82                           | 571.11 | 569.01 | 565.21 | -7.61                        |

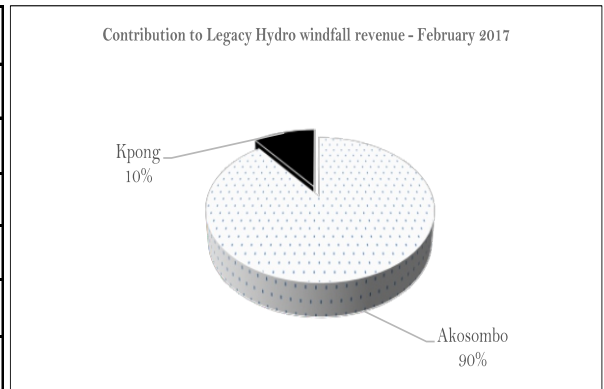
# ECONOMIC FACT SHEET

|   |          | Feb-17  | Jan-17  | Change  |
|---|----------|---------|---------|---------|
| Average Market Energy Cost              | US\$/MWh | 92.29   | 93.25   | (0.96)  |
| Average Market Capacity Charge (AMCC)   | US\$/MWh | 28.48   | 22.79   | 5.69    |
| Total Average Market Cost (TAC)         | US\$/MWh | 120.77  | 116.04  | 4.73    |
| System Marginal Cost (SMC)              | US\$/MWh | 135.52  | 121.16  | 14.36   |
| System Marginal Capacity Charge (SMCC)  | US\$/MWh | 37.50   | 44.00   | (6.50)  |
| Spot Market Price (SMP)                 | US\$/MWh | 173.02  | 165.16  | 7.86    |
| Composite Bulk Generation Charge (CBGC) | US\$/MWh | 94.64   | 94.64   | -       |
| Deviation of TAC from CBGC              | US\$/MWh | (26.13) | 1.49    | (27.62) |
| Deviation of SMP from CBGC              | US\$/MWh | (78.38) | (44.98) | (33.40) |



| Feb-17       |              |             |            |                      |
|--------------|--------------|-------------|------------|----------------------|
|              | Average Cost | Average SMP | Difference | Windfall Revenue     |
| Power Plant  | US\$/MWh     | US\$/MWh    | US\$/MWh   | US\$/MWh             |
| Akosombo     | 33.10        | 173.02      | 139.92     | 69,520,263.40        |
| Kpong        | 59.20        | 173.02      | 113.82     | 8,141,134.21         |
| <b>Total</b> | <b>92.30</b> | <b>-</b>    | <b>-</b>   | <b>77,661,397.60</b> |

| Average Fuel Prices |            |                |
|---------------------|------------|----------------|
|                     |            | Feb-17         |
| Fuel Type           | Unit       | Delivered Cost |
| Natural Gas         | US\$/MMBtu | 8.73           |
| LCO                 | US\$/BBL   | 55.29          |
| HFO                 | US\$/Tonne | 321.74         |
| DFO                 | US\$/Tonne | 484.59         |





## Other Market News and Trends

### 1. Estimated Windfall Revenue from Legacy Hydro Hits all-time high in February 2017;

The estimated Windfall Revenue which would have been realized from the expected sale of electricity generated by the cheaper legacy hydro plants (Akosombo and Kpong) on the Spot Market as required by the Electricity Regulation 2008 (L.I. 1937), shot to an all-time high in February 2017 since the inception of this Market Bulletin. Government could have raked in a whopping US\$ 77.66 Million in February 2017 alone from the Windfall Revenue.

The sharp rise in the Windfall Revenue stems from two factors

- i. Increased generation from the legacy hydro plants; and
- ii. High System Marginal Price (SMP) resulting from the need to call on relatively more expensive available thermal plants to come online to meet System Peak Load.

Even though the Windfall Revenue per MWh in February 2017 was not the highest since the inception of this Bulletin, (the highest occurred in June 2016), the relatively higher units of electricity generation from these legacy hydro plants in February 2017, ensured the highest total estimated Windfall Revenue was realized in the month.

The Windfall Revenue as could be recalled, is calculated using the difference between the SMP (which is calculated as the weighted costs of the marginal units using an optimized load duration curve for the month) and the historical accounting cost for the legacy hydro. (US\$33.1/MWh for Akosombo and US\$59.2/MWh for Kpong) and multiplying this difference by the units of electricity generated by the legacy hydros in the period.

Out of the total of US\$ 77.66 Million estimated Windfall Revenue in February 2017, US\$ 69.52 Million would have been realized from Akosombo GS representing 89.5% while Kpong GS would have accounted for US\$ 8.14 Million representing 10.5%. For each unit (MWh) of electricity generated from the Akosombo GS in February 2017, the resulting windfall revenue was estimated at US\$139.92, while a unit (MWh) of electricity generated from the Kpong GS in February, 2017, the resulting Windfall Revenue was estimated at US\$113.82. Fig. 1.1 also shows the estimated monthly total Windfall Revenue from each of Akosombo and Kpong Hydro Plants.

Figure 1.1 shows the legacy hydro windfall from January 2016 to February 2017

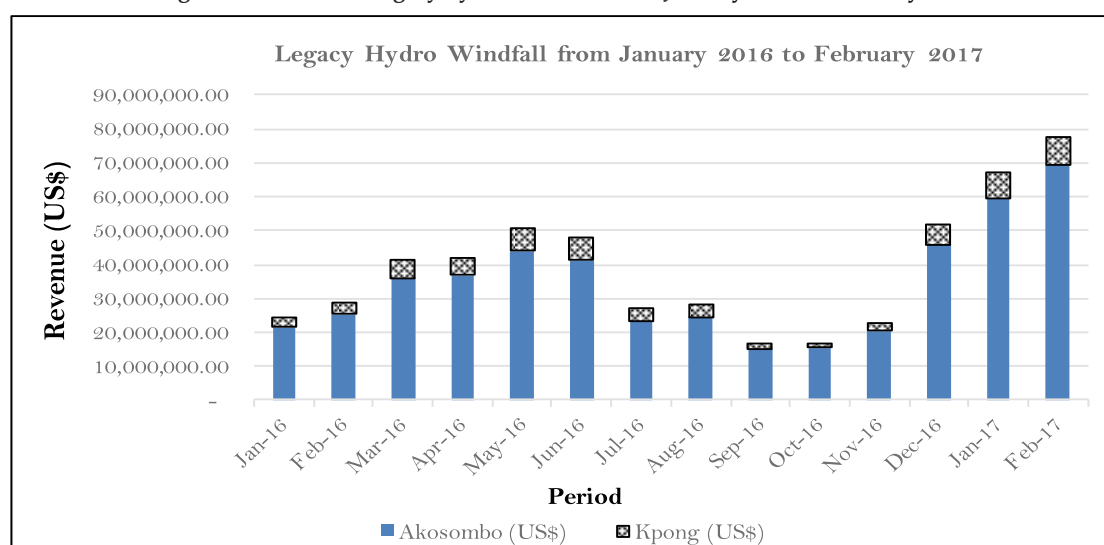


Table 1.1 windfall revenue per MWh of electricity generated from January 2016 to February 2017.

|        | Akosombo (US\$/MWh) | Kpong (US\$/MWh) |
|--------|---------------------|------------------|
| Jan-16 | 83.46               | 57.69            |
| Feb-16 | 92.37               | 65.72            |
| Mar-16 | 99.88               | 73.77            |
| Apr-16 | 92.86               | 66.76            |
| May-16 | 119.08              | 92.99            |
| Jun-16 | 141.55              | 115.47           |
| Jul-16 | 93.08               | 66.98            |
| Aug-16 | 103.23              | 77.11            |
| Sep-16 | 54.45               | 28.35            |
| Oct-16 | 44.31               | 21.75            |
| Nov-16 | 47.50               | 27.39            |
| Dec-16 | 128.01              | 90.98            |
| Jan-17 | 132.06              | 105.96           |
| Feb-17 | 139.92              | 113.82           |

## Other Market News and Trends

We wish to reiterate that, the Windfall Revenue could be another source of funds for retiring the lingering energy sector debts resulting from non-payment of fuel supplies for power generation as well as Government Indebtedness to ECG. The windfall could also be used to provide targeted subsidies to vulnerable classes of consumers and industries in a very transparent manner without distorting the electricity market competition principles as envisaged in the power sector reforms programme.

### 2.0 Performance Indicators of Power Plants

#### 2.1 Capacity Utilization Factor (CUF)

Karpowership continues to rank high among the power plants with a capacity utilization of 90.14% in February 2017 even though it was 9.4% lower than its capacity utilization in January 2017. The Karpowership continues to show that with adherence to strict maintenance schedules and constant supply of fuel, the generating units can attain a high capacity utilization factor. TICO had a CUF of 27.7% in February 2017 (20% less than that of January 2017) largely due to the fact that, one gas turbine was taken off in addition to the steam generator for maintenance.

The CUF of Ameri Energy Plant dropped from 67.15% in January 2017 to 10.54% in February 2017, the TT1PP halved its CUF from 73.2% in January 2017 to 36.51% in February 2017, and Sunon Asogli also saw its CUF significantly reduced from 40.5% in January 2017 to 13.38% in February 2017, all as a result of fuel supply inadequacy. The TT2PP, MRP and CENIT were totally offline due to inadequate fuel unavailability.

Trojan Power and KTRPP, saw significant increment in their CUF as a result of the need to make up for the generation deficit resulting from the fuel supply challenges that had caused some cheaper thermal plants to be offline. The hydro power plants all had a higher CUF in February 2017 than in January 2017 for the same reason. Akosombo GS had a CUF of 74.2%, which was 10.1% higher than in January 2017. Likewise, Bui GS recorded almost twice the CUF in January 2017 (27.8%) in February 2017 (45.6%). The capacity utilization factor of Bui GS in February 2017 of 45.6% suggest that Bui GS generated almost twice more than of its design CUF of 25% (Peaking plant). 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

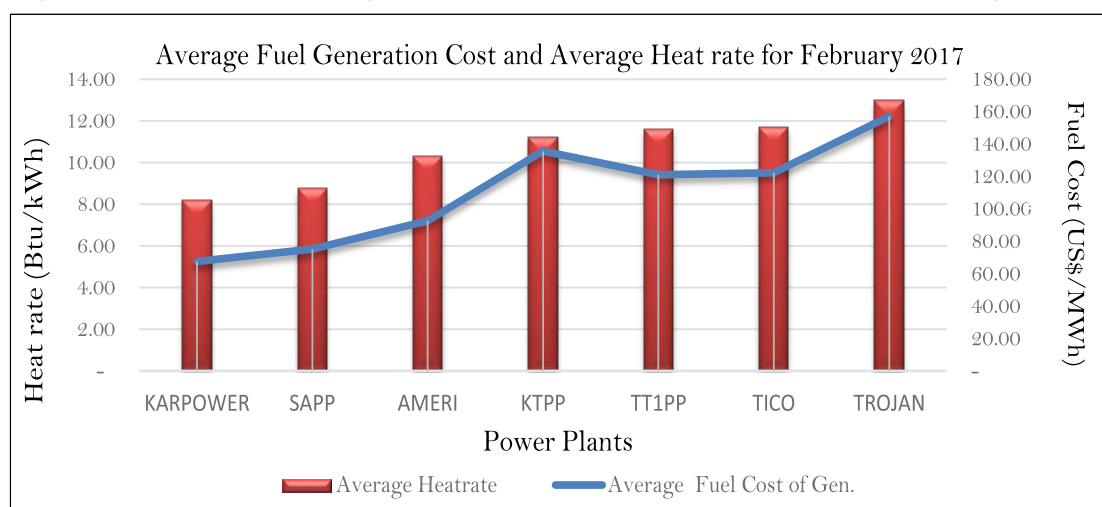
| Power Plant | Capacity Utiliation (%) | Average Heatrate (Btu/KWh) | Average Fuel Cost of Generation (US\$/MWh) |
|-------------|-------------------------|----------------------------|--|
| Akosombo    | 74.20                   | -                          | -  |
| Kpong       | 68.67                   | -                          | -  |
| Bui         | 45.60                   | -                          | -  |
| SEAP        | 13.38                   | 8,739.41                   | 75.07                                      |
| TAPCO       | -                       | -                          | -  |
| TICO        | 27.74                   | 11,697.70                  | 122.26                                     |
| TT1PP       | 36.51                   | 11,587.09                  | 121.11                                     |
| CENIT       | -                       | -                          | -  |
| TT2PP       | -                       | -                          | -  |
| MRP         | -                       | -                          | -  |
| KARPOWER    | 90.14                   | 8,172.41                   | 67.51                                      |
| AMERI       | 10.54                   | 10,297.40                  | 92.68                                      |
| TROJAN      | 33.44                   | 12,966.26                  | 157.08                                     |
| KTRPP       | 43.98                   | 11,186.42                  | 135.52                                     |
| AKSA        | -                       | -                          | -  |

#### 2.2 Heat Rate (Fuel Efficiency)

Karpowership continue to be the most efficient plant since we started the monthly fuel efficiency ranking of thermal power plants as it was once again ranked the most efficient plant in terms of fuel usage in February 2017 with an estimated heat rate of 8,172.41 Btu/kWh. The least efficient thermal power plants were TT1PP, TICO and Trojan with 11,587.09 Btu/KWh, 11,697.7 Btu/kWh and 12,966.26 Btu/kWh respectively. The TICO Plant had one of the highest heat rate in February 2017 (less efficient) because it generated solely on a simple cycle mode due to the shutdown of the steam turbine for warranty inspection. Cenit and KTRPP which were among the plants with the highest heat rate (Lower Fuel Efficiency) did not operate in February, 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

Based on the heat rates of the plants, the fuel cost of electricity generation by the power plants were estimated. It turned out that, Karpowership Power Plant, which was the most fuel efficient plant in February 2017, had the lowest fuel cost of generation estimated at US\$67.51/MWh due to its high efficiency and relatively lower average cost of HFO (US\$8.26/MMBtu) than natural gas (US\$8.73/MMBtu), LCO (US\$10.34) and DFO (US\$10.45). On the other hand, Trojan power plant which was the least efficient power plant in February 2017 had the highest average fuel cost of generation estimated at US\$157.08. Even though KTRPP was more efficient (Lower Heat Rate) than TT1PP and TICO, it had a higher average fuel cost of generation (US\$135.52/MWh) than TT1PP and CENIT due to the relatively higher cost of DFO than LCO in the month of February 2017. TICO dropped on the least cost generation rank due to its higher heat rate in February 2017 than in January 2017.

#### Acronyms

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

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# Save Power by Switching off Your FREEZER in the Night



Automatic Timer Switch



In homes without air conditioners, refrigerators and freezers are the highest power consuming appliances and account for about 70% of the power consumed.

Frozen food in a freezer can stay frozen for about two days (48 hours); a half-full freezer for about one day (24 hours) even when the power supply has been interrupted.

Electricity consumers can therefore reduce their consumption by about 30% by switching off their freezers with frozen food in the night when going to bed and switching them on the next morning.

Although consumers who have taken advantage of the cool temperatures experienced at night and switched off their freezers have observed significant energy cost savings, manual switching is not always convenient and the appliance may be forgotten till the next day.

The Energy Commission is introducing the Automatic Timer Switch (ATS) to enable consumers switch off and switch on their freezers automatically at predetermined times to reduce power consumption.

With the help of ATS, users do not have to wake up from their sleep to do the switch off and switch on of a freezer at the users' preferred times.

A programmed ATS will have to be inserted into the power output socket on the wall and freezer power input plug inserted into the output socket of the timer.

The Energy Commission is introducing the timers to consumers on pilot basis. Interested consumers can contact the Commission for further information.



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