2022 ENERGY OUTLOOK FOR GHANA

Demand and Supply Outlook

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EXECUTIVE SUMMARY

The Energy Commission in fulfilment of its mandate under the Energy Commission Act (Act 541, 1997) presents supply and demand forecasts for electricity, petroleum and woodfuel for the year 2022. Factors that could influence the demand and supply are also discussed.

Electricity Sub-sector

Electricity Demand

Ghana's system peak demand has been increasing at an annual growth rate of 9.2% since 2016. The system peak demand in 2021 was 3,246 MW, which was 5.0% more than 2020 system peak demand and 1.8% decrease from projected for the year. Peak load excluding export (domestic load) was 2,893 MW; an increase of 9.6% over 2020. The total electricity consumed including losses was 21,466 GWh as against the projected of 21,266 GWh. A total of 19,717 GWh was consumed during the same period in 2020.

For 2022, system peak demand is projected to be 3,545 MW. This represents an increase of 9.2% over the 2021 peak demand. The projected energy consumption including transmission system losses for 2022 is projected to be 23,579 GWh, an increase of 9.8% over 2021 consumption. The estimated transmission losses represent 4.5% of total projected electricity supply.

Electricity Supply

Installed generation capacity excluding embedded capacity as at the end of 2021 was 5,138 MW with a total dependable capacity of 4,710 MW. The installed capacity increases to 5,449.1 MW (with a dependable capacity of 4,975.2 MW) if embedded capacity at the sub-transmission (distribution grid) level are added, notably the renewables (solar and biogas), Genser and Trojan thermal plants.

Total electricity generation in the country including embedded generation was 22,094 GWh, an increase of 9.2% over 2020 generation. Without the embedded generation, the country's total generation in 2021 was 21,370 GWh, an increase of 8.4% over 2020.

For 2022, power generation capacity of 5,449.1 MW with a dependable capacity of 4,975.2 MW will be available to generate electricity to meet demand. The bulk (70.0%) of the dependable capacity will come from thermal sources. However, considering planned units' maintenance and fuel supply situation, it is anticipated that up to 4,044 MW of capacity will be made available to meet the expected system peak demand of 3,545 MW. The monthly demand and supply situation for 2022 gives monthly positive generation reserve margins ranging between 9% (317 MW) and 20% (663 MW). However, with gas supply outages anticipated due to maintenance works, generation capacity outage could outstrip 317 MW. Thus, outage beyond 317 MW will pose supply challenges if provision for alternative fuel supply is not made.

Hydropower and thermal plants are projected to generate 7,394 GWh (31.4%) and 16,000 GWh (67.9%) of total electricity supply in 2021. The remaining supply of 184 GWh, representing 0.8%, is expected to be met by other renewables, including solar PV and biogas operating at the sub-transmission level. No power import is anticipated in 2022. However, inadvertent energy exchanges on tie-lines could result from transient flows. Emergency imports may be necessitated as a result of short-term capacity shortages caused by faults or fuel supply contingencies.

Fuel for Power Generation

Total gas supplied in 2021 for electricity production was 95,632 MMscf, 5.4% short of projected. A total of 359,499 barrels and 22,127 barrels of LCO and diesel respectively was used for electricity generation. HFO used for the operation of AKSA plant, was above the projected 121,849 barrels reaching 496,332 barrels in 2021.

Fuel for thermal power plants in 2022 will be mainly natural gas. The total natural gas consumption for 2022 is projected to be about 139.2 TBtu. The expected gas flow from import source (N-gas) would average 60 MMscf/day throughout the year, whilst an average of 325 MMscf/day is expected from domestic gas fields during the year. An estimated 548,657 barrels of HFO will be required by AKSA plant in 2022.

For 2022, delivery price of gas will be a weighted average price of $6.08/mmBTU. Total cost of fuel is estimated to be $872.83 million in 2022. About $834.43 million will be required to procure natural gas and the remainder for the procurement of HFO.

Transmission

Analysis of the transmission network indicate that lowest losses are registered on the NITS in the Balanced Generation scenario. Thus, relocation of the 250 MW Ameri Power Plant from Takoradi to Kumasi to create another generation enclave aside the East and West enclaves, will reduce transmission system losses significantly, improve voltages and aid export.

The following are transmissions challenges expected in 2022:

- Loss of 330 kV Takoradi Thermal – Anwomaso, 330 kV Anwomaso – Kintampo and 330 kV Pokuase – Volta Lines cause severe system disturbances.
- Upgrade of the 161 kV Achimota – Mallam and Achimota – Accra Central lines without significant load transfer from Kasoa, Mallam and Accra Central causes system collapse.
- With Maximum Generation from the west, the western corridor lines become heavily loaded especially the 170 MVA Tarkwa – New Tarkwa and Tarkwa – Prestea lines.

GRIDCo is executing a number of projects aimed at improving the reliability, transfer capacity, reduce losses and improve voltages. Key among them are:

- 161 kV, Achimota - Accra line reconstruction
- 161kV Achimota – Mallam line reconstruction

Petroleum Sub-sector

Crude Oil

Crude oil production in 2021 was 55.05 million barrels from the three commercial fields - Jubilee, TEN and Sankofa-Gye Nyame. This was lower than 66.93 million barrels produced in 2020. Accordingly, average daily production of crude oil for the year was lower, at 150,841 barrels, a decline of 17.5% from 2020 average daily production.

Jubilee field's crude production in 2021 decreased to 27.34 million barrels from 30.42 million barrels in 2020. Corresponding average daily production equally dropped from an average of 83,162 barrels in 2020 to 74,858 barrels in 2021. TEN field's crude production dropped from 17.8 million barrels in 2020 to 11.98 million barrels in 2021. The average daily production at TEN was 32,844 barrels, lower than the 48,655 barrels produced in 2020. Finally, Sankofa-Gye Nyame field's[1] crude production in 2021 stood at 15.74 million barrels, a 15.8% decrease from 18.70 million barrels in 2020. Average daily production at Sankofa was 43,138 barrels in 2021, a decline from 51,102 barrels in 2020.

Total crude oil production in Ghana has decreased since 2020 when the global health pandemic started and is expected that 2022 will witness yet another decrease**.** The decrease is due to anticipated reduction in production from TEN and Sankofa fields. For 2022, total crude oil production from the three fields - Jubilee, TEN and Sankofa is expected to decrease to 53.40 million barrels, a 3.0% decline from 2021 production. Average daily production from the three fields combined is expected to be lower in 2022, averaging 146,258 barrels per day.

The Jubilee field is expected to increase its production from 27.34 million barrels in 2021 to 29.63 million barrels in 2022 at an average daily production of 81,158 barrels per day. Meanwhile, TEN and Sankofa fields are each expected to reduce their production in 2022 to 10.69 million barrels and 13.07 million barrels respectively. On a daily basis, the TEN field is expected to produce 29,300 barrels, while Sankofa is expected to produce 35,800 barrels per day in 2022.

The average Brent crude oil price in 2021 was US$ 71 per barrel, higher by 68.9% from 2020 average price and 50.0% higher than projected for the year. The price of US West Texas Intermediate (WTI) crude averaged US$73 per barrel in 2021 which is about 74.0% higher than 2020 average price. In 2021, the average achieved price by the Ghana Group (representing the interest of the Government of Ghana) for ten liftings on all three oil producing fields was US$69.18 per barrel. The achieved unit price was slightly lower than the international Brent average price of US$69.84 per barrel for the same lifting dates in 2021 for the three fields. Jubilee field's crude oil was sold on average at $69.75 per barrel. That of the TEN and the Sankofa-Gye Nyame fields in 2021 were sold at an average price of $69.11 and $68.79 per barrel.

[1] Also called OCTP (Offshore Cape Three Point) field

The US Energy Information Administration (US EIA) expects oil prices to assume a decreasing trend in 2022. However, due to heightened market concerns about the possibility of oil supply disruptions, notably related to tensions between Russia and Ukraine, prices are expected to rise. For 2022, the US EIA expects the price of Brent crude oil to average US$75 per barrel. It is expected that the market price of crude oil from Ghana's fields – Jubilee, TEN and Sankofa will hover around the US$75 per barrel benchmark price in 2022.

Natural Gas

Natural gas produced in 2021 from the three commercial fields – Jubilee, TEN and Sankofa was 256,262 MMscf. The gas produced is an increase by 7.7% from 2020 production and is the highest recorded since 2014. Average daily production of raw gas from the three fields combined was 702 MMscf/day, an increase of 7.9% from 2020 figure.

Gas produced from the Jubilee field increase by 9.4% in 2021 from 64,462 MMscf in 2020. Daily production of raw gas from the Jubilee field in 2021 was 193 MMscf/day, up from 176 MMscf/day in 2020. TEN field also witnessed a 9.3% increase in production in 2021 from 58,674 MMscf in 2020, with average daily production of 177 MMscf/day. Total raw gas produced from associated and non-associated sources at the Sankofa field was 121,605 MMscf in 2021, up from 114,826 MMscf produced in 2020. The corresponding daily average production from Sankofa field increased to 332 MMscf/day in 2021 from 315 MMscf/day in 2020. Non-associated gas produced from the Sankofa field constituted 57.5% of the total raw gas produced at the field.

Raw gas exported from Jubilee and TEN in 2021 to Atuabo Gas Processing Plant (AGPP) was 33,759 MMscf. Jubilee field exported 30,998 MMscf, up from 26,415 MMscf exported in 2020, while TEN exported 2,761 MMscf, down from 5,545 MMscf exported in 2020. Sankofa field exported 65,141 MMscf, representing 93.1% of the non-associated gas produced to the Onshore Receiving Facility (ORF) in 2021. The gas exported from the field represent a 15.2% increase over the volume exported in 2020. A total of 98,901 MMscf of associated and non-associated gas was exported in 2021 from the three fields, an increase of 11.7% over the 2020 volume of 88,531 MMscf. Average daily export of gas from the three fields combined was 271 MMscf/day, an increase of 12.0% over 2020 average daily export but a decrease of 11.1% from what was projected for the year.

Lean gas supplied for power and non-power use in 2021 was 115,503 MMscf, representing an increase of 7.8% over quantity supplied in 2020. The total lean gas in 2021 is made up of 33,138 MMscf supplied by AGPP and 64,783 MMscf of non-associated gas received at the ENI ORF. The remaining 17,583 MMscf was imported from Nigeria via WAGPCo.

Given the availability of domestic gas, priority will be given to usage of gas from the Ghana's fields. In 2022, raw gas export from Jubilee/TEN (associated) to the AGPP is expected to increase by 29.1% to 43,571 MMscf. Sankofa (non-associated gas) export to the ENI ORF will go up slightly by 1.3% to 66,000 MMscf in 2022. In all a total of 109,571 MMscf of associated and non-associated gas will be exported from the three fields in 2022, an increase of 10.8% over the 2021 export. Sankofa is expected to maintain its capacity to supply up to 210 MMscf/day, while Jubilee and TEN together are expected to supply 125 MMscf/day in 2022. The expected import from Nigeria will be 60 MMscf/day.

Petroleum Products

Total petroleum products produced in the country was 378 kilotonnes, down from 580 kilotonnes in 2020. The reduction may be due to challenges of securing the necessary financing to procure crude oil for the state-owned Tema Oil Refinery (TOR). In 2021, TOR operated for only four months (from January to April). Out of the total products produced, gasoil produced was 70 kilotonnes, a decrease of 53.2% from production in 2020. Also, gasoline production witnessed a drastic decline to 43 kilotonnes in 2021, representing 34.6% decrease from 2020 production. About 95 kilotonnes (1.8% produced by TOR and 98.2% produced by AGPP) of LPG was produced in 2021 as against 85 kilotonnes produced in 2020. ATK witnessed a reduction in production, from 28 kilotonnes in 2020 to 1 kilotonnes in 2021. Kerosene production was 24 kilotonnes in 2021 compared to 35 kilotonnes in 2020, while RFO produced was 145 kilotonnes in 2021, down from 216 kilotonnes produced in 2020.

Total petroleum products imported into the country increased from 3,966 kilotonnes in 2020 to 4,126 kilotonnes in 2021, representing an increase of 4.0%. Gasoil recorded the highest import of 1,820 kilotonnes in 2020, which is a 6.0% decrease from its import in 2020. Gasoline is next with an import of 1,769 kilotonnes in 2021, an 8.9% increase over its 2020 import. LPG import was 263 kilotonnes in 2021, a slight increase of 0.4% of import in 2020. ATK witnessed a huge increase in import, from 80 kilotonnes in 2020 to 188 kilotonnes in 2021.

The increase is largely due to the easing of restriction on air travel that was imposed as a measure to deal with the COVID-19 pandemic. HFO, mainly used for power generation, witnessed an import of 85 kilotonnes in 2021, up from 63 kilotonnes imported in 2020.

Total petroleum products consumed in 2021, increase by about 10.2%, from 4,133.4 kilotonnes in 2020 to 4,547.2 kilotonnes. The consumption increased by some 10.2% from 2020 and 1.9% of projected consumption for the year. Gasoil consumption was highest, constituting 2,097.9 kilotonnes in 2021, an increase of 6.8% over 2020 consumption of 1,964.1 kilotonnes and 5.4% of projected consumption of 1,991.3 kilotonnes. This was followed by gasoline consumption of 1,711.6 kilotonnes, up from 1,526.9 kilotonnes in 2020. LPG, ATK, premix, RFO and MGO consumptions also increased by 3.9%, 57.0%, 12.5%, 43.4% and 56.0% respectively from their 2020 consumptions. However, kerosene consumption witnessed a reduction by 7.5%, from 5.0 kilotonnes in the 2020 to 4.6 kilotonnes in 2021. MGO consumption also witnessed huge reduction by about 45.8%, from 51.3 kilotonnes to 27.8 kilotonnes.

For 2022, total petroleum products required is projected to be 4,931.5 kilotonnes, an increase of 8.0% over 2021 consumption. Out of this, gasoil consumption is forecast to be about 2,335.3 kilotonnes, increasing by 11.3% over the 2021 consumption, while gasoline will be 1,811.0 kilotonnes in 2022, up by 5.8% from the 2020 consumption. LPG consumption is expected to grow by 1.4% from 345 kilotonnes in 2021 to about 350.2 kilotonnes in 2022. ATK and kerosene consumption for 2022 are expected to be 240.0 kilotonnes and 5.0 kilotonnes, respectively. Premix and RFO is expected to increase to 79.7 kilotonnes and 77.31 kilotonnes respectively whiles MGO is expected to decrease to 33.07 kilotonnes. Supply to meet projected petroleum products consumption in 2022 will be largely import, since TOR is not likely to operate at full capacity largely due to financial challenges.

Woodfuel Sub-sector

In 2021, wood extracted for use directly as fuel (firewood) was estimated to be 1,937 ktoe. The wood extracted for the production of charcoal on the other hand was estimated to be 2,225 ktoe in 2021. The production of other biomass (mainly crop residue) was also estimated to be 30 ktoe in 2021.

The estimated wood to be extracted for use as firewood in 2022 would be 1,906 ktoe, a decrease of 1.6% from the estimated extraction in 2021. Also, wood to be extracted for charcoal production would be 2,290 ktoe, increasing by 3.0% over estimated extraction in 2021. The production of other biomass (mainly crop residue) would remain around 30 ktoe in 2022.

Biomass consumption in 2021 is estimated to be 3,162 ktoe. The residential sector has been the largest consumer of biomass in the country. In 2021, households consumed an estimated 2,655 ktoe of total biomass consumed, while the industrial and services sectors consumed 387 ktoe and 120 ktoe respectively. Over the last decade, biomass consumption has been estimated to be increasing. This trend could be reversed if government intensifies measures that will increase LPG penetration especially in rural areas.

In 2022, household consumption of biomass is expected to rise to an estimated value of 2,695 ktoe, while the services and industrial sectors are each expected to consume 123 ktoe and 414 ktoe respectively.

The national mean price for maxi bag of charcoal in 2021 was GH¢62.00, while mean price for mini bag of charcoal was GH¢44.00. The highest price of maxi and mini bags was recorded in Accra and Kumasi, respectively. The least price was recorded in Damongo for both maxi and mini bags. On average, the price per kilogram of a maxi and mini bag was GH¢1.27 and GH¢1.17, respectively. For 2022 charcoal price is expected to grow at the same rate as the national inflation rate for the country.

The issue with the slow pace in the use of LPG by households as the main cooking fuel is the high price. A comparison of charcoal and LPG price per mmBtu revealed that it costs more to get a unit of useful energy from LPG than from charcoal, regardless of stove efficiency.

PREFACE

ENERGY COMMISSION is mandated to prepare, review and update periodically indicative national plans to ensure that reasonable demands for energy are met in a sustainable manner. The Commission is also mandated to secure and maintain a comprehensive database for national decision making for the efficient development and utilisation of energy resources available to the nation. The Commission's jurisdiction includes promoting and ensuring uniform rules of practice for the production, transmission, wholesale supply, distribution and sale of electricity and natural gas.

In fulfilment of its mandates, the Commission has been preparing annual energy demand and supply outlook to provide guidelines to energy sector operators and potential investors as well as the wider business community wishing to operate in the country. The 2021 Annual Energy Outlook is to give government, industry and business, indications of the levels/quantities of electricity, liquid and gaseous fuels that would be required to be provided by the energy producers for this year.

The Energy Outlook for Ghana outlines projections for energy demand and supply for the year 2021. It provides an overview of the actual performance of the energy sector, specifically the electricity and petroleum industry performance as well as the woodfuel subsector of the preceding year (2020) comparing actuals to projections and providing highlights on the impact of the novel coronavirus disease (COVID-19) on the energy sector. It continues to forecast 2021 energy demand and supply.

In this report, 'Demand' is used when referring to gross fuel or energy required by a demand sector, e.g., residential, commercial, or industry. 'Supply Requirement' is supply or generation/production plus transmission/transport losses.

Your comments and suggestions are most welcome.

Ing. Oscar Amonoo Neizer

Executive Secretary

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ABBREVIATION

AGPP	Atuabo Gas Processing Plant
ATK	Aviation Turbo Kerosene
BGS	Bui Generation Station
BPA	Bui Power Authority
BSPs	Bulk Supply Points
CEB	Communauté Electrique du Bénin
CIE	Compagnie Ivoirienne d'Électricité
COVID-19	Novel Coronavirus Disease
ECG	Electricity Company of Ghana
EIA	US Energy Information Administration
EMOP	Electricity Market Oversight Panel
ESD	Emergency Shutdown
FPSO	Floating Production Storage and Offloading
GDP	Gross Domestic Product
GNGC	Ghana National Gas Company
GNPC	Ghana National Petroleum Corporation
GRIDCo	Ghana Grid Company
GWh	Gigawatt hour
HFO	Heavy Fuel Oil
IPPs	Independent Power Producers
kg	Kilogram
km	Kilometer
Ktoe	Thousand Tonnes of Oil Equivalent
KTPP	Kpone Thermal Power Plant
kv	Kilovolt
kW	Kilowatt
LCO	Light Crude Oil
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MAF	Million Acre Feet
MGO	Marine Gas Oil
MMBtu	Million British Thermal unit
MMscf	Million Standard Cubic Feet
MVA	Megavolt Amperes
MVAr	Megavolt Ampere of Reaction Power
MW	Megawatt
MWp	Megawatts-peak

NEDCo	Northern Electricity Distribution Company
NG	Natural Gas
N-Gas	Nigeria Gas
NITS	National Interconnected Transmission System
NMS	Network Manager System
NPA	National Petroleum Authority
OCTP	Offshore Cape Three Point
OMCs	Oil Market Companies
ORF	On-shore Receiving Facility
PC	Petroleum Commission
PIAC	Public Interest and Accountability Committee
PPTC	Power Planning Technical Committee
PURC	Public Utilities Regulatory Commission
PV	Photovoltaics
RFO	Residual Fuel Oil
SAPP	Sunon-Asogli Power Plant
SAPP	Sunon Asogli Power Plant
SCADA	Supervisory Control and Data Acquisition
TAPCO	Takoradi Power Company
Tbtu	Trillion British Thermal Unit
TDS	Takoradi Distribution Station
TEN	Tweneboa, Enyenra, Ntomme
TICO	Takoradi International Company
TOR	Tema Oil Refinery
TT1PP	Tema Thermal Power Plant 1
TT2PP	Tema Thermal Power Plant 2
TTIP	Tema-Takoradi Interconnection Pipeline
TUF	Transformer Utilization Factor
US WTI	US West Texas Intermediate
VALCO	Volta Aluminium Company
VRA	Volta River Authority
WAGP	West Africa Gas Pipeline
WAGPCo	West Africa Gas Pipeline Company
WAPCO	West Africa Pipeline Company
WAPP	West African Power Pool

Chapter 1: Introduction

1.1 Introduction

The 2022 Energy Outlook for Ghana provides indications of quantities of energy demand and supply for the year in order to provide guidelines to potential investors and the wider business community wishing to operate in the country. In doing so, the actual performance of the energy sector, specifically the electricity, petroleum and woodfuel subsector of the preceding year (2021) is assessed. In assessing the performance of the energy sector in 2021, actual data was collected and compared with projections and other benchmarks. It continues to provide an outlook for energy demand and supply in 2022 and discusses challenges that the sector is expected to face.

For Electricity Outlook, the report relied on projections in the 2022 Electricity Supply Plan for Ghana, which was produced by the Power Planning Technical Committee (PPTC). For Petroleum Outlook, planned crude oil production and natural gas uptake were obtained from Ghana National Petroleum Corporation (GNPC). Time series analysis using petroleum products consumption data from 1999 to 2021 was used to forecast petroleum product consumption for 2022[2]. The Outlook for Woodfuel production and consumption were extrapolated from field survey data. Also, the price of woodfuel (specifically charcoal) from the field survey is presented.

The 2022 Energy Outlook chapters are:

- Chapter 1 is the introductory chapter that gives some background information, methodology and the report outline.
- Chapter 2 is dedicated to a review of the electricity's system performance in 2021, given a comparative analysis of the projected and actual electricity demand, electricity supply and fuel supply in 2021. It also highlights major events which occurred during the year and their impact on the power system.
- Chapter 3 presents the outlook for electricity in 2022, giving estimates for electricity demand (both peak and energy demand) and fuel requirements to fire thermal power

[2] National Petroleum Authority: National Consumption from 1999-2021 http://www.npa.gov.gh/downloads/general

plants. The transmission outlook is also presented. The anticipated challenges to electricity supply for the year are also discussed in this chapter.

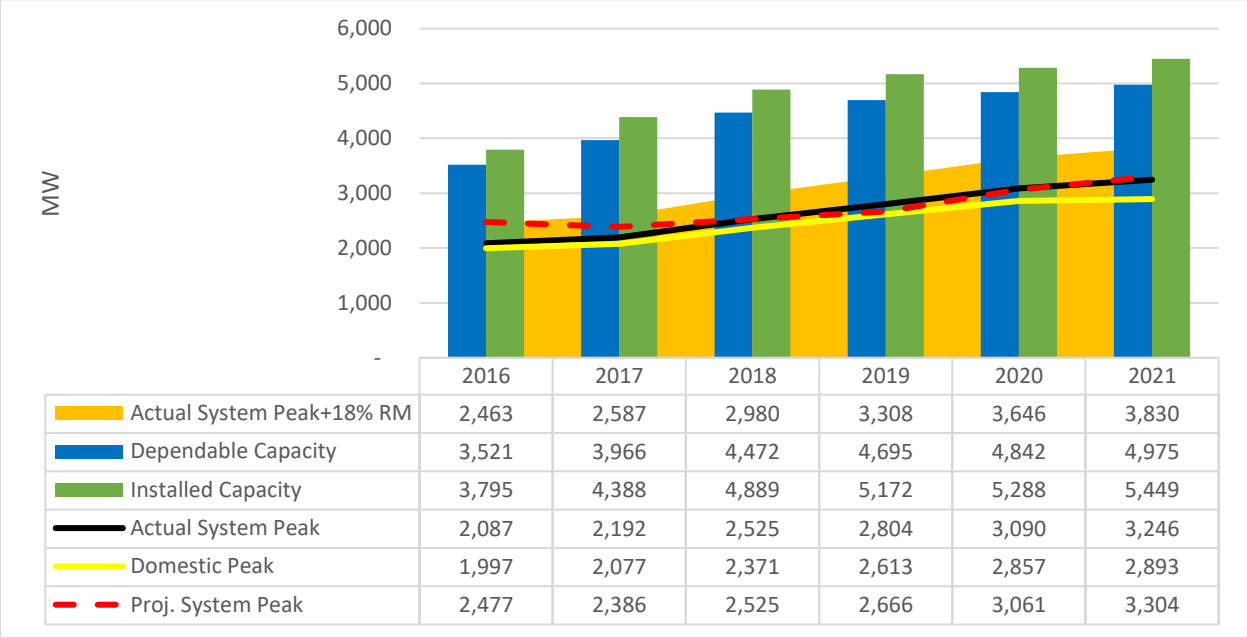
- Chapter 4 presents a review of the petroleum industry performance in 2021, focusing on petroleum production, import, export, consumption and prices.
- Chapter 5 presents the outlook for petroleum, focusing on crude oil production and prices, natural gas export from production fields, natural gas import and petroleum products consumption.
- Chapter 6 provides some updates on the woodfuel subsector by giving estimates for woodfuel production and consumption.
- Chapter 7 provides the conclusion and outlines some recommendations for policymakers' consideration.

Chapter Two: Electricity System Performance 2021

2.1 Electricity Demand in 2021

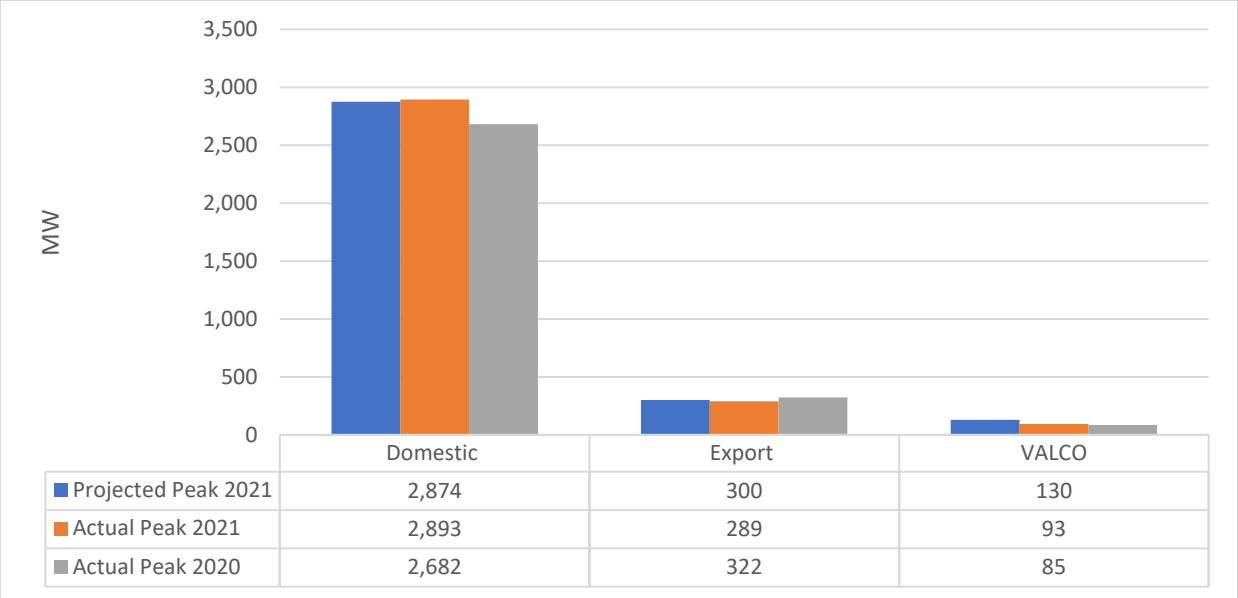
2.1.1 Peak Demand in 2021

The system peak load (maximum coincident load) recorded in 2021 was 3,246 MW, a 1.8% decrease from 3,304 MW projected in 2021. The peak load in 2021 represents an increase of 5.0% over 2020 system peak demand. System peak load has witnessed an increasing trend (7.6% annual growth rate) since 2016, as depicted in Figure 1.



	2016	2017	2018	2019	2020	2021
Actual System Peak+18% RM	2,463	2,587	2,980	3,308	3,646	3,830
Dependable Capacity	3,521	3,966	4,472	4,695	4,842	4,975
Installed Capacity	3,795	4,388	4,889	5,172	5,288	5,449
Actual System Peak	2,087	2,192	2,525	2,804	3,090	3,246
Domestic Peak	1,997	2,077	2,371	2,613	2,857	2,893
Proj. System Peak	2,477	2,386	2,525	2,666	3,061	3,304

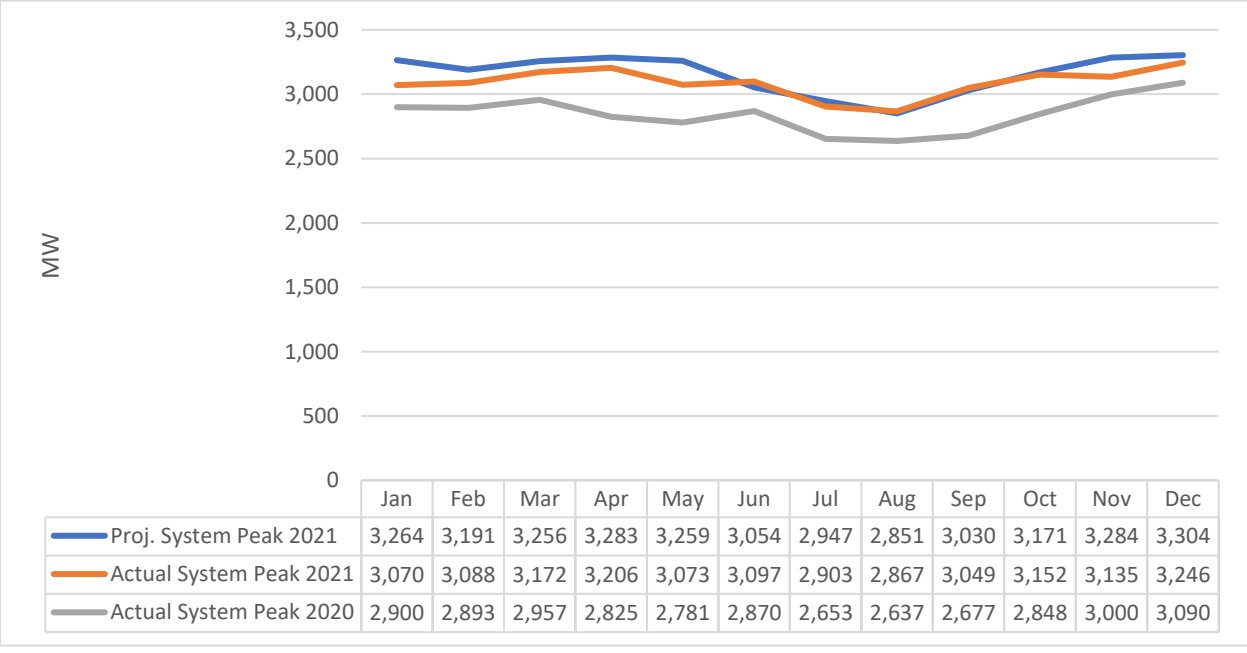
Figure 1: Trend in system peak demand from 2016-2021



	Domestic	Export	VALCO
Projected Peak 2021	2,874	300	130
Actual Peak 2021	2,893	289	93
Actual Peak 2020	2,682	322	85

Figure 2: System peak demand for 2021

Domestic load at peak was 2,893 MW, representing a 9.6% increase over 2020 and up by 0.6% of the 2021 projection. The export market and VALCO recorded 289 MW (down by 3.7% of the projected 300 MW) and 93 MW (28.5% decrease from the projected 130 MW), respectively (Figure 2). Figure 3 compares monthly actual and projected system peak load for 2021.



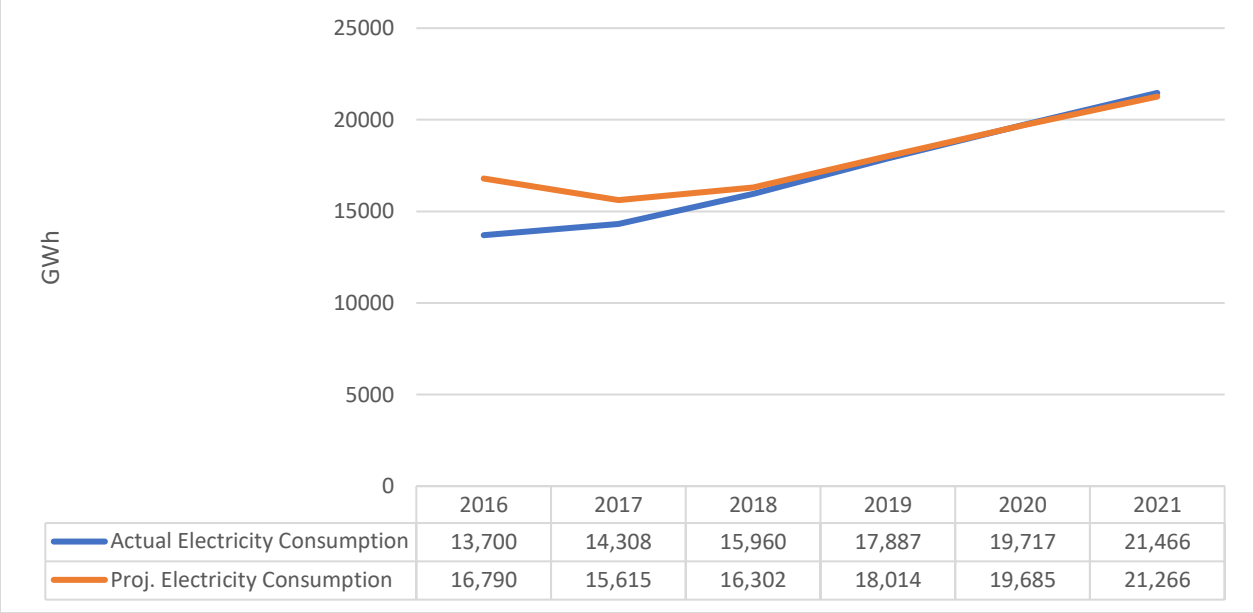
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proj. System Peak 2021	3,264	3,191	3,256	3,283	3,259	3,054	2,947	2,851	3,030	3,171	3,284	3,304
Actual System Peak 2021	3,070	3,088	3,172	3,206	3,073	3,097	2,903	2,867	3,049	3,152	3,135	3,246
Actual System Peak 2020	2,900	2,893	2,957	2,825	2,781	2,870	2,653	2,637	2,677	2,848	3,000	3,090

Figure 3: Monthly actual and projected system peak demand for 2021

The power system started with a system peak demand of 3,070 MW in January, which rose to 3,206 MW in April. Between June and October, the system peak was similar to the projection, then saw a modest rise, attaining a maximum system peak of 3,246 MW on December 8, 2021.

2.1.2 Electricity Consumption in 2021

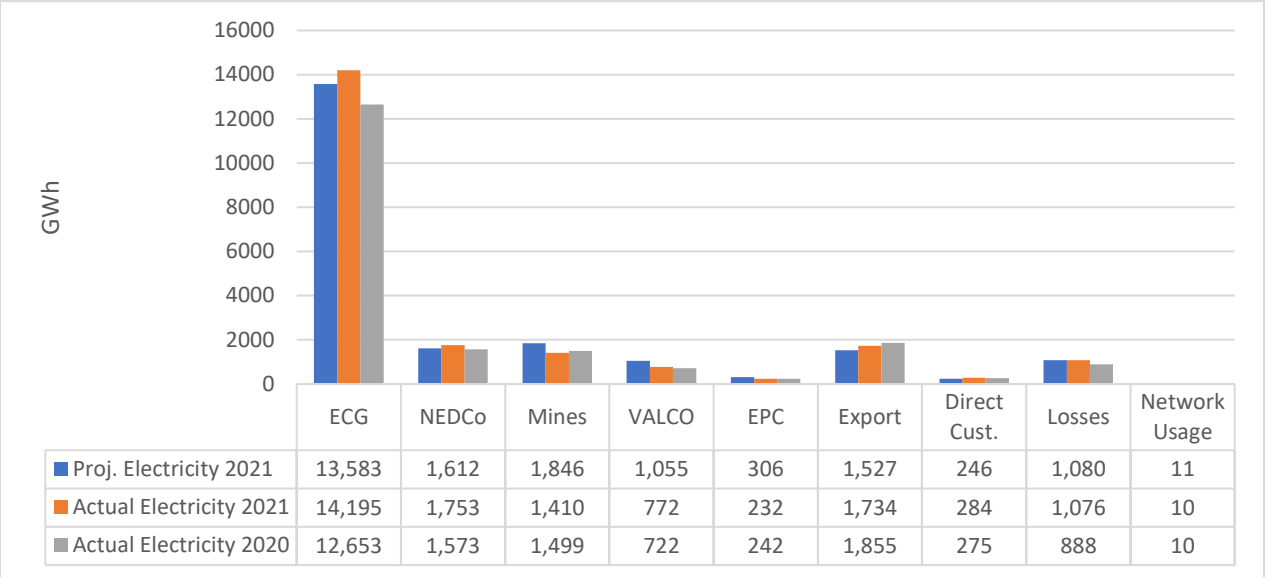
Electricity consumption continues to witness growth, as depicted in Figure 4. Total energy consumed increased from 13,700 GWh in 2016 to 21,466 GWh in 2021, representing an average annual growth of 7.8% (Figure 4).



	2016	2017	2018	2019	2020	2021
Actual Electricity Consumption	13,700	14,308	15,960	17,887	19,717	21,466
Proj. Electricity Consumption	16,790	15,615	16,302	18,014	19,685	21,266

Figure 4: Trend in electricity consumption from 2016-2021

Total electricity consumed in 2021, including losses, was 21,466 GWh, an increase of 8.9% over that of 2020 (19,717 GWh). The actual electricity consumed for 2021 was higher (0.9%) than the projected (21,266 GWh). Figure 5 presents the consumption by the various customer classes.



	ECG	NEDCo	Mines	VALCO	EPC	Export	Direct Cust.	Losses	Network Usage
Proj. Electricity 2021	13,583	1,612	1,846	1,055	306	1,527	246	1,080	11
Actual Electricity 2021	14,195	1,753	1,410	772	232	1,734	284	1,076	10
Actual Electricity 2020	12,653	1,573	1,499	722	242	1,855	275	888	10

Figure 5: Electricity consumption by customer classes for 2021

Electricity consumption by ECG in 2021 witnessed an increase of 12.2% over the 2020 level and a slight increase (4.5%) over the projected consumption for 2021. NEDCo also saw an increase of 11.4% in 2021 from 1,573 GWh consumed in 2020. However, Mines load has reduced by 6.0%, from 1,499 GWh in 2020. VALCO consumption increased from 722 GWh in 2020 to 772 GWh in 2021, representing a 7.0% increase. Consumption by Direct customers also witnessed an increase of about 3.4% in 2020. Export consumption witnessed a decline of 6.5% in 2021, which is primarily due to reduced supply to the export market.

2.2 Electricity Supply in 2021

2.2.1 Electricity Generation Capacity

Ghana's electricity generation sources are hydro, thermal (fired using natural gas, light crude oil, heavy fuel oil and diesel) and renewables (solar and biogas). Electricity generation capacity has increased over the last few years, as depicted in Figure 6. This is as a result of the coming onstream of new capacities from thermal and renewable sources year-on-year.

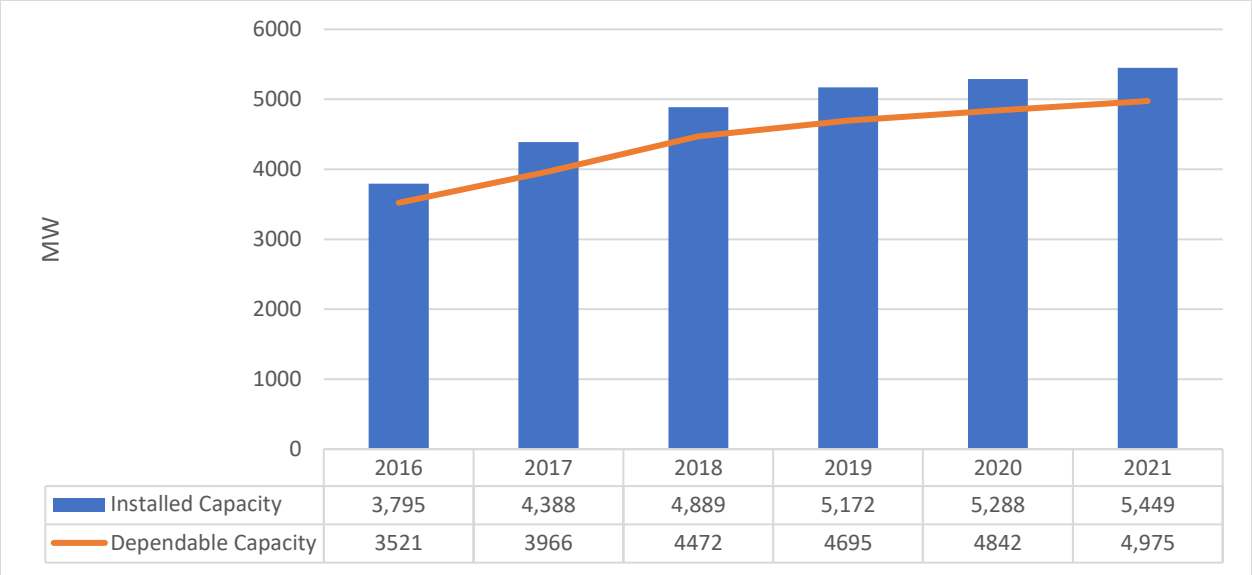


Figure 6: Installed and dependable capacity in the recent past

Installed electricity generation capacity increased from 3,795 MW in 2016 to 5,449 MW in 2021, representing an increase of 43.6%, with dependable capacity increasing from 3,521 MW in 2016 to 4,975 MW in 2021. Installed generation capacity excluding embedded generation units as of the end of 2021 was 5,138 MW, with a total dependable capacity of 4,710 MW. Figure 7 shows the shares of installed and dependable capacities by generating sources. The full complement of power plants in Ghana as of the end of December 2021 is shown in Table 1.

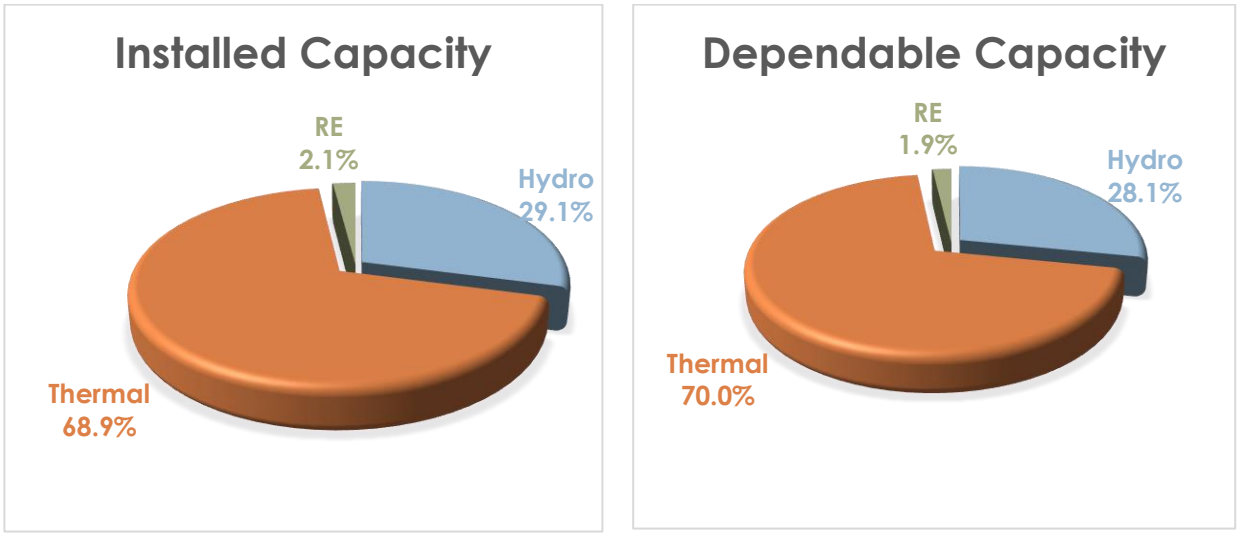


Figure 7: Shares of hydro, thermal and renewable capacity at the end of December 2021

Table 1: Installed and dependable capacity as of the end of December 2021

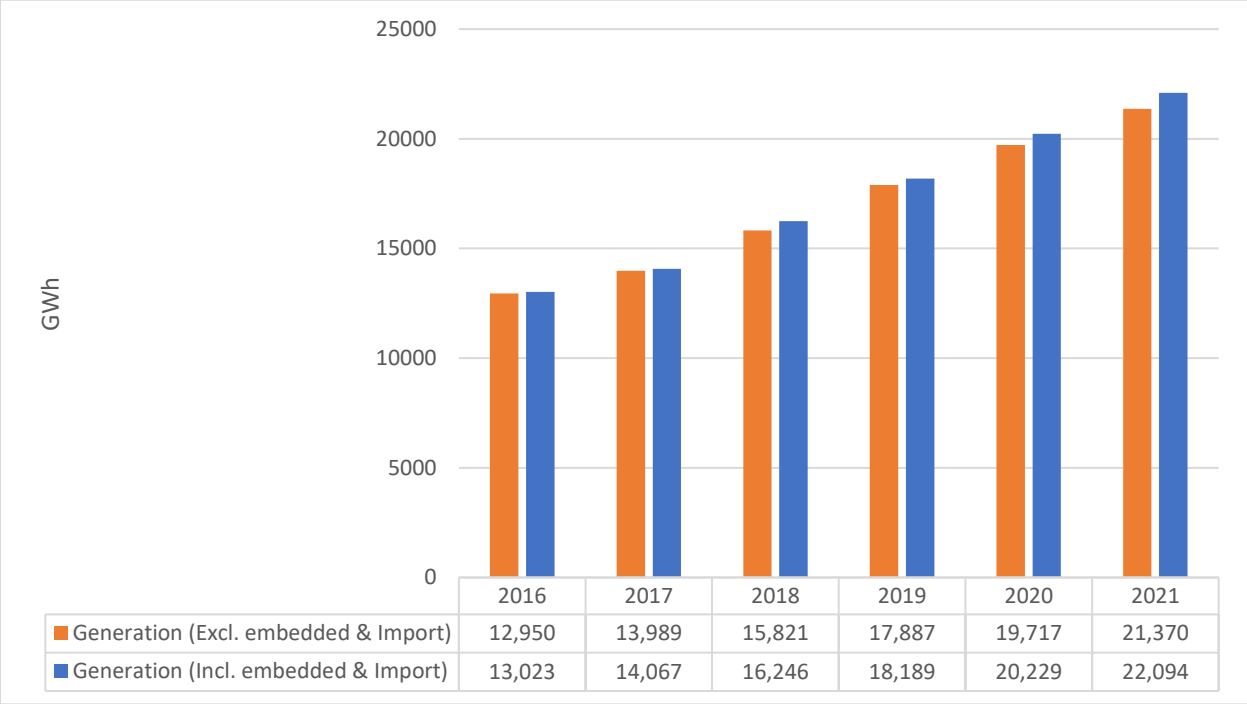
Power Plant	Fuel Type	Installed Capacity (Nameplate)	Dependable Capacity
Hydro Power Plants			
Akosombo	Hydro	1,020	900
Bui	Hydro	404	360
Kpong	Hydro	160	140
	Sub-total	***1,584***	***1,400***
Thermal Power Plants			
TAPCO	Oil/NG	330	300
TICO	Oil/NG	340	320
SAPP	NG	560	520
TT1PP	Oil/NG	110	100
TT2PP	Oil/NG	87	70
CENIT	Oil/NG	110	100
KTPP	Oil	220	200
AMERI	NG	250	230
Karpower	NG/HFO	470	450
AKSA	HFO	370	350
Cenpower	Oil/Diesel	360	340
Amandi	Oil/NG	203	190
Early Power*	NG/LPG	144	140
	Sub-total	**3,554**	**3,320**
Genser	NG/LPG	155	85
Trojan	Diesel/NG	44	39.6
Sub – total (incl. embedded generation)		***3,753***	***3,480.6***
Renewables *(excluding large hydro)*			
VRA Solar (Navrongo)	Solar	2.5	2
Meinergy Solar	Solar	20	16
BXC Solar	Solar	20	16
VRA Solar (Lawra)	Solar	6.5	4.5
VRA Solar (Kaleo)	Solar	13	10
Tsatsadu Hydro	Hydro	0.045	0.045
Bui Solar	Solar	50	46
Safisana Biogas	Biogas	0.1	0.1
	Sub – total	***112.145***	***94.645***
Total (incl embedded gen.)		**5,449.1**	**4,975.2**
Total (excl embedded gen.)		**5,138.0**	**4,710.0**

NB: * Being converted to run on natural gas

In 2021, the energy mix remained relatively stable, with hydro contributing 29.1% of the total installed capacity. Conventional thermal plants contributed 68.9% of the total installed capacity in 2021, while renewable sources accounted for 2.1% (Figure 7). The bulk of the dependable capacity is coming from thermal plants representing 70.0%.

2.2.2 Electricity Generation

Grid electricity generation continues to increase due to increasing electricity consumption. Figure 8 presents grid electricity generation over the last six years.



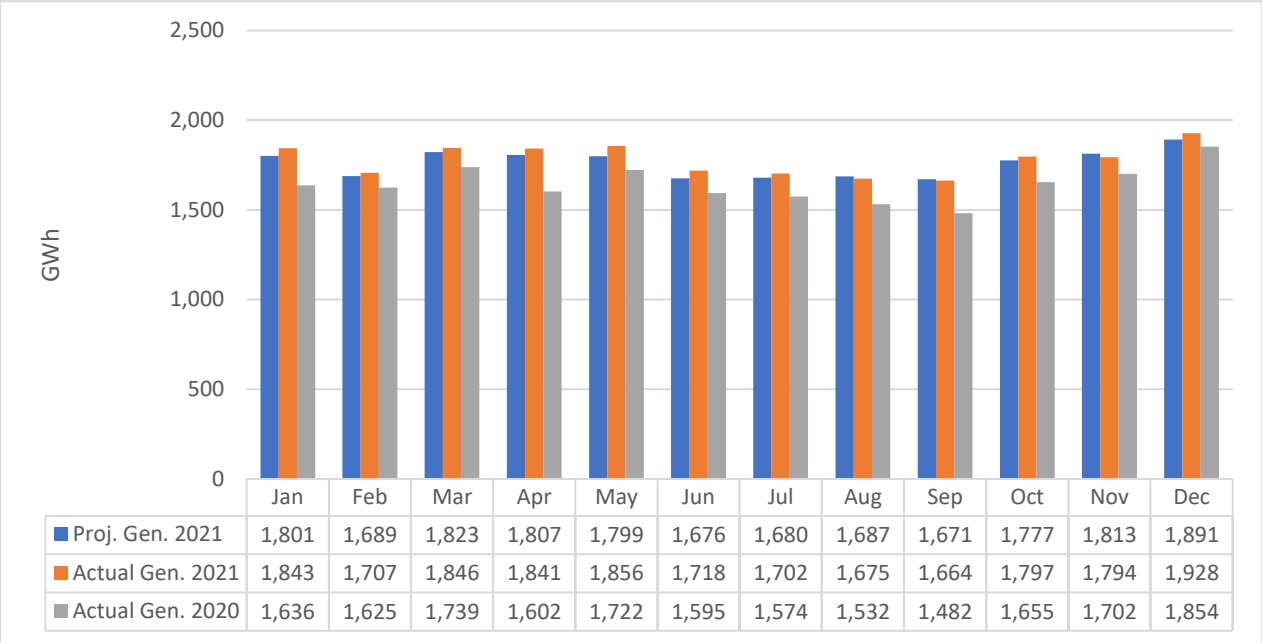
	2016	2017	2018	2019	2020	2021
Generation (Excl. embedded & Import)	12,950	13,989	15,821	17,887	19,717	21,370
Generation (Incl. embedded & Import)	13,023	14,067	16,246	18,189	20,229	22,094

Figure 8: Electricity generation (2016 – 2021)

Total electricity generation in the country, including embedded generation[3] and import in 2021, was 22,094 GWh[4], representing a 9.2% increase over what was generated in 2020. Total generation at the transmission level (excluding embedded generation and import) was 21,370 GWh, an increase of

[3] i.e. Genser thermal plant and the grid-tied solar plants delivering power at the sub-transmission level
[4] Excluding import is 22,051 GWh

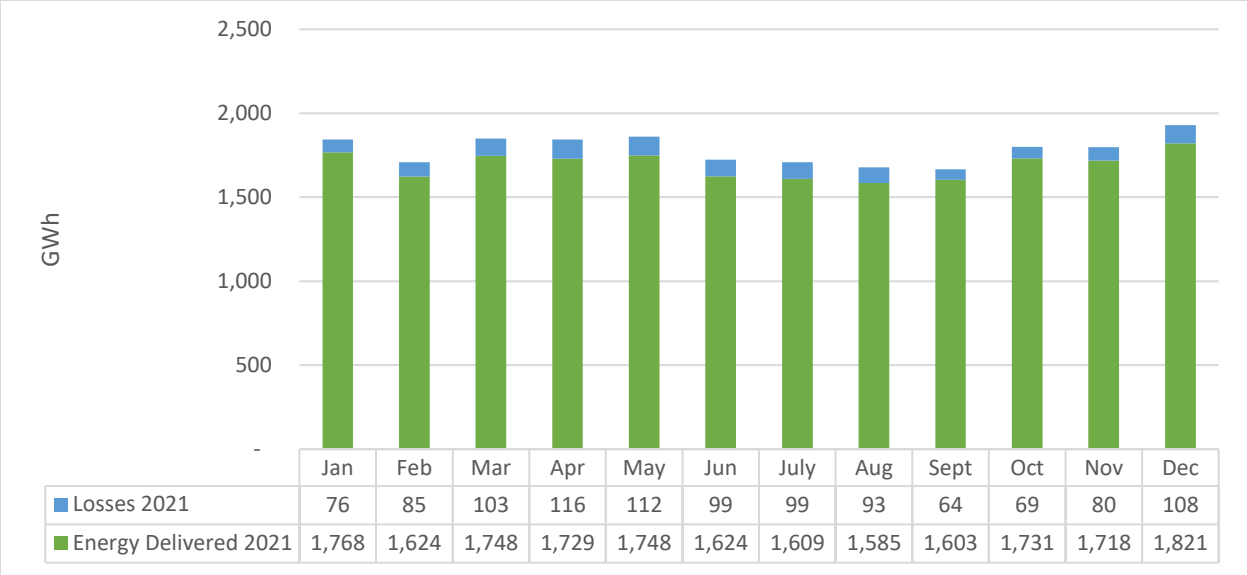
8.4% over the 2020 generation. Figure 9 presents monthly electricity generation at the transmission level in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proj. Gen. 2021	1,801	1,689	1,823	1,807	1,799	1,676	1,680	1,687	1,671	1,777	1,813	1,891
Actual Gen. 2021	1,843	1,707	1,846	1,841	1,856	1,718	1,702	1,675	1,664	1,797	1,794	1,928
Actual Gen. 2020	1,636	1,625	1,739	1,602	1,722	1,595	1,574	1,532	1,482	1,655	1,702	1,854

Figure 9: Monthly breakdown of electricity generation at the transmission level for 2021

Electricity made available for transmission through the National Interconnected Transmission System (NITS) during the year was 21,413 GWh consisting of 7,521 GWh (35.1%) from hydro sources, 13,849 GWh (64.7%) from thermal and 44 GWh (0.2%) from import. Total electricity generated in 2021 represents an 8.6% increase over what was generated in 2020 (Figure 10).



	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Losses 2021	76	85	103	116	112	99	99	93	64	69	80	108
Energy Delivered 2021	1,768	1,624	1,748	1,729	1,748	1,624	1,609	1,585	1,603	1,731	1,718	1,821

Figure 10: Monthly breakdown of energy transmitted and losses in 2021

Total electricity delivered to domestic and export customers was 20,308 GWh, representing a 7.9% increase over what was delivered in 2020 and 1.4% less than the 2021 projected requirement of 21,113 GWh. The electricity supplied[5] to the country for domestic consumption was 18,574 GWh, increasing by 9.4% over what was supplied in 2020.

Since 2018, transmission losses have continued to increase, surpassing the PURC benchmark of 4.1% (Figure 11). Losses grew considerably, rising from 888 GWh in 2020 to 1,105 GWh in 2021. The losses represent 5.2% of total electricity transmitted through the NITS and 0.4% less than the projected loss of 1,080 GWh for 2021. The rise in losses is attributed to congestion in the NITS due to delays in transmission lines upgrade and expansion projects. Also, the high losses resulted from a lack of generation in the northern parts of the NITS due to limited dispatch of Bui, which was attributed to poor headwater levels from the beginning of the year.

[5] Gross grid electricity plus imports, less wheeled, less exports, less transmission losses

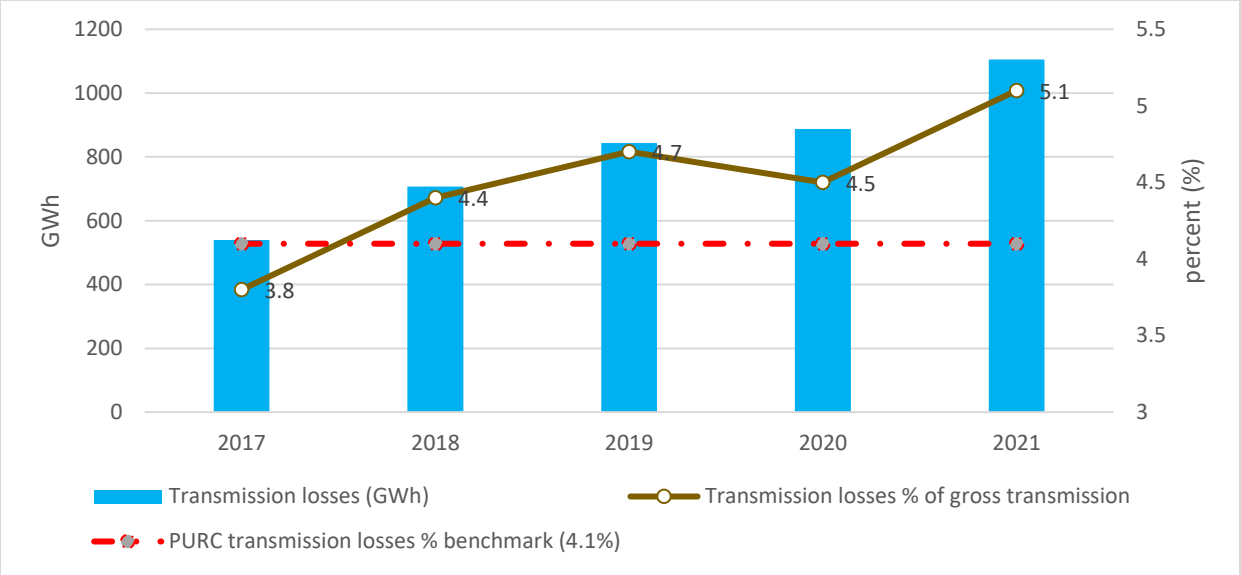


Figure 11: Trend in transmission losses in the recent past

2.2.3 Performance of Generation Sources in 2021

2.2.3.1 Hydro Generation Sources

The Volta Lake started the year 2021 at an elevation of 267.7 ft (81.6 m) and ended the year at an elevation of 269.2 ft (82.0 m). The Lake recorded a maximum of 271.3 ft (82.7 m), which is 31.3 ft above the minimum operating level of 240 ft during the 2021 inflow season and a rise of 11.8 ft above the minimum level of 259.6 ft recorded in the year. The total net inflow recorded in 2021 was 31.01 MAF, which implies that an above-average inflow of 30.01 MAF was obtained in 2021. Figure 12 shows the Akosombo reservoir trajectory for 2021 plotted against the trajectory for 2020.

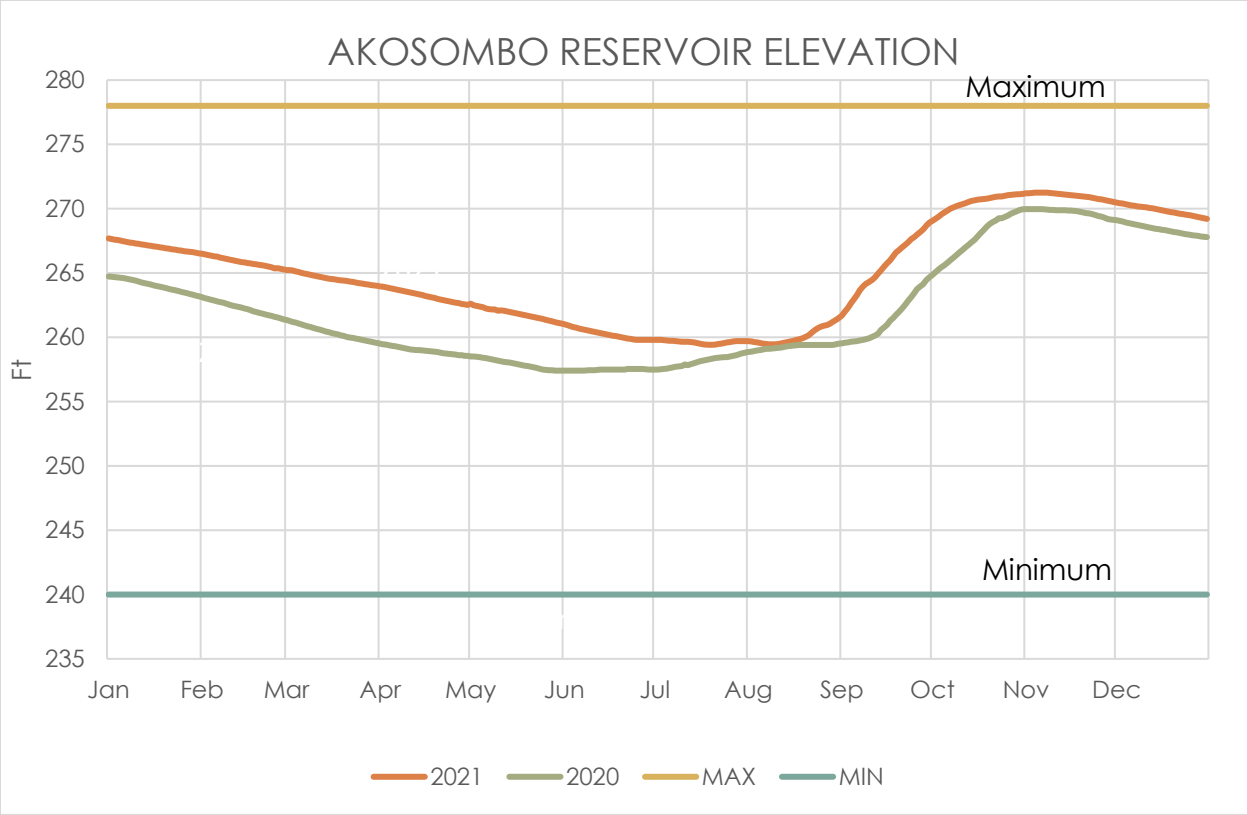


Figure 12: Akosombo Reservoir Elevation

The Bui Reservoir level at the beginning of 2021 was 172.16 masl. Based on the year start elevation and a plan to adopt a conservative approach towards the reservoir draw down, Bui was expected to operate two (2) units at peak during 2021. However, due to system exigencies, the plant operated off-peak in addition to the peak requirements resulting in the reservoir dropping to a minimum water level of 166.70 masl on June 25, 2021, at the end of the dry season. This was the lowest elevation of the reservoir since the commissioning of the Bui Generating Station (BGS). The minimum level reached was thus 2.7m lower than the projected minimum of 169.40 masl for the year.

The Bui Reservoir Elevation at the end of 2021 was 177.58 masl, which is 9.58m above the minimum operating level (168 masl). The maximum level attained during the inflow season was 180.90 masl on October 27, 2021. Figure 13 shows the Bui reservoir trajectory in 2020 and 2021.

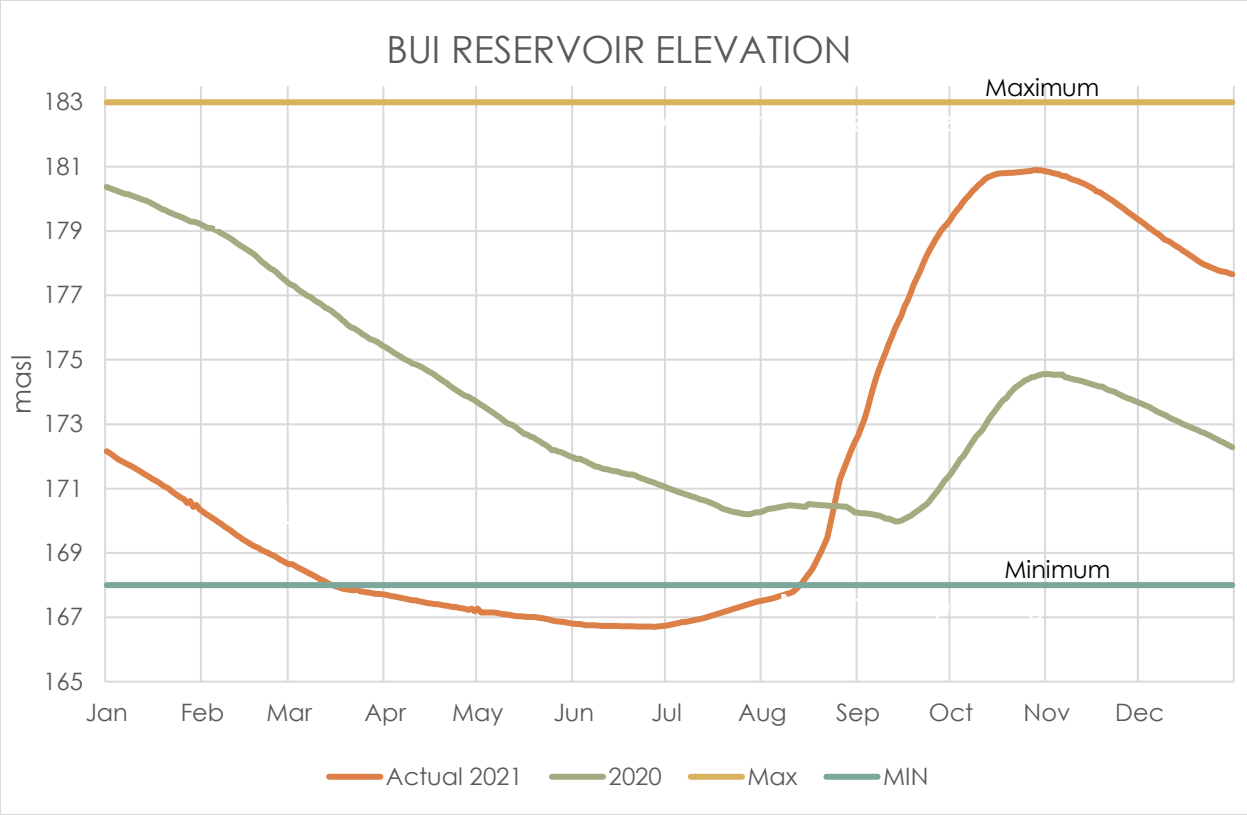


Figure 13: Bui Reservoir Elevation

Based on the planned mode of operations and elevations achieved, overall, hydro generation in 2021 was 7,521 GWh as against the projected generation of 7,001 GWh. This represents a 3.2% increase from hydro generation in 2020. Figure 14 presents electricity generation from the three hydropower plants (Akosombo, Kpong and Bui) in 2021.

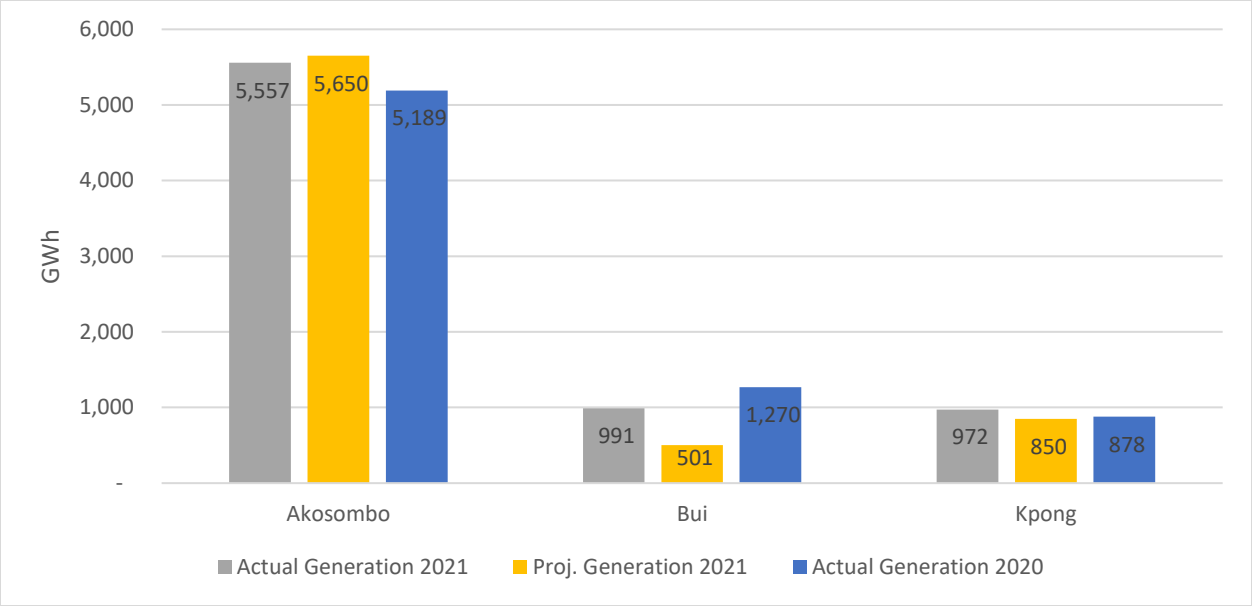


Figure 14: 2021 projected and actual hydro generation

Akosombo hydropower plant produced 5,557 GWh in 2021 against the projected supply of 5,650 GWh, representing 1.6% less than the projected. Akosombo generation saw an increase of 7.1% over the 2020 generation. Kpong generated 972 GWh against a projected generation of 850 GWh, representing 14.4% more than projected and 10.8% more than the generation in 2020. Bui hydro plant also generated 991 GWh compared to the projected 501 GWh[6], representing 97.8% more than projected but 21.9% less than the generation in 2020. Reduced generation at Bui was attributed to poor headwater levels from the beginning of 2021.

2.2.3.2 Thermal Sources

Total grid electricity generated from the thermal plants, excluding the embedded generation, was 13,849 GWh, 1.8% less than what was projected for 2021. The generation from thermal sources was 11.9% higher than the generation in 2020. Projected and actual generation from thermal plants in 2021 are presented in Figure 15.

[6] 2021 Electricity Supply Plan for the Ghana Power System
http://energycom.gov.gh/files/2020%20Supply%20Plan%20Mid%20Year%20Review.pdf

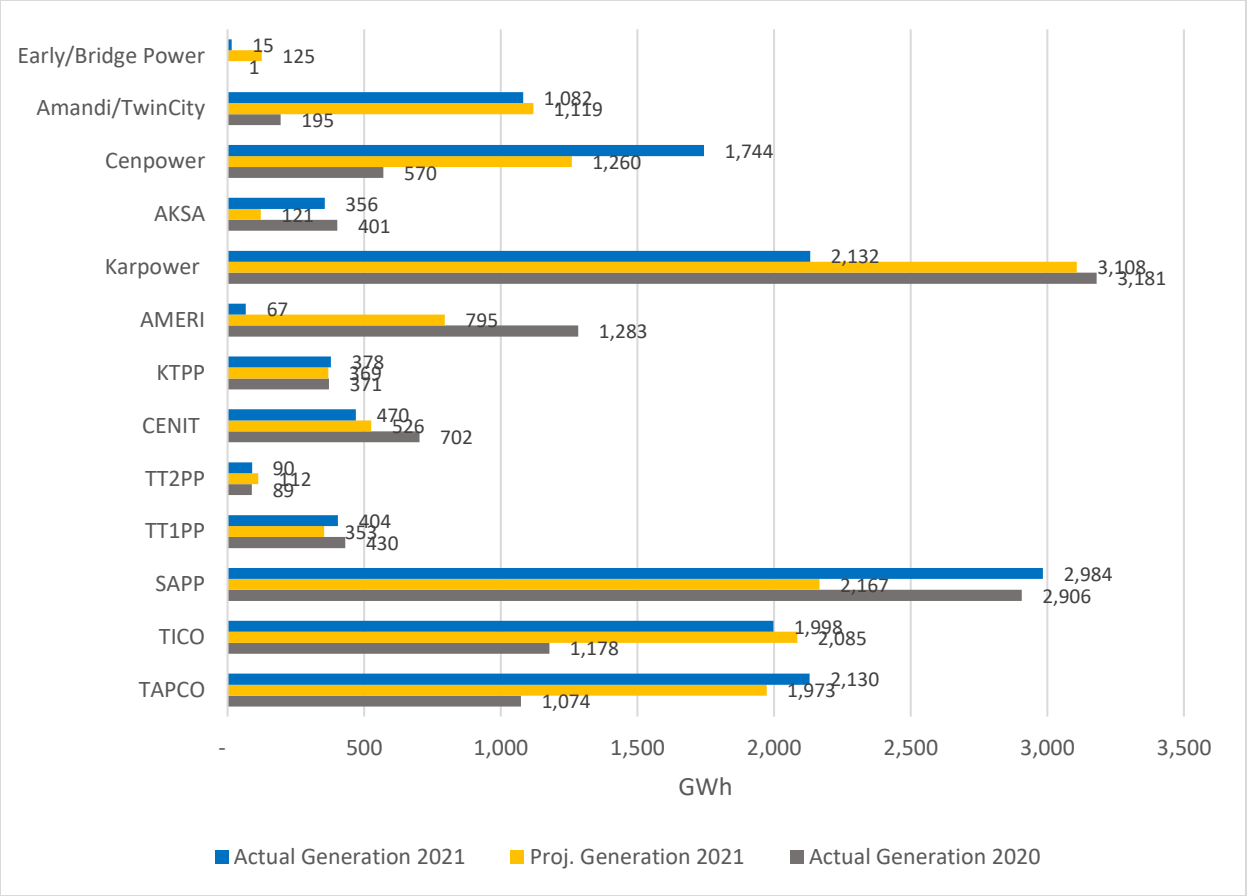
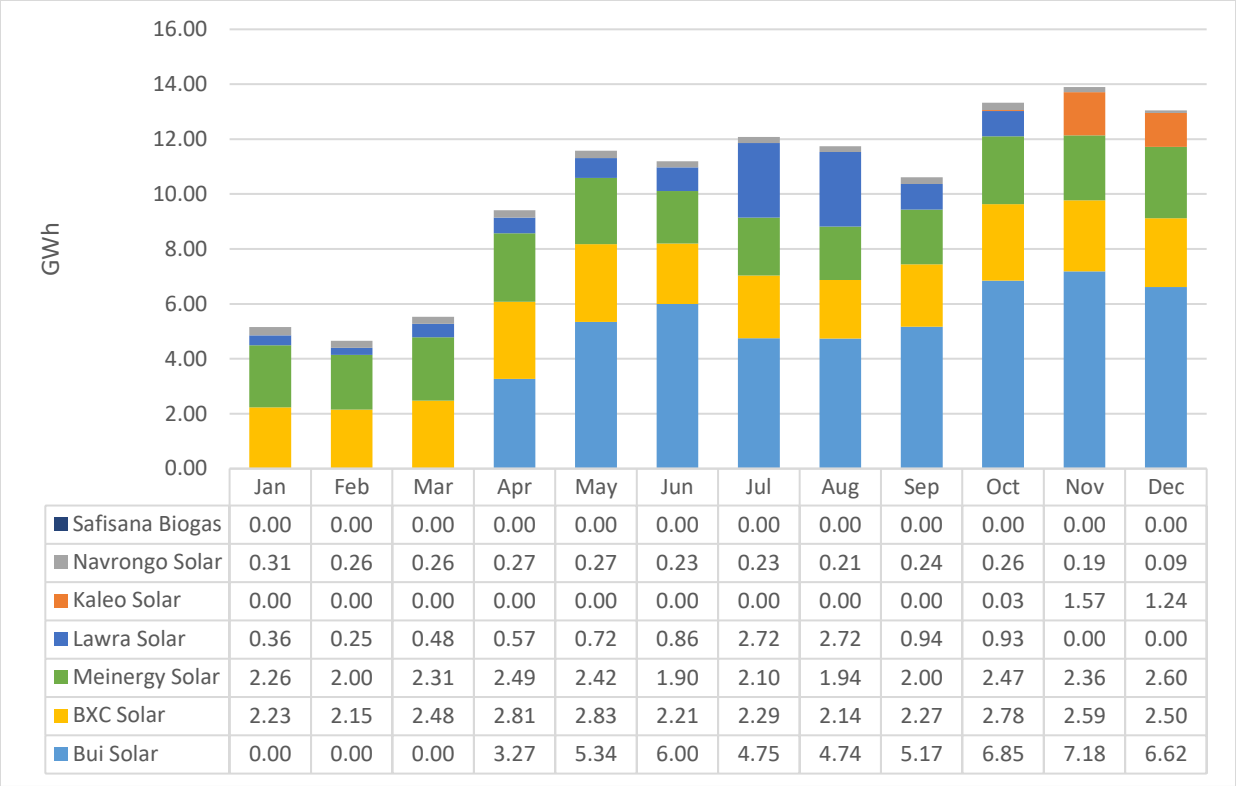


Figure 15: 2021 Projected and actual generation from thermal sources

2.2.3.3 Embedded Generation

Grid-tied embedded generation at the distribution level, particularly solar, has become prominent in recent times. The first 25 MWp of the Bui Solar PV plant was commissioned on April 14, 2020, and an additional 25MWp was also synchronized to the grid on April 25, 2021, increasing the installed capacity to 50 MWp. The 13 MWp VRA Kaleo solar PV plant was also commissioned on October 29, 2021. Figure 16 details the existing embedded generators and their monthly energies delivered in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Safisana Biogas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navrongo Solar	0.31	0.26	0.26	0.27	0.27	0.23	0.23	0.21	0.24	0.26	0.19	0.09
Kaleo Solar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	1.57	1.24
Lawra Solar	0.36	0.25	0.48	0.57	0.72	0.86	2.72	2.72	0.94	0.93	0.00	0.00
Meinergy Solar	2.26	2.00	2.31	2.49	2.42	1.90	2.10	1.94	2.00	2.47	2.36	2.60
BXC Solar	2.23	2.15	2.48	2.81	2.83	2.21	2.29	2.14	2.27	2.78	2.59	2.50
Bui Solar	0.00	0.00	0.00	3.27	5.34	6.00	4.75	4.74	5.17	6.85	7.18	6.62

Figure 16: Monthly electricity generation from solar and biogas in 2021

2.2.3.4 Electricity Exchange

Electricity export to neighbouring countries declined from 1,855 GWh in 2020 to 1,734 GWh in 2021. Out of the total electricity exported in 2021, 575 GWh was exported to Togo/Benin (CEB) as against 715 GWh exported in 2020. Export to Burkina Faso was 962 GWh in 2021 as against 990 GWh in 2020, representing a 2.8% decline. A total of 241 GWh was exchanged between Ghana and Cote d'Ivoire, made up of 44 GWh of import and 197 GWh of export. The exchanges between Ghana and Cote d'Ivoire were, however, inadvertent. Figure 17 presents the monthly export of electricity to SONABEL, CEB and CIE in 2021.

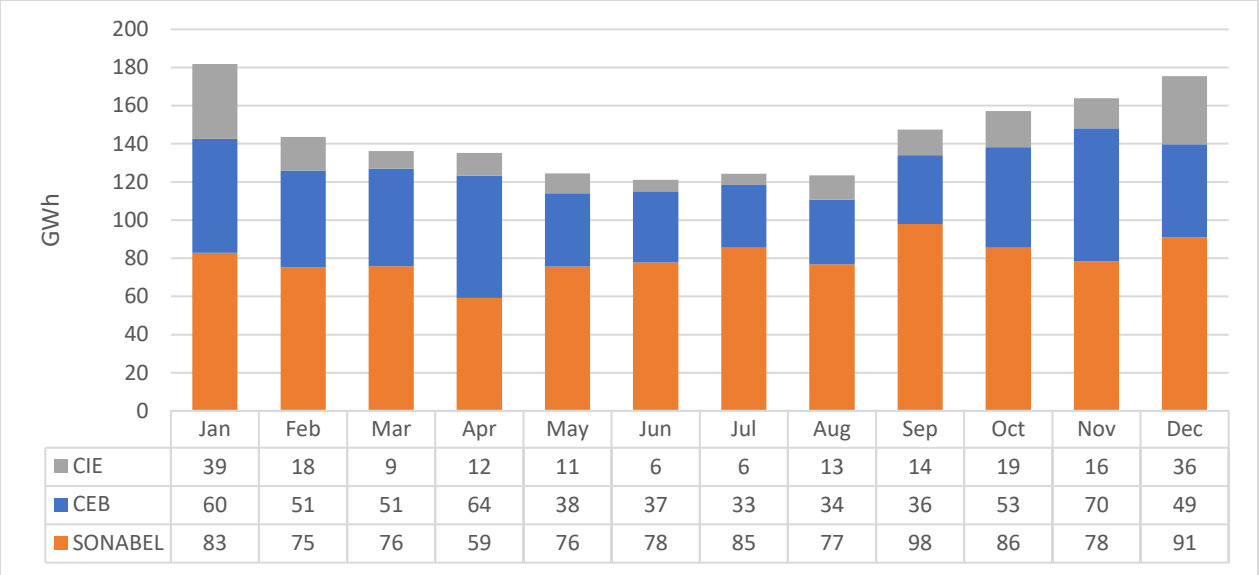


Figure 17: Monthly export of electricity to SONABEL, CEB and CIE in 2021

2.3 Fuel Supply in 2021

2.3.1 Fuel Consumption

The main fuel used by thermal plants are Natural gas, Light Crude Oil (LCO) and Heavy Fuel Oil (HFO). Up to 89% of installed thermal plants depend on natural gas as the primary fuel source due to its comparative advantage over oil in terms of indigeneity, cost and environmental friendliness. The various fuels and their quantities consumed by the thermal plants for the year 2021 are shown in Table 2.

Table 2: Fuels used by the thermal plants in 2021

Power Plant	GAS		LCO		Diesel		HFO	
	MMscf				Bbls			
	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual
TAPCO	15,612	15,730	-	-	-	-	-	-
TICO	14,583	12,959	-	193,455	-	578	-	-
AMERI	7,936	604	-		-		-	-
TT1PP	3,658	4,676	-	-	-	-	-	-
TT2PP	1,166	824	-	-	-	-	-	-
KTPP	3,849	3,877	-	1,934	-	15,346	-	-
SAPP	15,883	21,499	-	-	-	-	-	-
CENIT	5,492	4,901	-	-	-	-	-	-
KARPOWER	22,214	15,860	-	-	-	-	-	76

Power Plant	GAS		LCO		Diesel		HFO	
	MMscf				Bbls			
	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual
AKSA	670	-	-	-	-	-	121,849	496,332
CENPOWER	9,167	11,482	-	146,420	-	2,785	-	-
AMANDI	8,156	7,508	-	17,690	-	3,418	-	-
BRIDGE POWER	1,263	-	-	-	-	-	-	-
GENSER	-	6,749	-	-	-	-	-	-
Total	**109,649**	**106,669**	-	**359,499**	-	**22,127**	**121,849**	**496,408**

Source: GRIDCo Daily Report

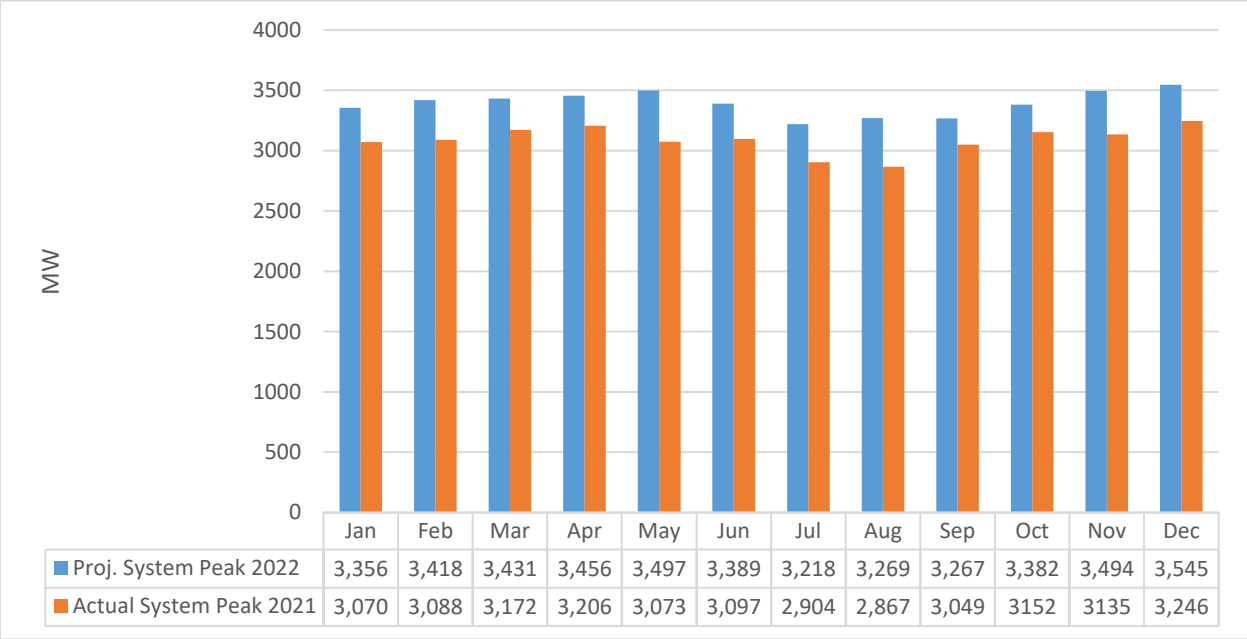
Natural gas used in 2021 for electricity generation was 106,669 MMscf, a 2.7% short of projected and 11.5% more than what was used in 2020. Though no LCO was projected for use in 2021, about 359,499 barrels was used, with higher volumes going into the operation of the TICO and Cenpower plants. Diesel used was 22,127 barrels, with majority used by KTPP for power generation. HFO used for the operation of AKSA plant was above the projected 212,859 barrels, reaching 496,408 barrels in 2021, while Karpower used 76 barrels.

Chapter Three: Electricity Outlook 2022

3.1 Electricity Demand Outlook

3.1.1 Projected Peak Demand for 2022

Ghana's system peak in 2022 is forecast to be 3,545 MW. This represents an increase of 9.2% over 2021 actual peak demand of 3,246 MW and is expected to occur in December 2022. Figure 18 presents the monthly projected peak demand for 2022. The contribution of the various customer classes to the projected system peak demand is also presented in Figure 19.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proj. System Peak 2022	3,356	3,418	3,431	3,456	3,497	3,389	3,218	3,269	3,267	3,382	3,494	3,545
Actual System Peak 2021	3,070	3,088	3,172	3,206	3,073	3,097	2,904	2,867	3,049	3152	3135	3,246

Figure 18: Monthly projected peak demand for 2022

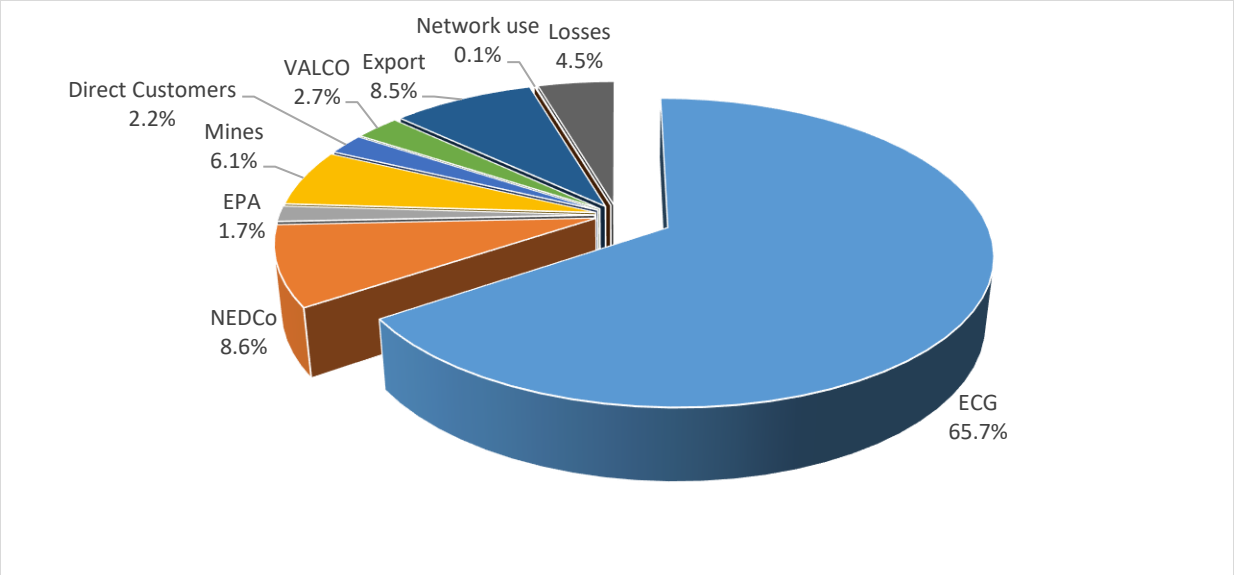
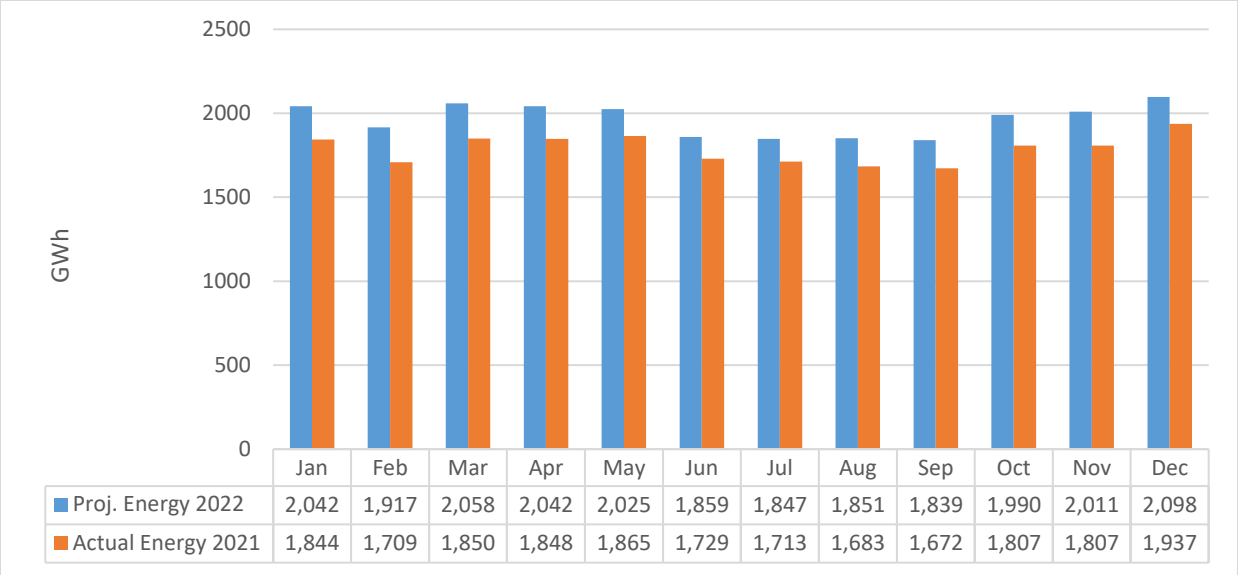


Figure 19: Share of projected peak demand by customer class

ECG is expected to contribute 65.7% to the system peak in 2022, followed by NEDCo contributing 8.6%. Export (to Togo/Benin, Côte d'Ivoire and SONABEL) and the Mines are expected to contribute 8.5% and 6.1%, respectively to system peak in 2022. VALCO operating on two pot-lines is expected to contribute 2.7% of the system peak demand, whilst other direct customers and transmission losses will contribute 2.2% and 4.5% of system peak in 2022, respectively. Network usage will contribute only 0.1%.

3.1.2 Projected Electricity Consumption for 2022

In 2022, 23,579 GWh (including transmission network losses and usage of 1,070 GWh), is projected to be consumed. The estimated transmission losses and network use represents 4.5% of total projected energy consumption. The projected 2022 energy consumption represents an increase of 9.8% over the 2021 consumption of 21,466 GWh. The expected monthly energy consumption for 2022 is presented in Figure 20.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proj. Energy 2022	2,042	1,917	2,058	2,042	2,025	1,859	1,847	1,851	1,839	1,990	2,011	2,098
Actual Energy 2021	1,844	1,709	1,850	1,848	1,865	1,729	1,713	1,683	1,672	1,807	1,807	1,937

Figure 20: Projected monthly energy consumption for 2022

ECG is projected to consume 15,817 GWh of electricity, representing 67.1% of the total projected energy consumption for 2022. NEDCo and Mines are projected to consume 1,904 GWh and 1,406 GWh of electricity, respectively, representing 8.1% and 6.0% of total consumption, respectively. Export (to Togo/Benin, Côte d'Ivoire and SONABEL) will constitute 8.3% of total consumption, whilst VALCO operating on two pot-lines will use 3.2% of the projected total electricity consumption in 2022. Energy losses are expected to constitute 4.5% of the total projected electricity supply, which is more than the PURC benchmark of 4.1%. The share of projected consumption by the various customer classes is presented in Figure 21.

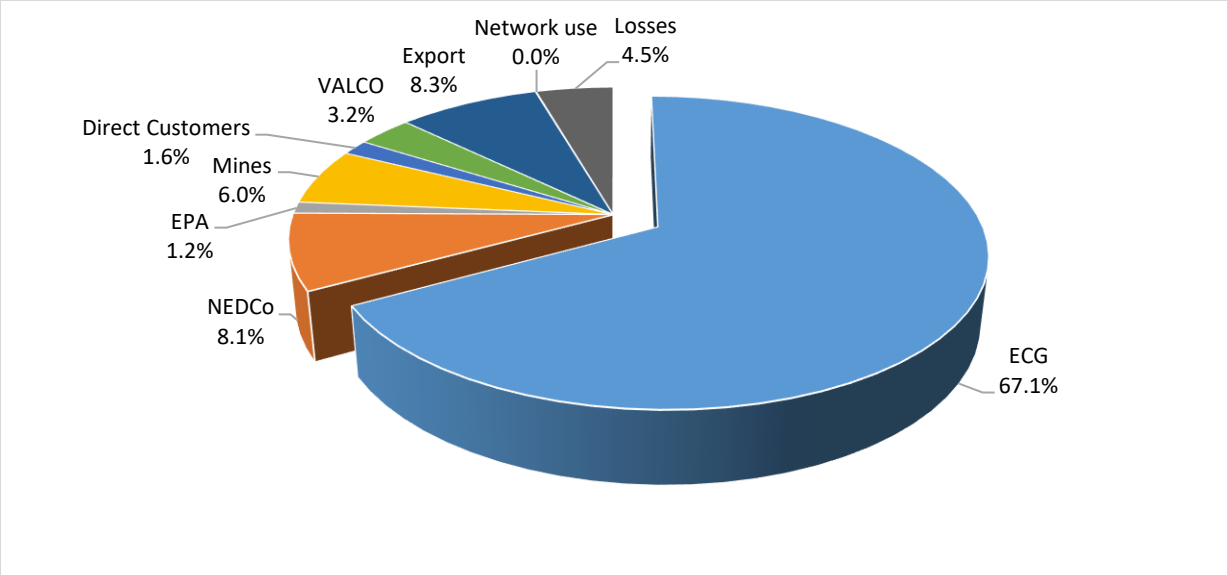


Figure 21: Share of projected energy consumption by the various customer classes

3.2 Electricity Supply Outlook

3.2.1 Generation Sources for 2022

Existing and committed power plants (plants expected to come on line during the year) considered for electricity supply outlook for 2022 are presented in Table 4. Generation capacity from thermal sources will constitute 68.9% of total electricity generation capacity in 2022.

Table 3: Existing and committed power plants for 2022

Power Plant	Fuel Type	Installed Capacity (Nameplate)	% Share	Dependable Capacity
Hydro Power Plants				
Akosombo	Hydro	1,020		900
Bui	Hydro	404		360
Kpong	Hydro	160		140
	Sub-total	***1,584***	***29.1***	***1,400***
Thermal Power Plants				
Takoradi Power Company (TAPCO)	Oil/NG	330		300
Takoradi International Company (TICO)	Oil/NG	340		320
Sunon–Asogli Power (SAPP)	NG	560		520
Tema Thermal Plant1 (TT1P)	Oil/NG	110		100
Tema Thermal Plant2 (TT2P)	Oil/NG	87		70
CENIT Energy Ltd (CEL)	Oil/NG	110		100
KTPP	Oil	220		200
AMERI	NG	250		230
Karpower	NG/HFO	470		450
AKSA	HFO	370		350
Cenpower	Oil/Diesel	360		340
Amandi	Oil/NG	203		190
Early Power*	Gas/LPG	144		140
	Sub-total	**3,554**	**69.2**	**3,310**
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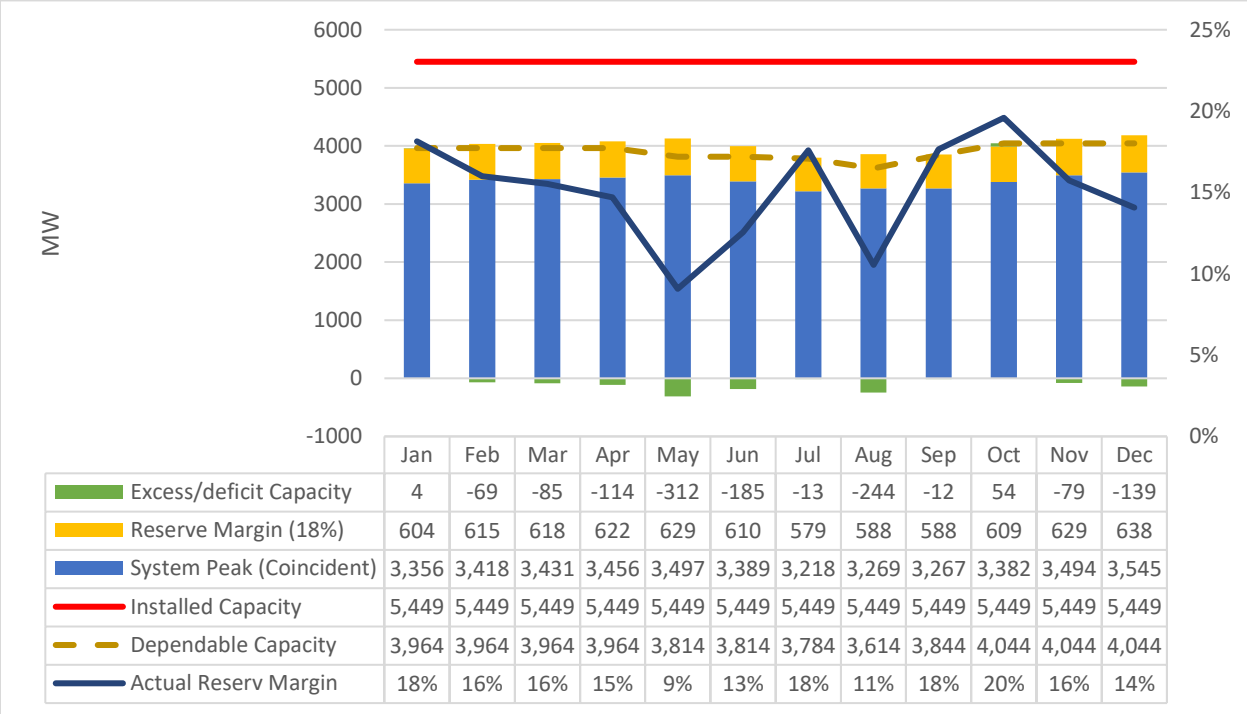
Trojan	Diesel/NG	44		39.6
Sub – total (incl. embedded gen.)		***3,753***	***68.9***	***3,481***
Renewables *(excl. large hydro)*				
VRA Solar (Navrongo)	Solar	2.5		2
Meinergy Solar	Solar	20		16
BXC Solar	Solar	20		16
VRA Solar (Lawra)	Solar	6.5		4.5
VRA Solar (Kaleo)	Solar	13		10
Tsatsadu Hydro	Hydro	0.045		0.045
Bui Solar	Solar	50		45
Safisana Biogas	Biogas	0.1		0.1
	Sub – total	***112.145***	***2.1***	***94.645***
Total (incl embedded gen.)		**5,449.1**		**4,975.2**
Total (excl embedded gen.)		**5,138.0**		**4,710.0**

*Being converted to run on natural gas and will not be available in 2022

3.2.2 Generation Capacity and Projected Peak Demand

Projected monthly dependable capacities, taking planned units' maintenance and fuel supply situation into consideration, are shown in Figure 22. The monthly demand and supply situation for 2022 gives monthly positive generation reserve margins ranging between 9% (317 MW) and 20% (663 MW). A reserve margin of 9.0% in May means if two units of capacity 150 MW each are lost, supply can still meet the projected demand. However, with gas supply outages anticipated due to maintenance works, generation capacity outage could outstrip 317 MW. This could pose supply challenges if provision for alternative fuel supply is not made.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Excess/deficit Capacity	4	-69	-85	-114	-312	-185	-13	-244	-12	54	-79	-139
Reserve Margin (18%)	604	615	618	622	629	610	579	588	588	609	629	638
System Peak (Coincident)	3,356	3,418	3,431	3,456	3,497	3,389	3,218	3,269	3,267	3,382	3,494	3,545
Installed Capacity	5,449	5,449	5,449	5,449	5,449	5,449	5,449	5,449	5,449	5,449	5,449	5,449
Dependable Capacity	3,964	3,964	3,964	3,964	3,814	3,814	3,784	3,614	3,844	4,044	4,044	4,044
Actual Reserv Margin	18%	16%	16%	15%	9%	13%	18%	11%	18%	20%	16%	14%

Figure 22: Projected monthly available capacity versus system peak for 2022

3.2.3 Generation Sources Availability in 2022

3.2.3.1 Hydro Generation Sources

The planned Supervisory Control and Data Acquisition (SCADA) maintenance work at Akosombo hydropower plant is expected to continue making available a maximum of five units throughout 2022. This gives an operating capacity of up to 750 MW with an average capacity of

150 MW for each of the five available units. The Kpong hydro power plant (downstream of Akosombo) will have all its four units available in 2022, with a total capacity of 140 MW.

The elevation at Akosombo at the beginning of 2022 was 269.1 ft (82.0 m). The elevation is expected to drop by about 9.3 ft (2.8 m) per the projected generation. This will result in a projected minimum elevation of 259.8 ft (79.2 m) in the year. Figure 23 presents the projected Akosombo reservoir trajectory for 2022.

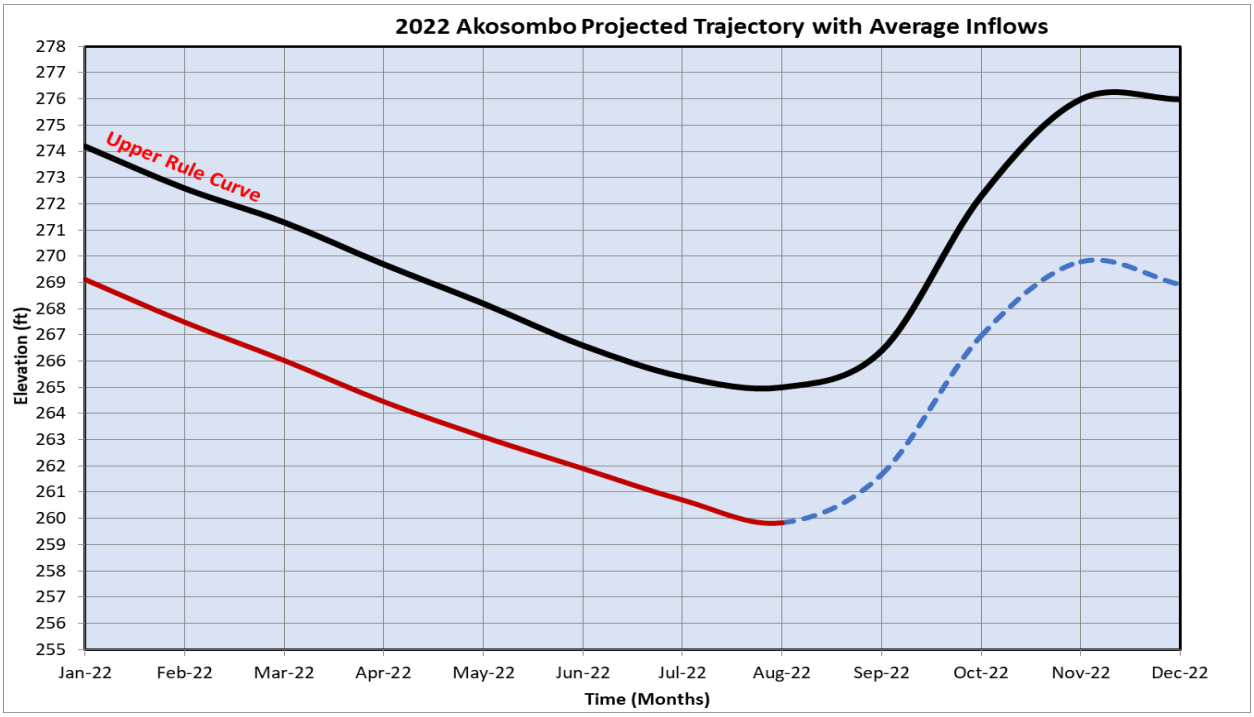


Figure 23: Akosombo reservoir trajectory for 2022

The year start elevation of Akosombo reservoir is very high, about 6 feet (1.83 m) below the Upper Rule Curve, and this poses a risk of water spilling from the reservoir if very high inflows are recorded in 2022. Further analysis showed that inflows above 40 MAF is likely to lead to spillage from the reservoir in 2022. Ceteris Paribus, it would be necessary to achieve the planned level of generation at the Akosombo and Kpong hydro stations to reduce the likelihood of spilling in 2022.

The third hydropower plant, Bui, is expected to continue with planned Level 'A' maintenance in the first and second half of 2022, resulting in a maximum availability of two units during that

period. The plant is projected to run an average of two units throughout 2022, with an average generation capacity of 220 MW to support demand. Bui reservoir trajectory for 2022 is presented in Figure 24.

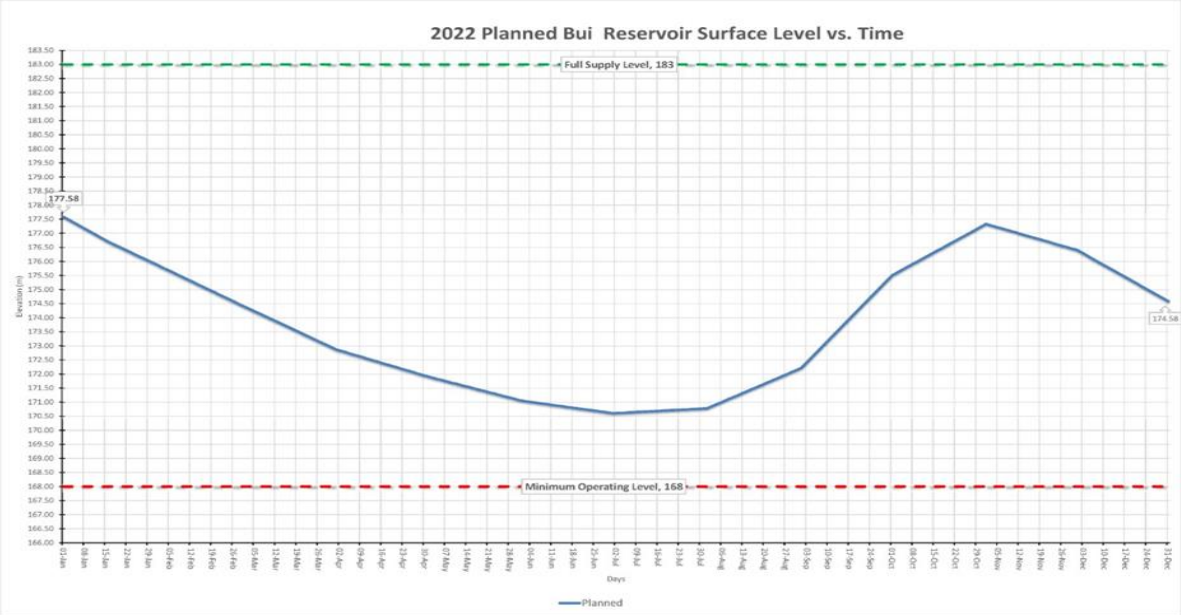


Figure 24: Bui reservoir trajectory

For the continuous and sustainable operation of the Bui hydropower plant, the reservoir level at the end of the dry season in 2022 should not drop below the elevation of 170.0 masl. With a year-start elevation estimated to be 177.6 masl, the year-end elevation is projected at 174.6 masl.

3.2.3.2 Thermal Generation Sources

Total dependable capacity for existing thermal plants is 3,347 MW. Early power, also known as Bridge power, was expected to commission a 144 MW thermal power plant, however, the developers are carrying out some works to convert the plant from running on LPG to Natural gas. As a result, the plant will not be in operation in 2022.

3.2.3.3 Renewable Generation Sources

VRA has a total of 22 MW of solar plants made up of 2.5 MWp Solar power plant at Navrongo, 6.5 MWp at Kaleo and a 13 MWp plant at Lawra. BPA also has a 50 MWp Bui Solar PV farm

located at Bui. The Bui solar plant is expected to add an additional 50MWp from July 2022. The BPA also has the Tsatsadu Microhydro Plant which will operate at 40kW from April 2022 to October 2022 (based on hydrology). Generation is also expected from the 20 MW BXC solar plant, 20 MW Meinergy solar power and 0.1 MW Safisana Biomass plant.

3.2.3.4 Electricity Exchange

Power import in 2022 is not anticipated. However, inadvertent energy exchanges on tie-lines could result from transient flows. Emergency imports may be necessitated as a result of short-term capacity shortages caused by faults or fuel supply contingencies. On the other hand, electricity export to neighbouring countries would be 1,953 GWh in 2022.

3.2.4 Demand-Supply Balance for 2022

The criteria to be used to determine which power plants would be dispatched on a monthly basis during the year are as follows:

i. Power plant nomination based on new Dispatch Protocol
ii. Availability of fuel for power plants
iii. Must-run plants/take-or-pay plants
iv. Variable or intermittent systems like the grid-tied solar plants
v. System stability requirements
vi. PURC and EMOP energy allocation for the year

It should be noted that in instances where there is supply surplus, some plants would not be dispatched. The electricity demand-supply balance for 2022 is presented in Table 4.

Table 4: 2022 Projected electricity demand/supply balance, GWh

Customer Class	**Demand/Supply**
Domestic	20,860.0
VALCO	765.4
Export (CEB+CIE+SONABEL)	1,953.2
Total Energy Requirement	***23,578.6***
Projected Generation	
Akosombo	5,513.3
Kpong	986.9
Bui	894.0
Sub-total	***7,394.2***
TAPCO	2,002.9
TICO	2,298.6
TT1PP	347.5
KTPP	375.4
TT2PP	111.7
AMERI Power Plant	572.4
SAPP	2,068.7
CENIT	744.6
Karpower Barge	3,347.3
AKSA	249.4
CEN Power	2,466.8
Amandi	1,414.7
Early Power	-
Sub-total	***16,000.0***
Renewable	
VRA Solar (Navrongo)	3.0
VRA Solar (Kaleo)	21.9
VRA Solar (Lawra)	9.9
Bui Solar	94
BxC Solar	27.0
Safisana	0.7
Meinergy Solar	27.0
Sub-total	***184.4***
Grand Total	**23,578.6**

Hydro generation for 2022 is expected to be 7,394 GWh, down from 7,521 GWh in 2021. The reduced generation is as a result of anticipated reduction in generation from Bui hydro plant. A greater portion of electricity generation would therefore come from thermal sources. Total generation from thermal is projected to be 16,000 GWh, an increase of 14.1% over 2021

generation. With the coming on stream of VRA Kaleo/Lawra solar and Bui solar, generation from renewable sources is expected to be 184 GWh, in 2021 up from 55 GWh in 2021. Figure 27 shows the share of generation from various sources.

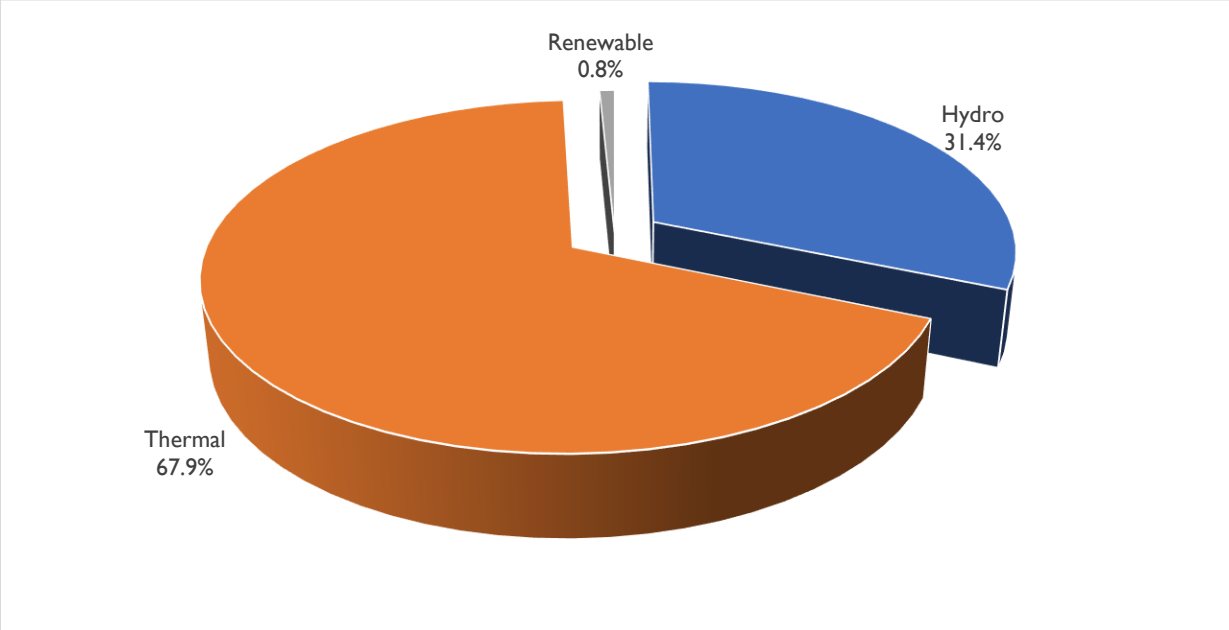


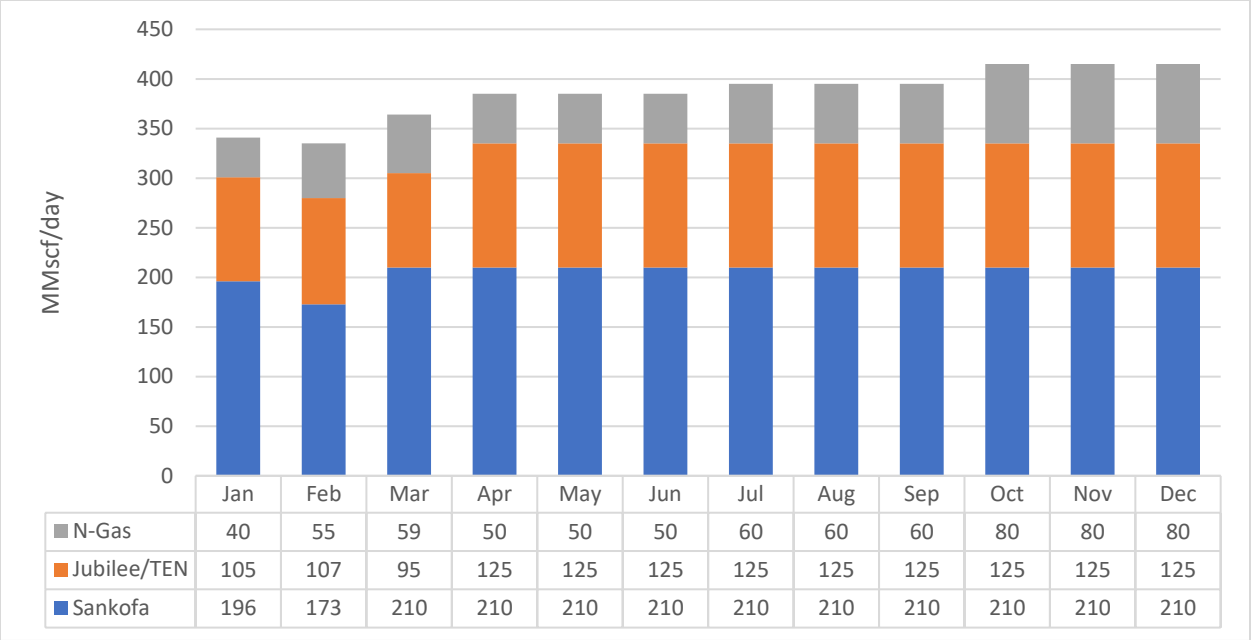
Figure 25: Share of electricity supply by generation type for 2022

Thermal generation would constitute 67.9% of total generation in 2022, whilst hydro generation would contribute 31.4%. Generation from renewable sources (solar PV and Biogas) would constitute 0.8% of total electricity generation in 2022.

3.3 Fuel Supply Outlook

3.3.1 Fuel Requirements

Natural gas will continue to be the dominant fuel for thermal plants in 2022. It is expected to come from indigenous gas from Jubilee, TEN and ENI Sankofa fields and import through WAGP and Tema LNG terminal. Figure 26 shows the expected natural gas flowrates from the various sources for power generation.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N-Gas	40	55	59	50	50	50	60	60	60	80	80	80
Jubilee/TEN	105	107	95	125	125	125	125	125	125	125	125	125
Sankofa	196	173	210	210	210	210	210	210	210	210	210	210

Figure 26: Natural gas flowrates for thermal power plants in 2022

Gas supply from the Jubilee and TEN fields is limited to 125 MMscf/day in line with the AGPP operating capacity of 135 MMscf/day of raw gas. Sankofa field is expected to maintain its capacity to supply up to 210 MMscf/day. Import from Nigeria through the WAGP is expected to average 50 MMscf/day in the first half of 2022, then increase to 60 MMscf/day in the third quarter and further increase to 80 MMscf/day in the last quarter of 2022.

Based on the assumed gas supply from domestic and import sources, the total natural gas requirement for power generation for 2022 is projected to be 139.2 Tbtu. Total gas requirement for each thermal plant is shown in Figures 27.

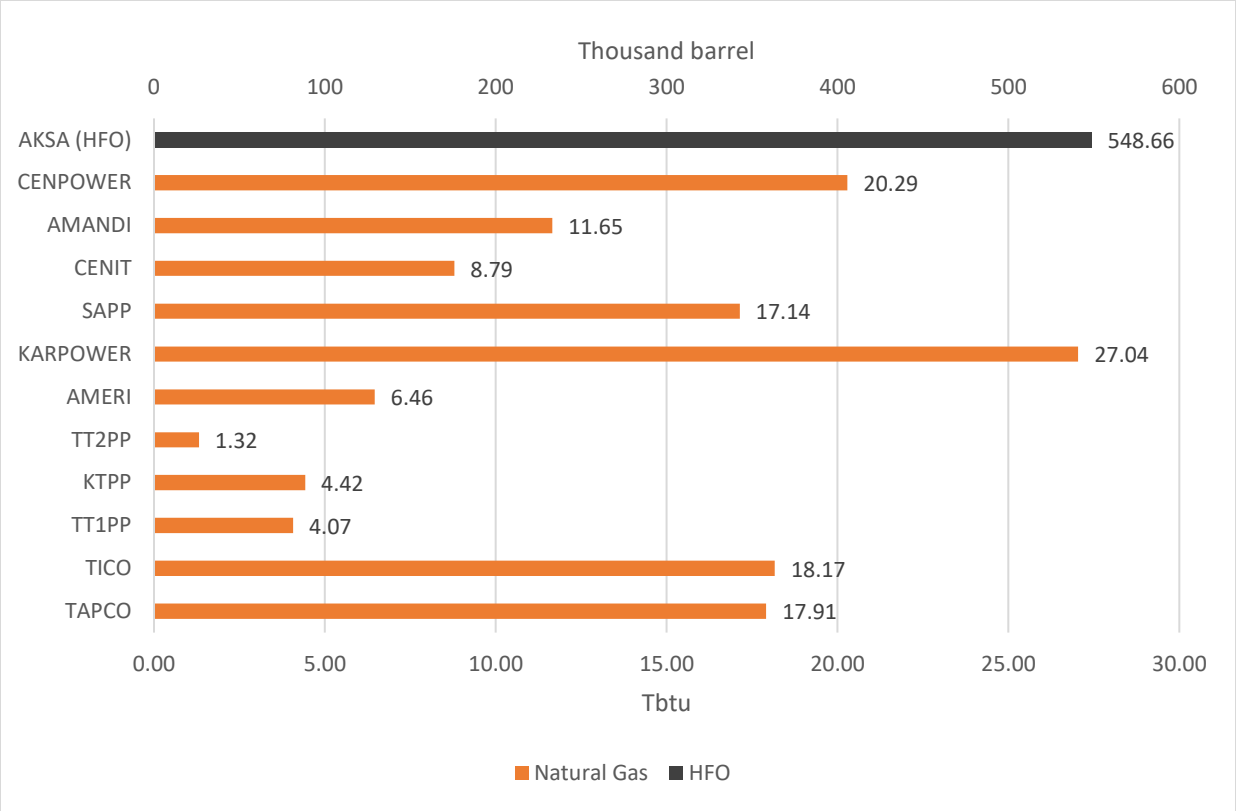


Figure 27: Thermal plants fuel requirements for 2022

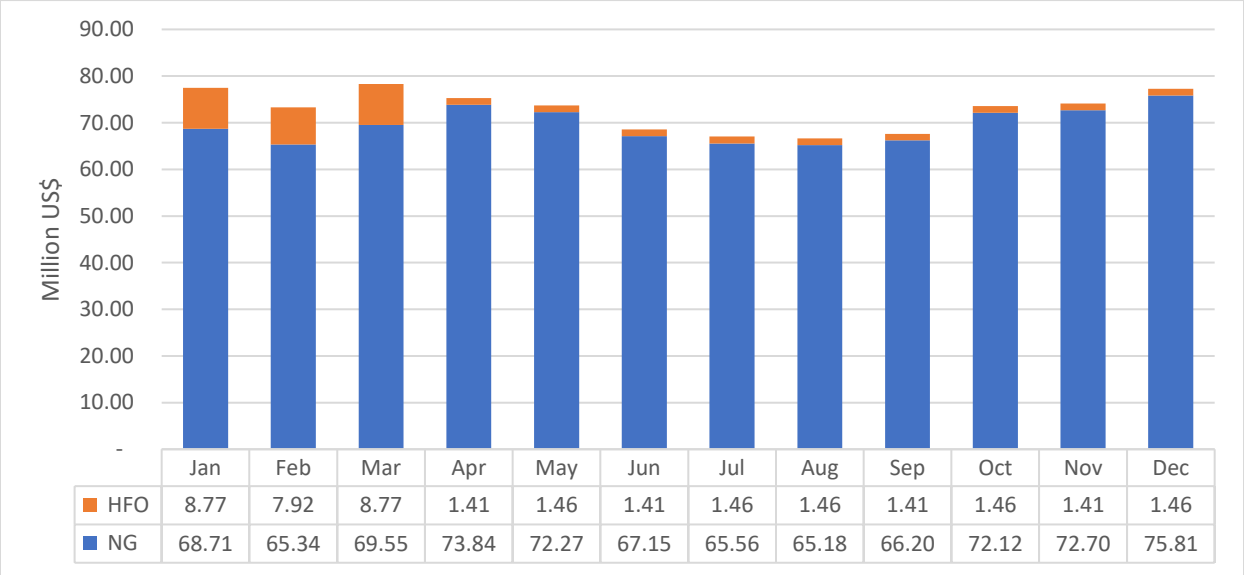
AKSA will run on heavy fuel oil (HFO) in 2022 and expected to operate as a standby plant. The plant will require a total of 548.7 thousand barrels in the year. Light crude oil (LCO) and diesel would be used as backup fuels for some plants. The stock of LCO at VRA power station at Tema and Takoradi at the beginning of January 2022 was 43,605 barrels and 178,658 barrels respectively, while diesel stock was 132,165 barrels.

3.3.2 Fuel Price and Cost

Assuming the weighted average price of lean gas for both domestic and import (N-gas and LNG) sources remains at US$6.08/MMBtu[7], about US$834.43 million would be needed for gas procurement in 2022. This translates to on average, a monthly amount of US$69.54 million to procure natural gas. HFO for the running of AKSA plant would be procured at an expected

[7] Published by the Public Utility Regulatory Authority (PURC)

delivery price of US$70/barrels and about $38.40 million will be required to procure HFO. Overall, an amount of US$872.83 million is required to purchase fuel for thermal power generation. Figure 28 presents monthly total cost of natural gas and HFO for the thermal plants for 2022.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HFO	8.77	7.92	8.77	1.41	1.46	1.41	1.46	1.46	1.41	1.46	1.41	1.46
NG	68.71	65.34	69.55	73.84	72.27	67.15	65.56	65.18	66.20	72.12	72.70	75.81

Figure 28: Expected monthly total cost of natural gas and HFO for the thermal plants for 2022

3.3.3 Gas Infrastructure Maintenance for 2022

Planned maintenance activities for the year 2022 include:

1. The OCTP FPSO and ORF is to be shut down for maintenance for 5 days from the 21st to 26th of February 2022. This will curtail gas export from the Sankofa production facility. Jubilee and TEN gas are expected to be available to partly make up for the Sankofa gas during this period. Liquid fuel would also be used to supplement the thermal generation requirement during this period.

2. The Jubilee FPSO is expected to shut down for maintenance for 12 days from 28th April to 11th May 2022. TEN will fully substitute Jubilee gas during this period. There are no scheduled maintenance activities for the TEN and Tema LNG facilities.

3. There will be a maintenance on GNGC's Takoradi Distribution Station (TDS) for 17 days from 15th March to 2nd April 2022. Also, GNGC plans to carry out a maintenance programme for the Atuabo Gas Processing Plant (AGPP) to be scheduled for a period of 10 days from July to October 2022 window. This will potentially affect gas supply.

4. The West African Gas Pipeline (WAPCo) will conduct its mandatory semi-annual Emergency Shutdown (ESD) tests in Tema and Takoradi in January and will conduct the second test in July for a period of 3-4 hours. WAPCo has also provided a shutdown programme of between 7 and 10 days to be scheduled between July and October for the replacement of twelve (12) defective valves on the Takoradi process area. WAPCo is expected to conduct an external inspection and mitigation of higher risk areas on the main offshore pipeline in the year. However, there are no planned shutdown maintenance activities that will affect gas supply in the Tema area.

3.4 Transmission Outlook

3.4.1 Overview of Transmission System

The National Interconnected Transmission System (NITS) is the backbone for transmitting electricity from various generating stations to load centres. Electricity transmission is done at three main voltage levels; 69 kV (3.4% of total transmission circuit length), 161 kV (76.5% of total transmission circuit length) and 330 kV (18.6% of total transmission circuit length). There is also a 74 km of 225 kV voltage level transmission that facilitates interconnection with Ghana's western neighbour Cote d'Ivoire and northern neighbour Burkina Faso. There is also an interconnection with Togo through two 161 kV lines and a 330 kV line. The 330 kV interconnection with Togo was constructed as part of activities towards the implementation of the West African Power Pool (WAPP). The NITS, as at end of year 2021 was made up of:

- Total transmission circuit length of 6,472.23 km;
- Total number of Bulk Supply Points (BSPs) of 68;

- Total number of load transformers at BSPs - 144;
- Total transformation capacity – 9,642.0 MVA;
- Total capacity of fixed capacitive compensation devices – 796.2 MVAr;
- Total capacity of reactors - 230 MVAr;
- One 40 MVAr Static Synchronous Compensator (STATCOM1) installed at the Tamale substation.

The fixed capacitors, reactors and the STATCOM complement the generating units in providing the reactive power requirements on the NITS in order to maintain voltages within normal levels and minimize transmission losses.

There is a System Control Centre (SCC) in Tema responsible for the real time dispatch (monitoring, coordination, and control of operations) of the Ghana Power System including cross-border power exchanges with neighbouring countries. The SCC is equipped with a Network Manager System (NMS), which is the main tool used to monitor and conduct dispatch operations on the Ghana Power System.

3.4.2 Transmission Line Feeder and Substation Availability in 2022

The criteria used for ensuring high transmission Line, Feeder and Substation availability are as follow:

- All existing transmission lines are expected to be in service in 2022 to ensure transmission of electricity from the generation stations to the Bulk Supply Points across the nation and to enable the execution of power exchanges with neighbouring countries.
- Maintenance work on transmission lines and substations is to be organised in order not to significantly affect power supply to customers except for single transformer substations and consumers served on radial lines.

Maintenance work on transmission lines and substations are not expected to significantly affect power supply to customers except for single transformer substations and consumers served on single radial lines. Most transformers in operation on the NITS are designed with a capability of 100% continuous loading and Transformer Utilization Factor (TUF). Indications from GRIDCo

therefore, suggests that there is adequate transformer capacity on the NITS for the supply of power under normal operating conditions.

3.4.3 Transmission Losses in 2022

Analysis of the transmission network indicate that lowest losses are registered on the NITS in the Balanced Generation scenario. This means that in situations where there are gas interruptions which affect thermal generation and compel high volumes of generation from a particular enclave (West or East), losses increase significantly. The relocation of Ameri to Kumasi to create another generation enclave is expected to reduce losses on the NITS further.

GRIDCo is embarking on a number of projects which are expected to improve the reliability, transfer capacity and to reduce losses and improve voltages on the NITS. These include:

- 161kV Kasoa Substation with 50MVAr SVC Plus,
- Upgrade of the 161kV Achimota-Mallam transmission corridor,
- Western Corridor Transmission system upgrades (GRIDCo is at the verge of securing funds with the assistance of the Ministries of Energy & Finance) to upgrade the old 161kV lines from the Takoradi Thermal plant through Prestea to New Obuasi along with substation upgrades and
- The Siemens projects for the development of the 330/161kV Dunkwa II substation, 3rd BSP in Kumasi and the replacement of the 161kV capacitor bank in Kumasi with a 50MVAr SVC Plus.

3.5 Electricity Supply Challenges in 2022

3.5.1 Fuel Supply Challenges

Hydro Fuel Risk

Even though there are high prospects for rainfall this year, it would still be prudent to continue the conservative dispatch of the hydro plants to ensure that the reservoirs are not drawn down

below their minimum operating levels to guarantee sustainable operations in the coming years. The availability and reliability of the thermal units are also very key to maintain the planned hydro draft rate.

Thermal Fuel Risk

Gas supply reliability from domestic and import sources remains a major risk to the country's electricity supply reliability. Although there is relatively high installed generating capacity, gas supply sustainability remains one of the major risks to reliable electricity supply in Ghana. Any disruptions in fuel supply, mostly gas, would render some thermal plants inoperable, which will negatively impact supply reliability.

Any disruption can be averted by securing alternative fuels supply for the power plants to make up for any shortfall in gas supply within the period.

3.5.2 Transmission Challenges

The loss of the 330 kV Takoradi Thermal – Anwomaso line results in rerouting of almost all the power on the 330 kV circuit to the 161kV circuit between Aboadze Enclave and Kumasi. This leads to overloads along the 161kV line circuit in the Western corridor. This will lead to system disturbances triggered by congestion on the 161kV lines between Takoradi Thermal and Prestea. The solution is to break into the 330kV Takoradi Thermal – Anwomaso line at Dunkwa with a connection to the 161kV network at the existing Dunkwa substation and the upgrade of the 170 MVA Western corridor lines.

The loss of the 330 kV Anwomaso - Kintampo transmission line results in re-routing on the 161 kV circuit between Anwomaso and Kumasi, severely overloading the line as well as the 330/161kV Autotransformers at Anwomaso. Breaking into the 330kV Takoradi Thermal - Anwomaso line at Dunkwa minimizes the impact of the line outage. The permanent solution is to upgrade the 161 kV circuit between Anwomaso and Kumasi and develop a 3rd bulk supply point for Kumasi at the 330kV level.

Loss of the 330 kV A4 – Volta Line overloads the 170 MVA low capacity Achimota – Accra

Central and Achimota – Mallam lines. With the loss of this line, the load at A4BSP would have to be served from Aboadze. There is significant power flow on the Achimota – Accra Central and Achimota – Mallam lines. Upgrade of the 170 MVA lines are required to avert system disturbance.

Loss of the 330 kV Kintampo – Tamale line overloads the 161 kV low capacity between Kintampo and Tamale and cause eventual system disturbance. A second 330 kV line is required from Aboadze to Bolgatanga to avert this disturbance.

A loss of the 161 kV Tarkwa – Prestea line results in overload on the parallel 170 MVA Tarkwa – New Tarkwa – Prestea line circuit which causes it to trip. This situation will be mitigated by a break into the 330kV Takoradi Thermal – Anwomaso line at Dunkwa. The 161kV Aboadze-Takoradi-Tarkwa -New Tarkwa - Prestea lines will however require upgrade in the medium term.

A contingency on this line overloads the smaller capacity 161kV Takoradi Thermal - Takoradi and Takoradi - Tarkwa lines. This will eventually cause these lines to trip on overload. Upgrade of the Western corridor lines will avoid any system disturbances.

Loss of the 330 kV Adubiyili - Nayagnia line overloads the 161 kV low capacity between Tamale and Bolgatanga and cause eventual system disturbance. A second 330 kV line is required from Takoradi Thermal to Nayagnia to avert this disturbance.

At present, one of the two 200 MVA 225/161 kV auto-transformers in service on the Ghana – Cote d'Ivoire tie-line is faulted. Also, one of the two 200 MVA 225/330 kV auto-transformers in service on the Ghana – Burkina tie-line is faulted and being shipped to the supplier for examination. This has limited the capacity of the Ghana power system to export power to Cote d'Ivoire and also to Burkina in 2022. In order to improve the capacity and the reliability of the Ghana power system to export supply to our neighbours in the sub-region, there is a need to replace the two each 200MVA 161/225kV Prestea and 200MVA 330/225kV Nayagnia auto transformers with ones having phase shifting capabilities. The replacement of the transformers with Phase Shifting ones will help dispatchers attain greater control of power flow on our interconnections with our neighbours and reduce inadvertent power flows, especially on the Ghana – Cote d'Ivoire interconnection.

Chapter Four: Petroleum Sub-sector Performance 2021

4.1 Crude Oil

4.1.1 Crude Oil Production

Crude oil continues to be exploited from three fields – Jubilee, Tweneboa Enyenra Ntomme (TEN) and Sankofa Gye Nyame fields (hereafter referred to as Sankofa field). As shown in Figure 29, crude oil witnessed reduced production since the advent of COVID-19 in 2020.

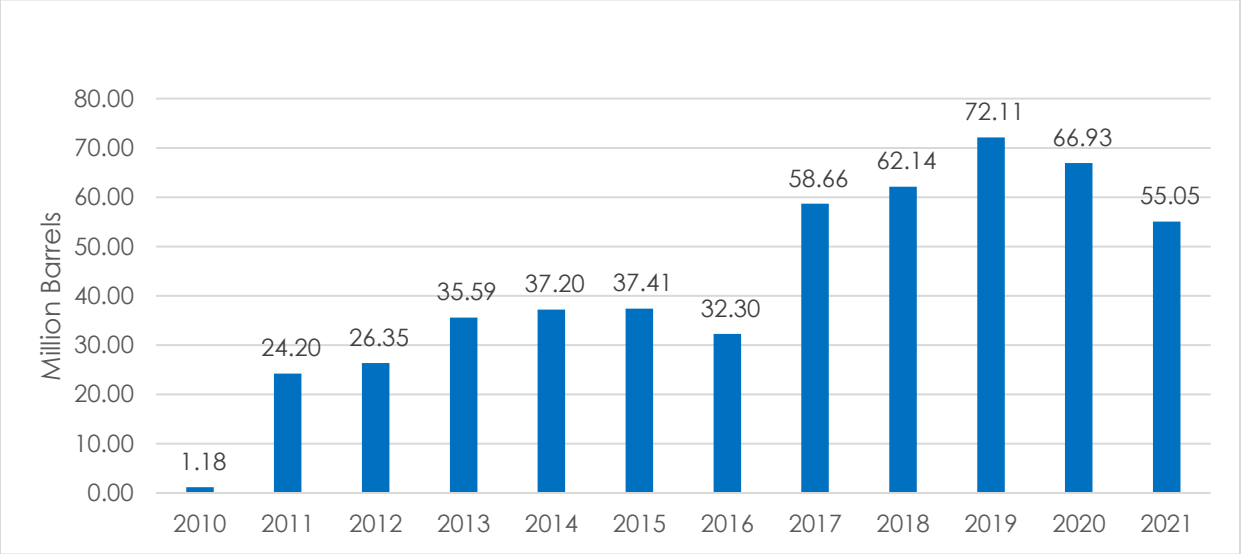
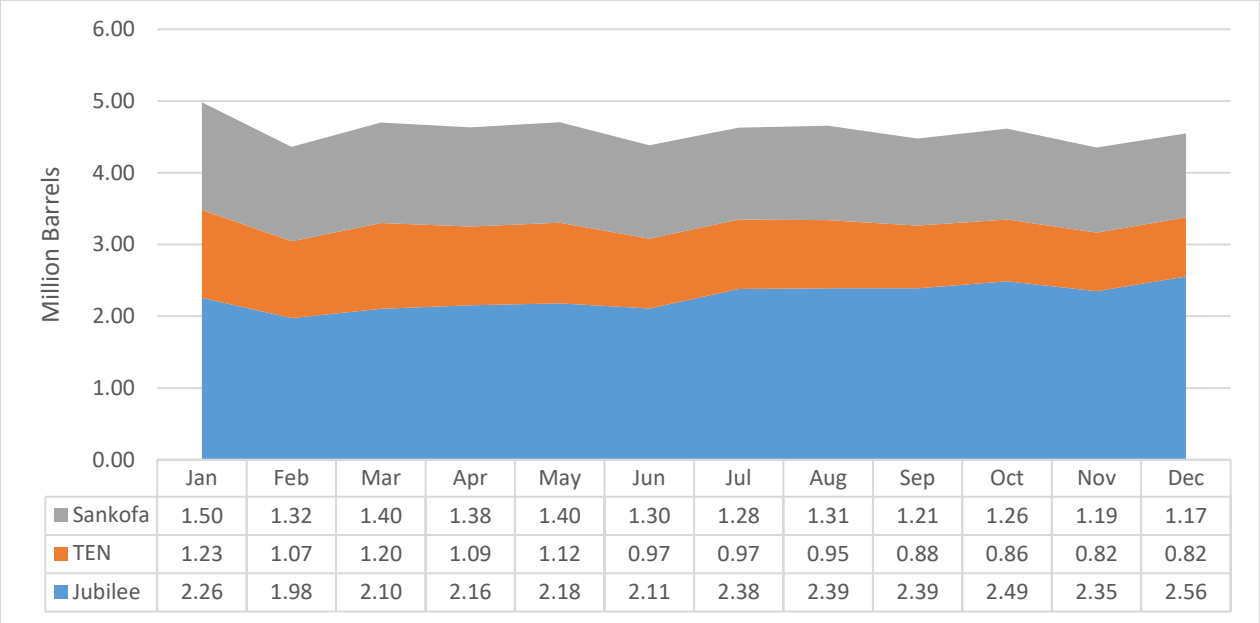


Figure 29: Crude oil production from 2010 to 2021

Source: Petroleum Commission

Total volume of crude oil produced from the three commercial fields - Jubilee, TEN and Sankofa in 2021 was 55.05 million barrels, lower than 66.93 million barrels produced in 2020. The decrease in production in 2021 was due to reduced production in all three fields. Figure 30 shows the monthly production of crude oil from the three fields in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sankofa	1.50	1.32	1.40	1.38	1.40	1.30	1.28	1.31	1.21	1.26	1.19	1.17
TEN	1.23	1.07	1.20	1.09	1.12	0.97	0.97	0.95	0.88	0.86	0.82	0.82
Jubilee	2.26	1.98	2.10	2.16	2.18	2.11	2.38	2.39	2.39	2.49	2.35	2.56

Figure 30: Monthly crude oil production in 2021, million barrels

Source: Petroleum Commission (PC)

In 2021, 27.34 million barrels of crude oil was produced from the Jubilee field, down from 30.42 million barrels in 2020. The Jubilee field recorded its lowest production in February and the highest production in December. As can be observed in Figure 30, production increased in the second half of 2021 due to the addition of two production wells and one water injection well.

The TEN field produced 11.98 million barrels of crude oil in 2021, lower than the 17.80 million barrels produced in 2020. The field recorded its highest oil production in January, and thereafter production declined mostly in the second half of the year. The decline in production was attributed to factors such as flow assurance issues, inadequate pressure support, challenges in water injection, and increasing Gas-Oil Ratio, among others.

The Sankofa field saw a decrease of 15.8%, with 15.74 million barrels of crude oil produced in 2021 as against 18.70 million barrels in 2020. The field's highest monthly production was in January and thereafter witnessed an uneven decline to its lowest output in December. The decline in production, was due to the activation of emergency shutdowns among other issues[8].

[8] Public Interest and Accountability Committee (PIAC): https://www.piacghana.org/portal/files/downloads/piac_reports/piac_2021_annual_report.pdf

Average daily production from the three fields combined was lower in 2021 compared to 2020. Average daily production per day reduced from 182,918 barrels in 2020 to 150,841 barrels in 2021, representing a decline of 17.5%. This also witnessed a reduction of 4.4% from the projected average daily production for 2021[9] (Figure 31).

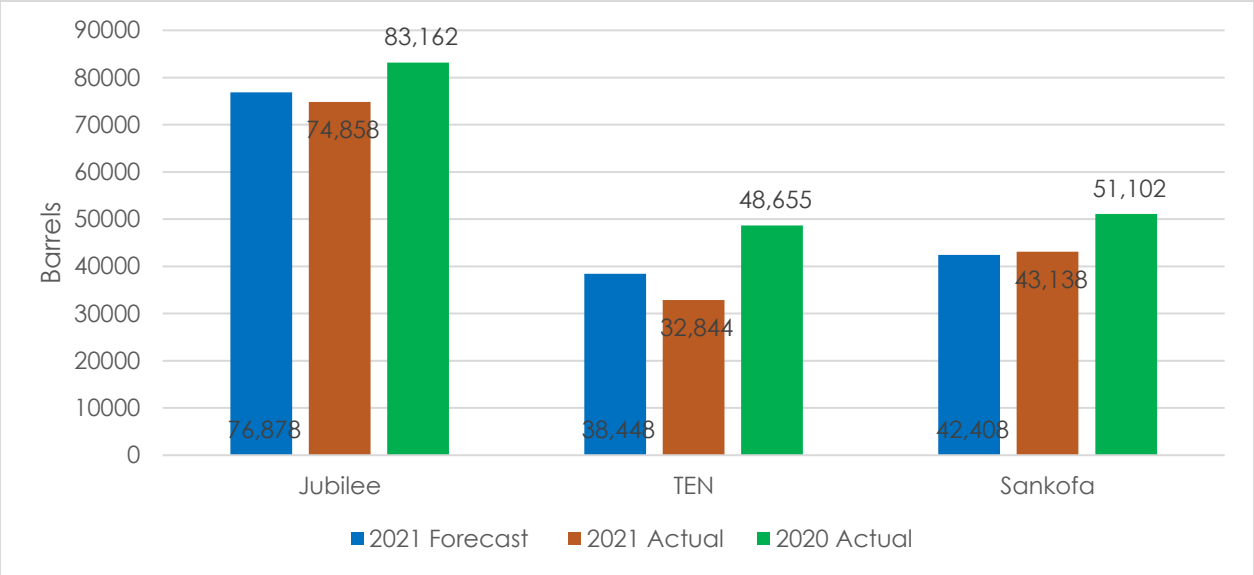
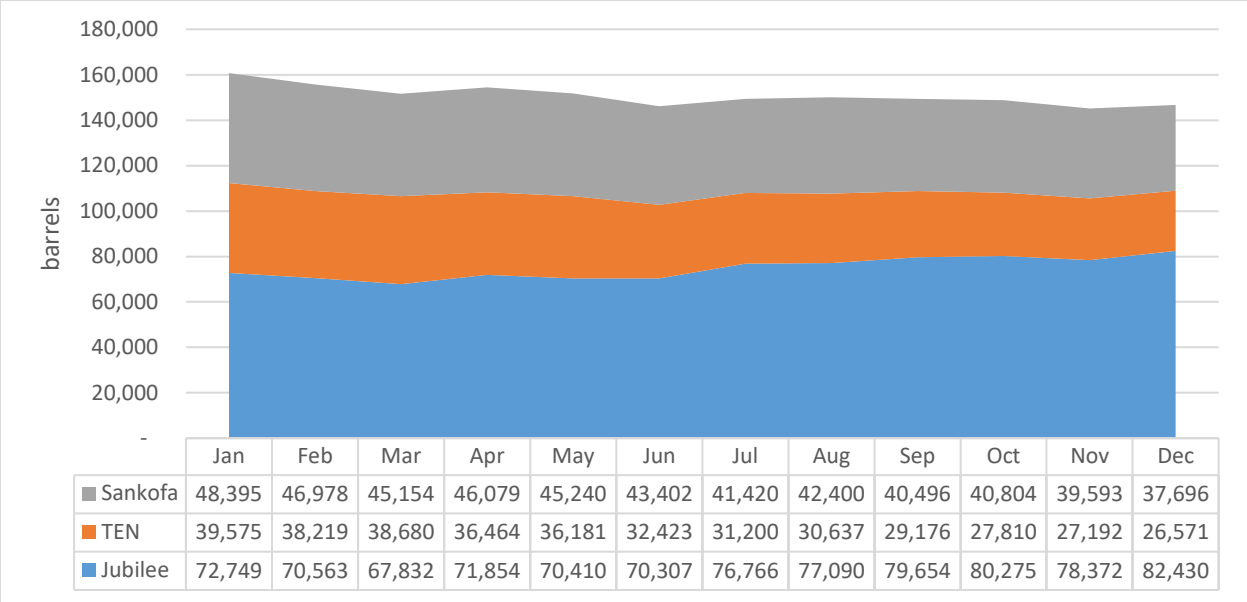


Figure 31: Actual and projected average daily production of crude oil

[9] 2021 Energy (Supply and Demand) Outlook for Ghana: http://energycom.gov.gh/planning/data-center/energy-outlook-for-ghana



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sankofa	48,395	46,978	45,154	46,079	45,240	43,402	41,420	42,400	40,496	40,804	39,593	37,696
TEN	39,575	38,219	38,680	36,464	36,181	32,423	31,200	30,637	29,176	27,810	27,192	26,571
Jubilee	72,749	70,563	67,832	71,854	70,410	70,307	76,766	77,090	79,654	80,275	78,372	82,430

Figure 32: Monthly average daily volumes of crude oil production in 2021

Source: PC

Average daily production from Jubilee field in 2021 was 74,858 barrels compared to 83,162 barrels in 2020, representing a decrease of 10.0%. Jubilee recorded its highest daily production in December and the lowest in June. Similarly, the average daily production from the TEN field reduced from 48,655 barrels in 2020 to 32,844 barrels in 2021. Production from Sankofa field also reduced from an average of 51,102 barrels per day in 2020 to 43,138 barrels per day in 2021. As observed in Figure 32, Sankofa field exceeded its projected production for 2021, while Jubilee and TEN fell short of their anticipated production.

4.1.2 Crude Oil Import

The country relies on crude oil imports for its refineries and power generation. Figure 33 presents monthly volumes of crude oil imported into the country in 2021.

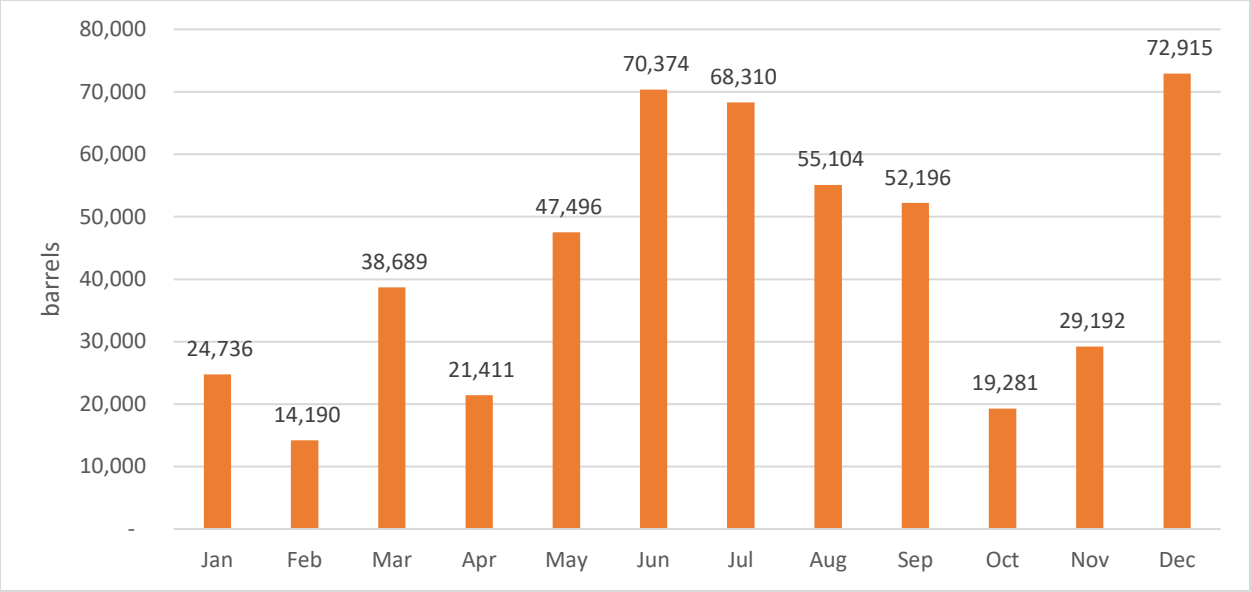


Figure 33: Monthly crude oil imported into the country in 2021

Source: NPA

Total crude oil imported in 2021 was 513,895 barrels, a decrease of 89.4% of import in 2020. The crude oil imported in 2021 was for the refineries, mostly the privately-owned ones (Platon Gas Oil Limited and Akwaaba Oil Limited). The state-owned refinery, TOR did not import crude oil for refinery purposes, and no crude oil was imported for power plants use in 2021.

4.1.3 Crude Oil Price

The health pandemic encountered from COVID-19 in 2020 led the price of crude to evolve with significant volatility. In April 2020, the global benchmark crude - Europe Brent, traded below US$10 per barrel, a level not seen since the beginning of the third millennium. At the same time, US benchmark crude West Texas Intermediate (WTI) reached negative levels of -US$37 per barrel for the first time in history. From then on, crude prices took a progressive upward trend. Figure 34 depicts average monthly crude oil prices for the two international reference crude oil over the last two decades.

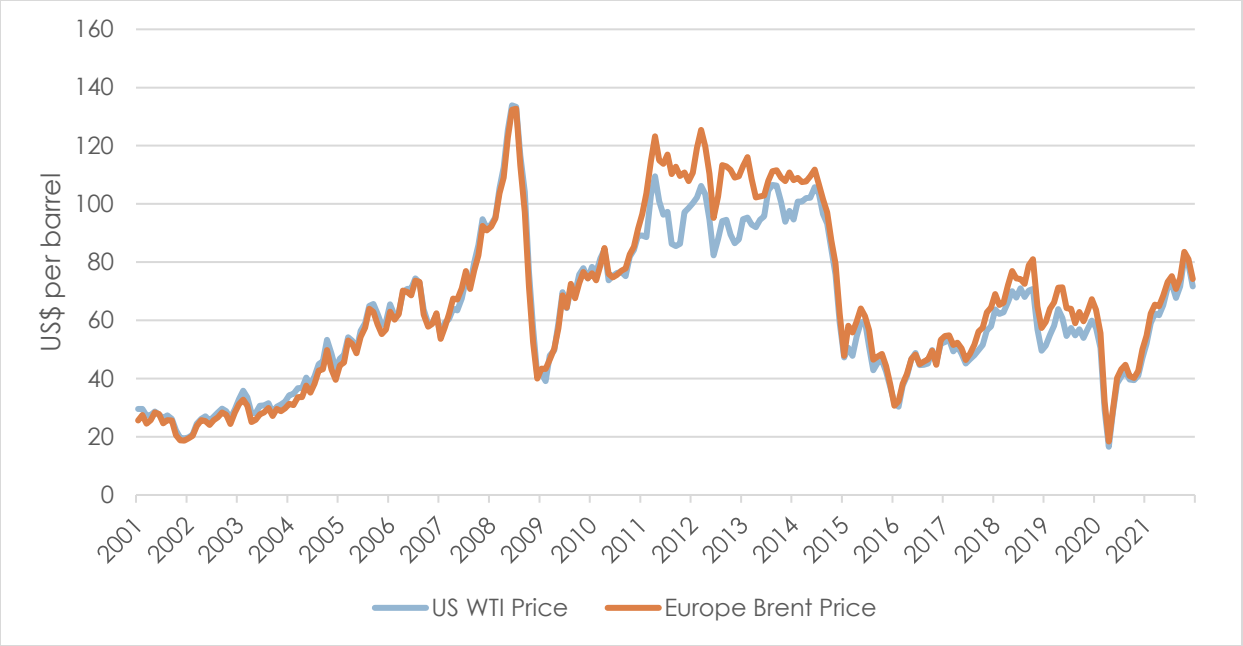


Figure 34: Average crude oil prices for US WTI and Europe Brent 2001-2021

Source: US Energy Information Administration

The average Brent crude oil price in 2021 was US$71 per barrel. This represents a 68.9% higher than the average price in 2020 and 50.0% higher than projected for the year. The price of US WTI averaged US$73 per barrel in 2021, which is about 74.0% higher than the average price in 2020 and 54% higher than projected for the year.

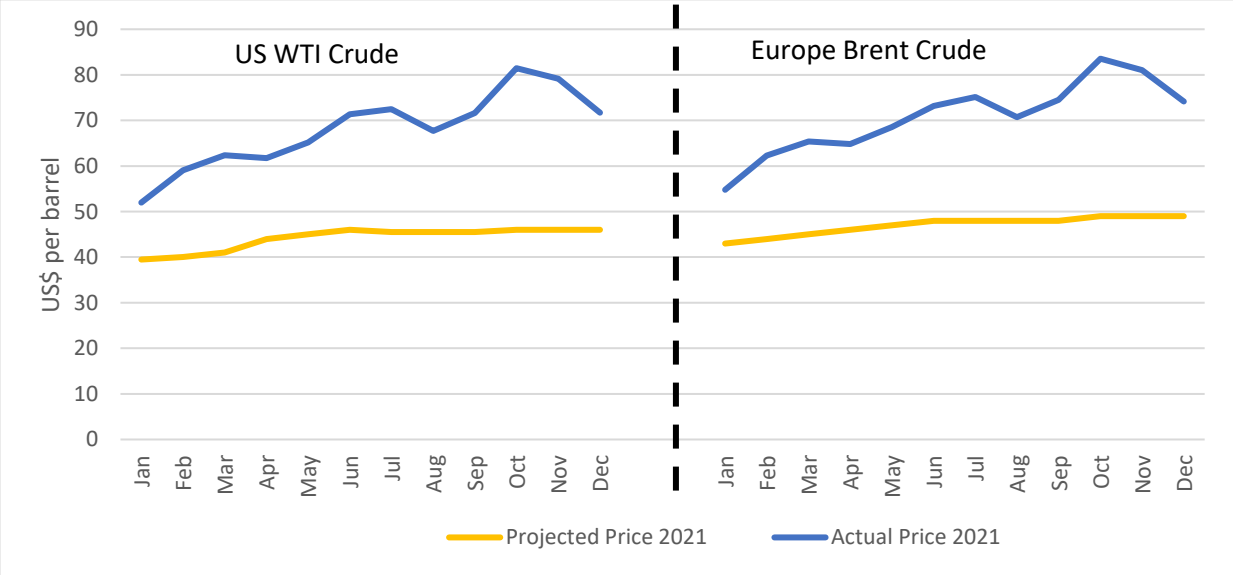


Figure 35: Monthly international average crude oil prices in 2021, US$ per barrel

Source: US Energy Information Administration

Ghana continues to export its crude oil produced from the three oil-producing fields. In 2021, the average achieved price by Ghana Group for all three oil-producing fields was US$69.18 per barrel, an increase from the average achieved price of US$42.21 per barrel in 2020. The achieved unit price was slightly lower than the international Brent average price of US$69.84 per barrel for the same lifting dates in 2021 for the three fields. Table 5 presents the achieved prices of Jubilee, TEN and Sankofa fields in 2021.

Table 5: Achieved market price of Ghana Group oil liftings in 2021, US$/barrel

Field	Date Lift	Ghana Group Achieved Price	International Price (Europe Brent)
Jubilee	06-Mar-2021	65.01	65.63
	27-Apr-2021	63.63	64.70
	16-Jul-2021	71.60	71.81
	28-Aug-2021	73.76	74.58
	08-Dec-2021	74.77	74.10
	Average	**69.75**	**70.16**
TEN	16-Feb-2021	61.57	62.22
	06-Jul-2021	74.38	75.03
	15-Dec-2021	71.37	72.72
	Average	**69.11**	**69.99**
Sankofa	18-Apr-21	64.93	65.48
	13-Jul-21	72.65	73.25
	Average	**68.79**	**69.37**

Source: GNPC

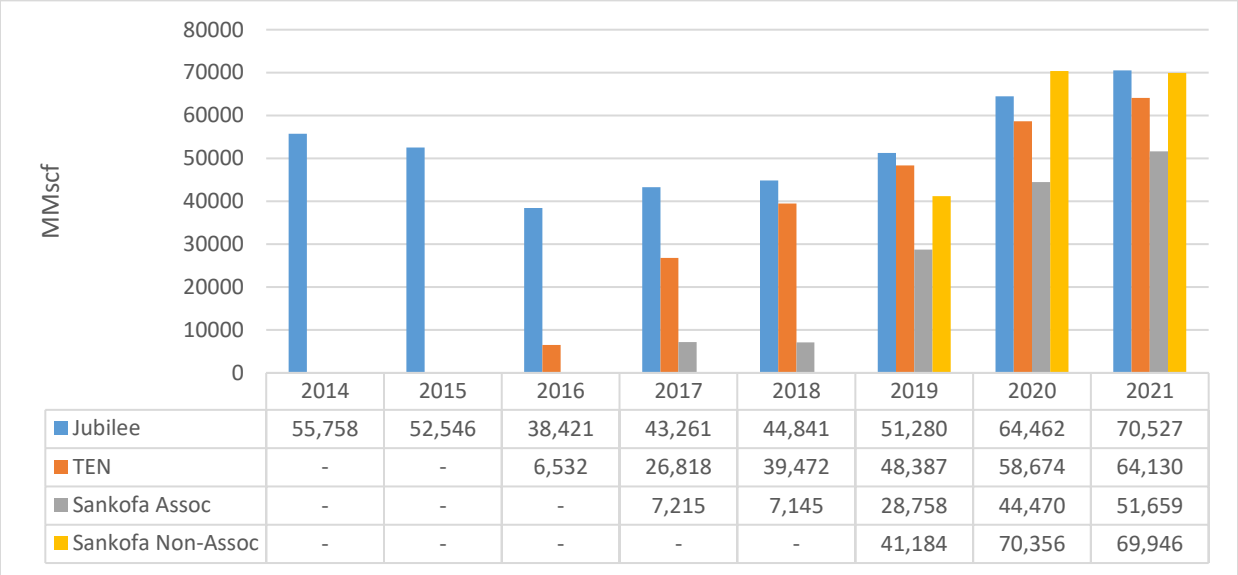
The average price achieved by Ghana Group for five liftings at the Jubilee field in 2021 was US$69.75 per barrel compared to US$40 per barrel for six liftings in 2020. The achieved unit price for the Jubilee field was slightly lower than the international Brent average price of US$70.16 per barrel for the same lifting dates in 2021. For the TEN field, the average price achieved was US$69.11 per barrel for three liftings in 2021, which is higher than the average price of US$41 per barrel achieved for also three liftings in 2020. The achieved unit price for the TEN field was slightly lower than the Brent average price of US$69.99 per barrel for the same lifting dates in 2021. There were two liftings at the Sankofa field for an achieved average price of US$68.79 per barrel in 2021, up from US$44 per barrel for three liftings in 2020. The achieved unit price for

the Sankofa field was also a bit lower than the international Brent average price of US$69.37 per barrel for the same lifting dates in 2021.

4.2 Natural Gas

4.2.1 Natural Gas Production

Natural gas produced (both associated and non-associated) from the three fields – Jubilee, TEN and Sankofa in 2021 was 256,262 MMscf. This represents a 7.7% increase over the volume of 237,963 MMscf produced in 2020 and is the highest recorded since 2014. This is mainly due to relatively stable operations on the three producing fields and the increased gas offtake nominations, particularly for electricity generation. Figure 36 presents the volumes of raw gas produced since 2014.



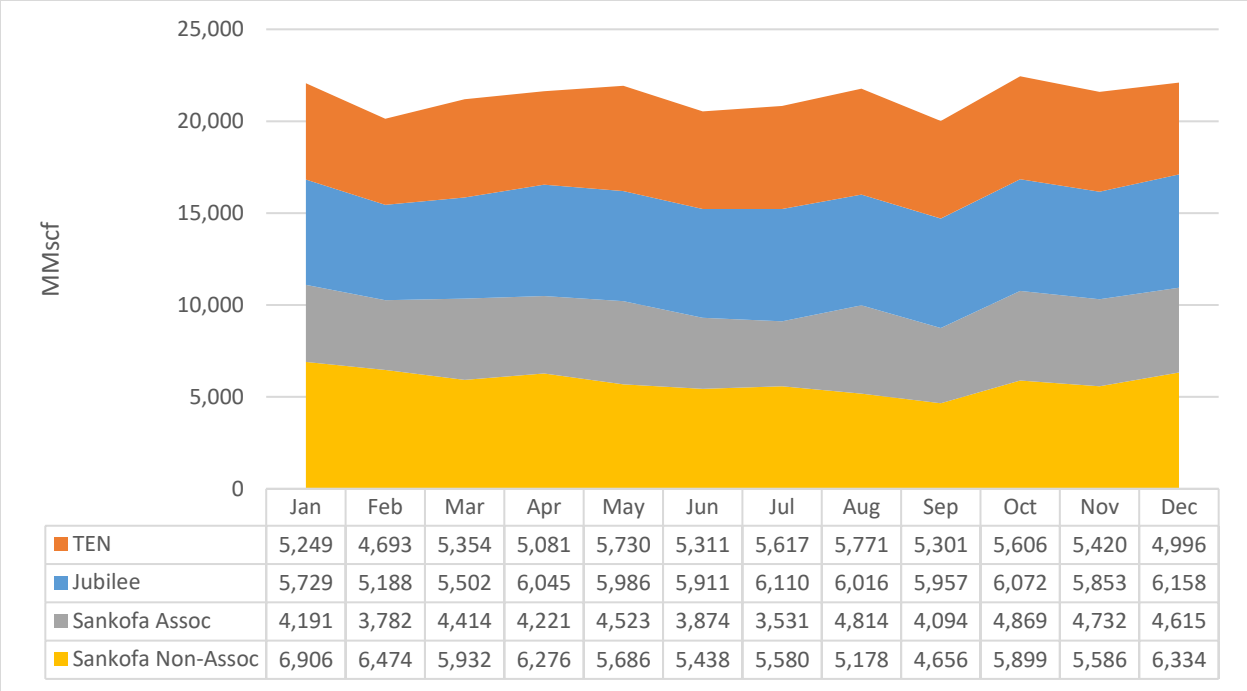
	2014	2015	2016	2017	2018	2019	2020	2021
Jubilee	55,758	52,546	38,421	43,261	44,841	51,280	64,462	70,527
TEN	-	-	6,532	26,818	39,472	48,387	58,674	64,130
Sankofa Assoc	-	-	-	7,215	7,145	28,758	44,470	51,659
Sankofa Non-Assoc	-	-	-	-	-	41,184	70,356	69,946

Figure 36: Volumes of raw gas production from 2014 to 2021

Source: GNPC and PC

Raw gas produced from the Jubilee field increased by 9.4%, from 64,462 MMscf in 2020 to 70,527 MMScf in 2021. TEN field also witnessed a 9.3% increase in production, from 58,674 MMscf in 2020 to 64,130 MMscf in 2021. Total raw gas production from associated and non-associated sources at the Sankofa field was 121,605 MMscf in 2021, up from 114,826 MMscf produced in 2020. This constituted 42.5% of associated gas and 57.5% of the non-associated gas at the Sankofa

field in 2021. Figure 37 presents the monthly production of raw gas for Jubilee, TEN and Sankofa in 2021.

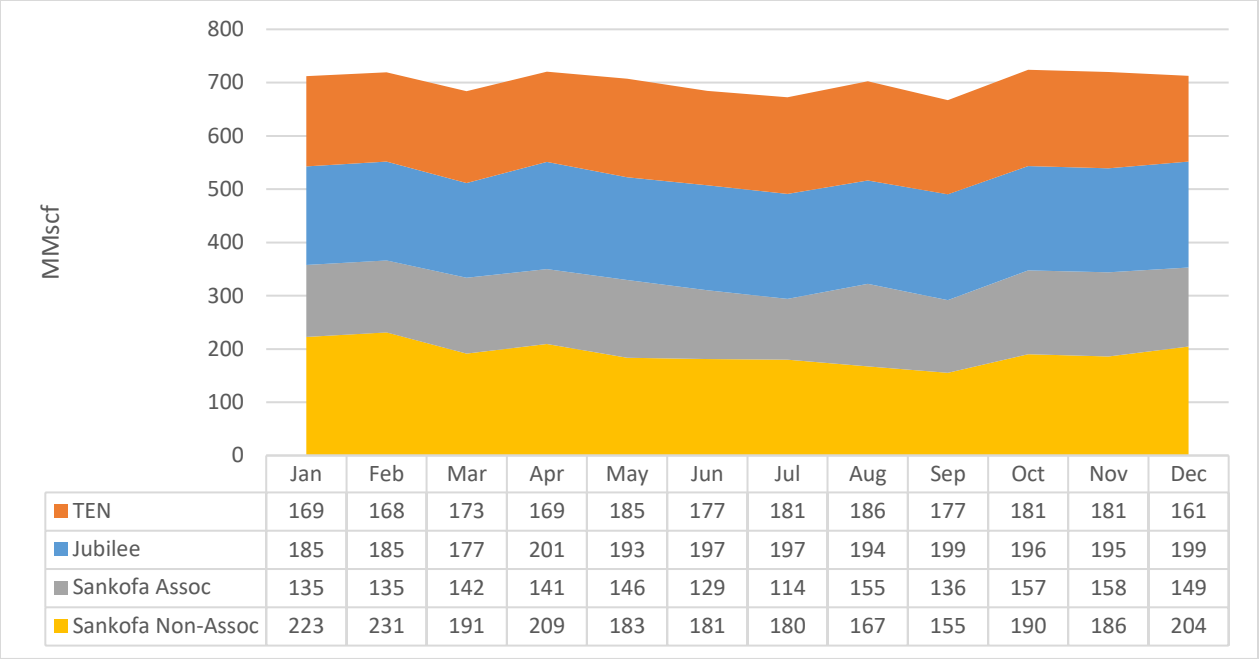


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TEN	5,249	4,693	5,354	5,081	5,730	5,311	5,617	5,771	5,301	5,606	5,420	4,996
Jubilee	5,729	5,188	5,502	6,045	5,986	5,911	6,110	6,016	5,957	6,072	5,853	6,158
Sankofa Assoc	4,191	3,782	4,414	4,221	4,523	3,874	3,531	4,814	4,094	4,869	4,732	4,615
Sankofa Non-Assoc	6,906	6,474	5,932	6,276	5,686	5,438	5,580	5,178	4,656	5,899	5,586	6,334

Figure 37: Monthly raw gas production in 2021

Source: PC

In 2021, the average daily production of raw gas from the three fields combined was 702 MMscf/day, an increase of 7.9% over 2020 average daily production. Figure 38 presents monthly average daily production of raw gas for Jubilee, TEN and Sankofa in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TEN	169	168	173	169	185	177	181	186	177	181	181	161
Jubilee	185	185	177	201	193	197	197	194	199	196	195	199
Sankofa Assoc	135	135	142	141	146	129	114	155	136	157	158	149
Sankofa Non-Assoc	223	231	191	209	183	181	180	167	155	190	186	204

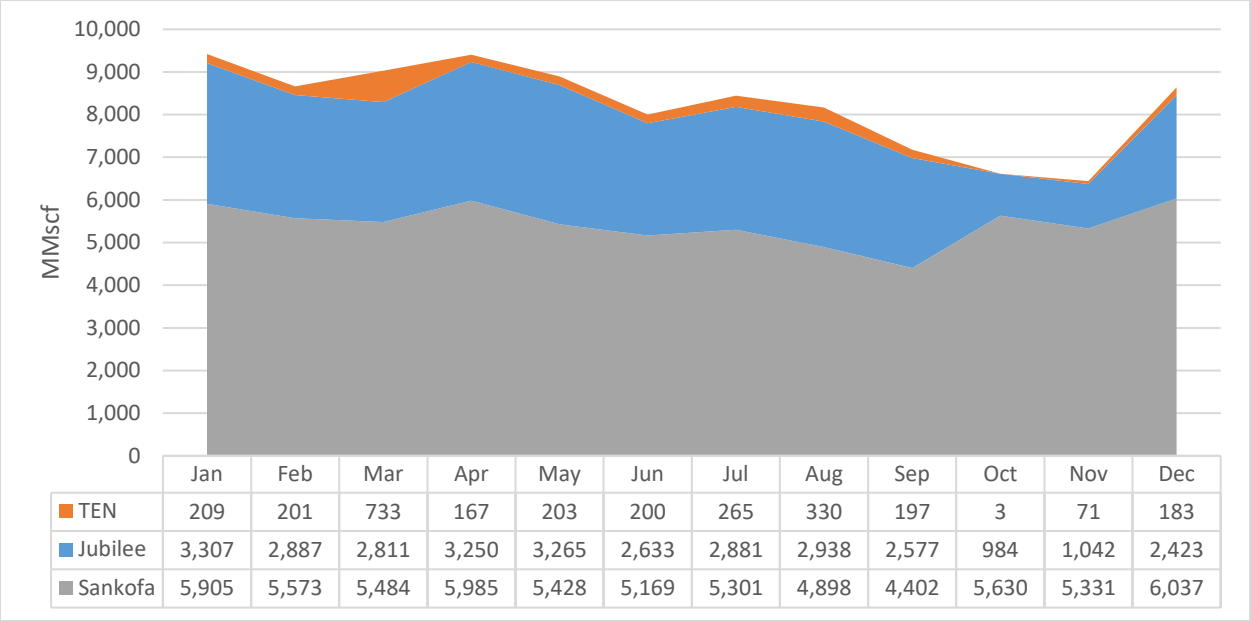
Figure 38: Monthly average daily volumes of natural gas produced in 2021

Source: GNPC

Daily production of raw gas from the Jubilee field in 2021 was 193 MMscf/day, up from 176 MMscf/day in 2020. Average daily production from the TEN field also increased from 160 MMscf/day in 2020 to 177 MMscf/day in 2021. Average daily production from both Jubilee and TEN was 369 MMscf/day in 2021. Daily average production from Sankofa field (both associated and non-associated) increased to 332 MMscf/day in 2021 from 315 MMscf/day in 2020.

4.2.2 Gas Export from Producing Fields

Total raw gas exported from Jubilee (associated gas) to Atuabo Gas Processing Plant (AGPP) and from Sankofa (non-associated gas) to the ENI Offshore Receiving Facility (ENI ORF) witnessed a significant increase in 2021. However, gas export from TEN (associated gas) to the AGPP witnessed a considerable reduction to about half. A total of 98,901 MMscf of associated and non-associated gas was exported in 2021, an increase of 11.7% over the 2020 volume of 88,531 MMscf. Figure 39 presents monthly gas export from the three fields in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TEN	209	201	733	167	203	200	265	330	197	3	71	183
Jubilee	3,307	2,887	2,811	3,250	3,265	2,633	2,881	2,938	2,577	984	1,042	2,423
Sankofa	5,905	5,573	5,484	5,985	5,428	5,169	5,301	4,898	4,402	5,630	5,331	6,037

Figure 39: Monthly raw gas exported from Jubilee, TEN and Sankofa in 2021

Source: PC

AGPP continues to receive a steady supply of raw gas from the Jubilee field. The field exported 30,998 MMscf of raw gas to AGPP in 2021, representing 43.9% of gas produced, with the remainder re-injected, used as fuel or flared. The raw gas exported was 17.4% higher than that of 2020 (26,415 MMscf). The high in export was attributed to a substantial increase in gas offtake in 2021.

There was a significant decrease in raw gas supplied from the TEN field to the AGPP in 2021. The field exported 2,761 MMscf to the AGPP in 2021, down from 5,545 MMscf exported in 2020. A greater portion of raw gas produced from the TEN field (95.2%) was either re-injected, used as fuel on the FPSO or flared. The TEN field associated gas is treated as a Jubilee foundation gas under a substitution agreement between the Jubilee and TEN field's partners that might have accounted for the low export.

The Sankofa field exported 65,141 MMscf, representing 93.1% of the non-associated gas produced to the ORF in 2021. The gas exported from the field represented a 15.2% increase over the volumes exported in 2020 (56,621 MMscf). The remaining volume of gas was re-injected, flared

or used for electricity generation on the FPSO. The ORF experienced plant-upsets and maintenance works which resulted in the reduction of gas export to the facility.

In 2021, average daily export of gas from the three fields combined was 271 MMscf/day, an increase of 12.0% over 2020 average daily export but a decrease of 11.1% from what was projected for the year (Figure 40)[10]. Figure 41 presents monthly average daily export of gas from the three fields in 2021.

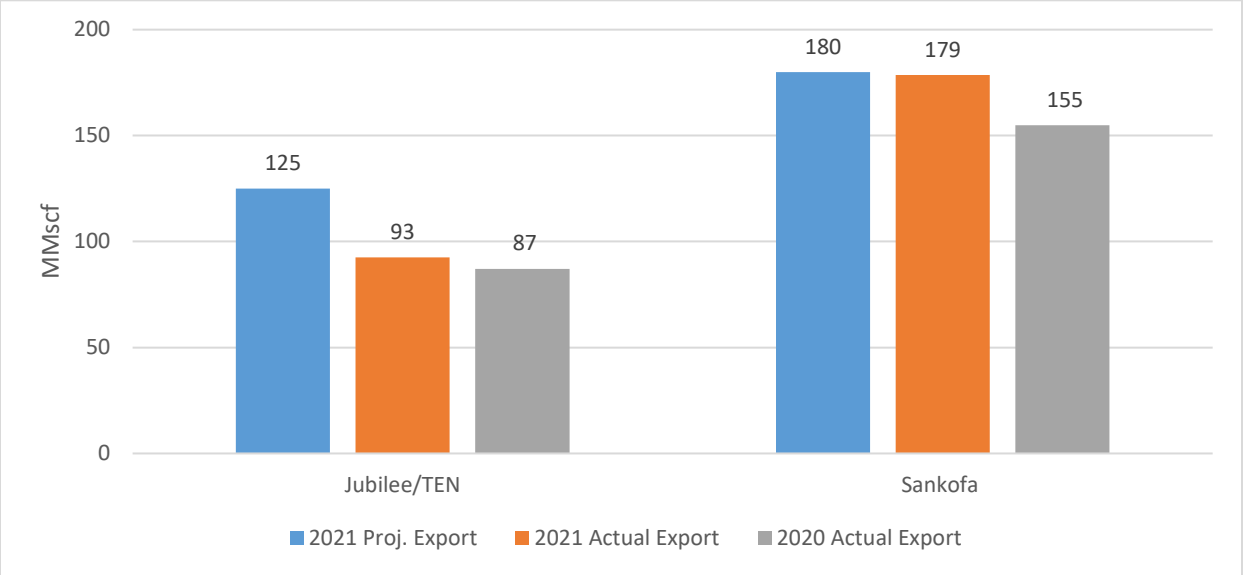
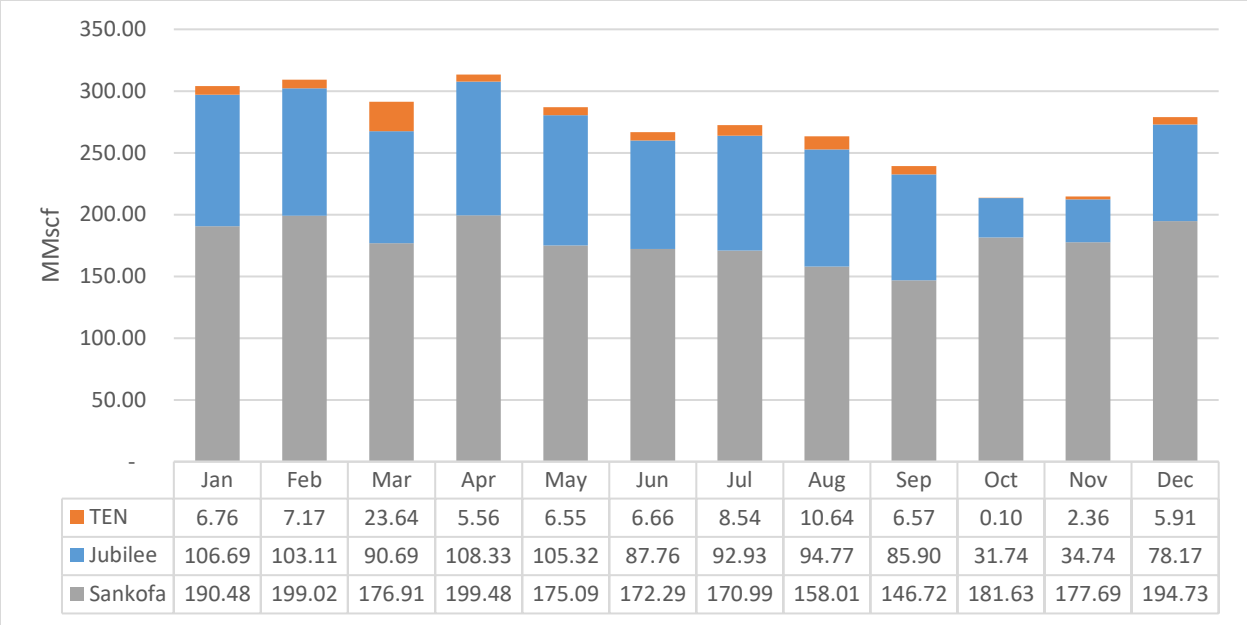


Figure 40: Projected and actual average daily gas exported from the three fields in 2021

[10] 2021 Energy (Supply and Demand) Outlook for Ghana: http://energycom.gov.gh/planning/data-center/energy-outlook-for-ghana



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TEN	6.76	7.17	23.64	5.56	6.55	6.66	8.54	10.64	6.57	0.10	2.36	5.91
Jubilee	106.69	103.11	90.69	108.33	105.32	87.76	92.93	94.77	85.90	31.74	34.74	78.17
Sankofa	190.48	199.02	176.91	199.48	175.09	172.29	170.99	158.01	146.72	181.63	177.69	194.73

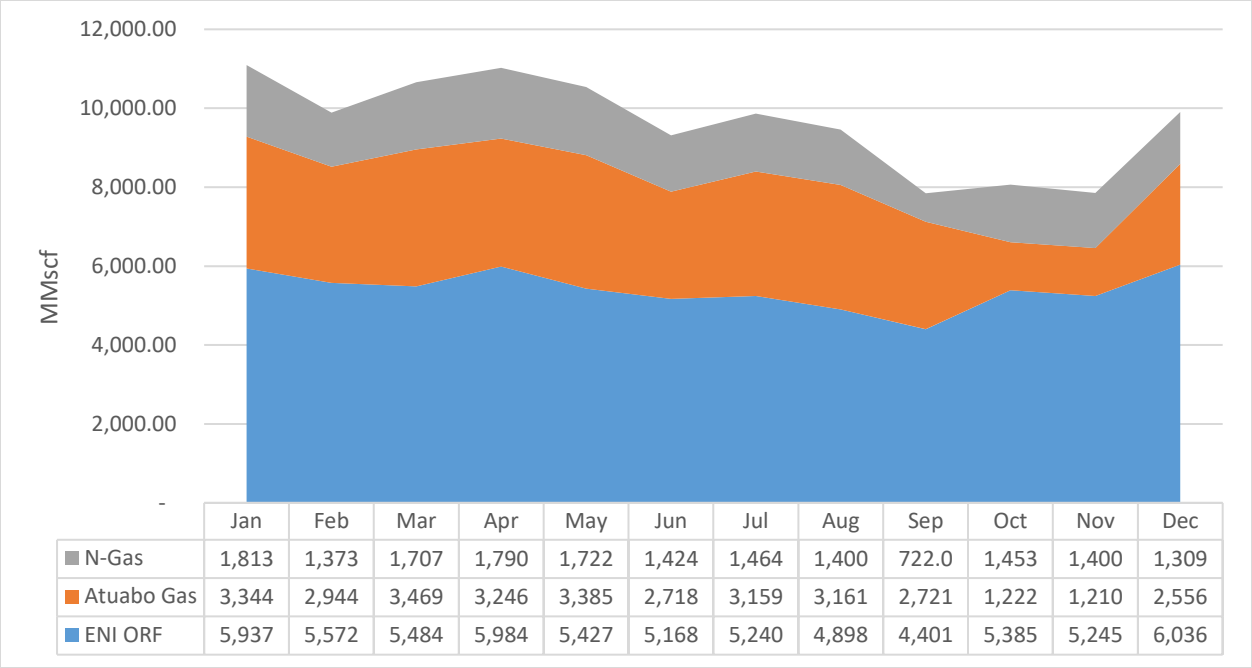
Figure 41: Monthly average daily export of gas from the three fields in 2021

Source: PC

Daily export of raw gas from the Jubilee field in 2021 was 85 MMscf/day, up from 72 MMscf/day in 2020. However, the average daily export from the TEN field decreased by about half from 15 MMscf/day in 2020 to 8 MMscf/day in 2021. Average daily export from both Jubilee and TEN was 93 MMscf/day, which was lower than the average daily export of 125 MMscf/day projected in 2021. The gas exported from Jubilee/TEN was 6.2% higher than 2020 export. Daily average export from Sankofa field (non-associated) increased to 179 MMscf/day in 2021 from 155 MMscf/day in 2020 and almost the same as projected.

4.2.3 Lean Gas Supplied in 2021

Total lean gas supplied from three main sources - AGPP, ENI ORF and Nigeria rose to 115,503 MMscf in 2021, up from 107,138 MMscf in 2020. The total lean gas in 2021 is made up of 33,138 MMscf supplied by AGPP from processing raw gas exported from Jubilee and TEN fields and 64,783 MMscf of non-associated gas received at the ENI ORF. The remaining 17,583 MMscf was imported from Nigeria via WAGPCo. The increase in supply of lean gas in 2021 was as a result of increase demand for electricity and appreciable increase demand for non-power purposes. Monthly supplies of lean gas from the three sources are presented in Figure 42.

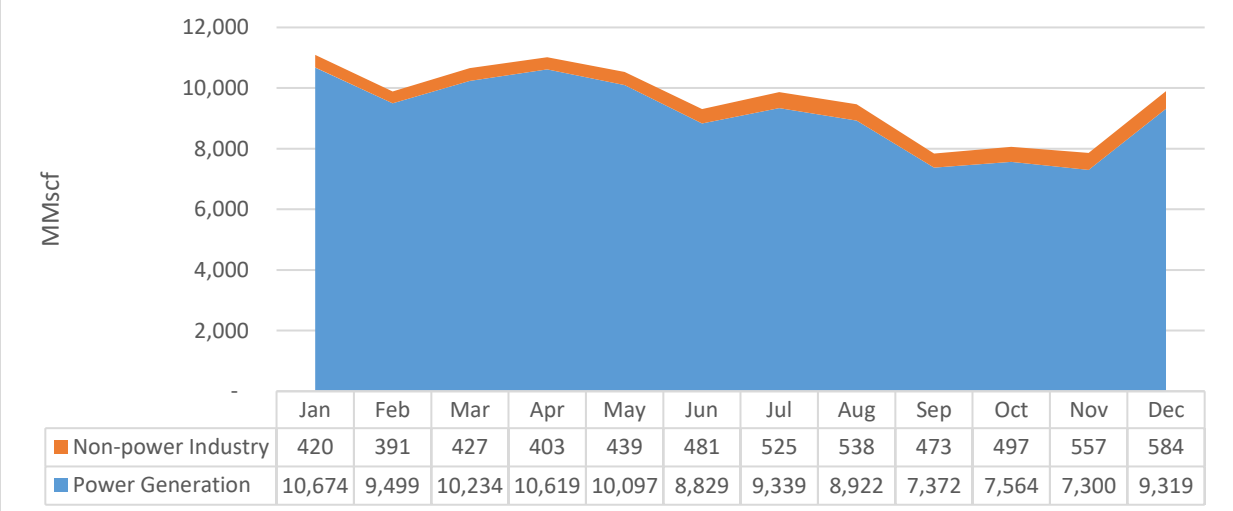


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N-Gas	1,813	1,373	1,707	1,790	1,722	1,424	1,464	1,400	722.0	1,453	1,400	1,309
Atuabo Gas	3,344	2,944	3,469	3,246	3,385	2,718	3,159	3,161	2,721	1,222	1,210	2,556
ENI ORF	5,937	5,572	5,484	5,984	5,427	5,168	5,240	4,898	4,401	5,385	5,245	6,036

Figure 42: Monthly lean gas supplied by AGPP, ENI ORF and WAGPCo

Source: GNGC, VRA

In terms of industrial share, a large portion (95.0%) of gas supplied in 2021 is for power generation. The remaining 5.0% of gas supplied is for non-power uses (industrial uses), mainly the ceramics industry.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Non-power Industry	420	391	427	403	439	481	525	538	473	497	557	584
Power Generation	10,674	9,499	10,234	10,619	10,097	8,829	9,339	8,922	7,372	7,564	7,300	9,319

Figure 43: Monthly lean gas supplied

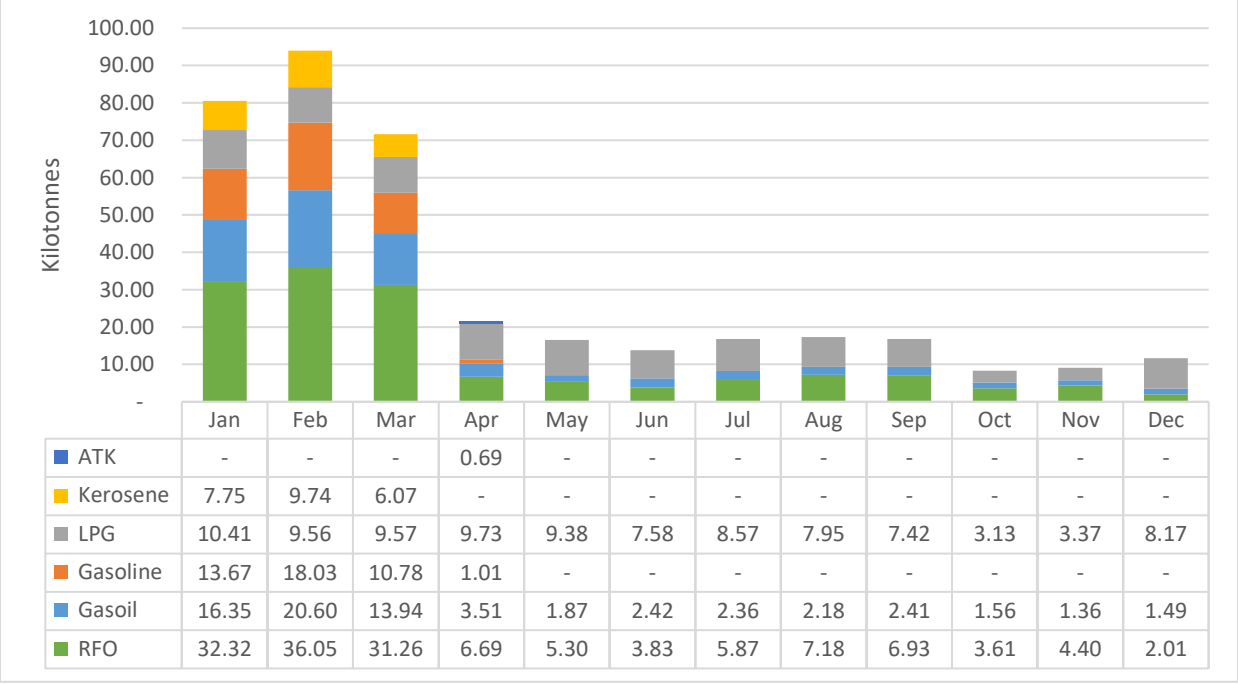
Source: GNGC, VRA

Gas supplied for power generation rose to 109,768 MMscf, up from 102,714 MMscf in 2020. Total supply for industrial uses was 5,735 MMscf in 2021, up from 4,424 MMscf in 2020. The highest lean gas supplied for power generation was in January and the lowest was in November (Figure 43)

4.3 Petroleum Product

4.3.1 Petroleum Products Production

Total petroleum products produced[11] reduced from 580 kilotonnes in 2020 to 378 kilotonnes in 2021. The reduction may be due to challenges in securing the necessary financing to procure crude oil for the state-owned Tema Oil Refinery (TOR). In 2021, TOR only operated for four (4) months that is from January to April. Figure 44 presents the monthly quantities of petroleum products refined in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ATK	-	-	-	0.69	-	-	-	-	-	-	-	-
Kerosene	7.75	9.74	6.07	-	-	-	-	-	-	-	-	-
LPG	10.41	9.56	9.57	9.73	9.38	7.58	8.57	7.95	7.42	3.13	3.37	8.17
Gasoline	13.67	18.03	10.78	1.01	-	-	-	-	-	-	-	-
Gasoil	16.35	20.60	13.94	3.51	1.87	2.42	2.36	2.18	2.41	1.56	1.36	1.49
RFO	32.32	36.05	31.26	6.69	5.30	3.83	5.87	7.18	6.93	3.61	4.40	2.01

Figure 44: Petroleum products produced in the country in 2021

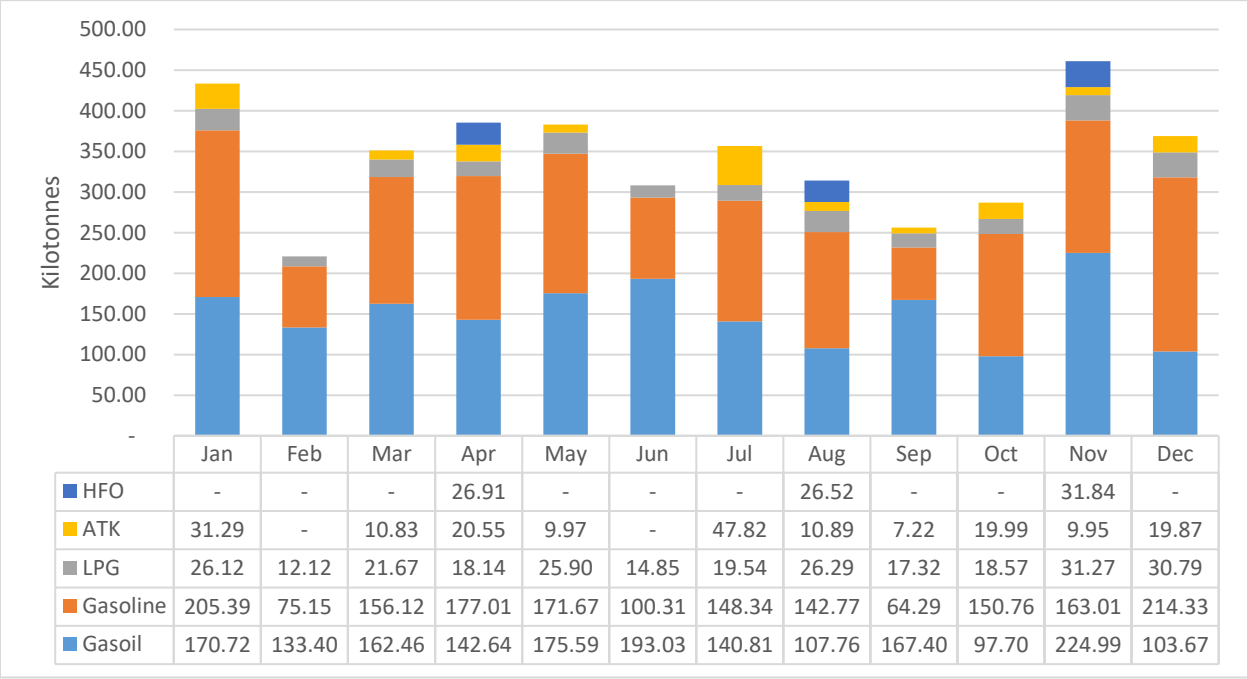
Source: NPA, GNGC

[11] Currently, there are three refineries that process crude oil into the various petroleum products in the country. these are the state-owned Tema Oil Refinery (TOR) and two privately owned refineries namely Platon Gas Oil Limited and Akwaaba Oil Limited

Gasoil (diesel) production witnessed a drastic decline to 70 kilotonnes in 2021, representing 53.2% decrease from 2020 production. Gasoline (petrol) produced was 43 kilotonnes in 2021, a decrease of 34.6% from production in 2020. About 95 kilotonnes (1.8% produced by TOR and 98.2% produced by AGPP) of liquefied petroleum gas (LPG) was produced in 2021 as against 85 kilotonnes produced in 2020. Aviation Turbo Kerosene (ATK) witnessed a reduction in production, from 28 kilotonnes in 2020 to a mere one (1) kilotonnes in 2021. Kerosene production was 24 kilotonnes in 2021 compared to 35 kilotonnes in 2020, while Residual Fuel Oil (RFO) produced was 145 kilotonnes in 2021, down from 216 kilotonnes produced in 2020.

4.3.2 Petroleum Product Import

With production woefully inadequate, the country has to rely on imports of petroleum products to meet demand. Total import increased from 3,966 kilotonnes in 2020 to 4,126 kilotonnes in 2021, representing an increase of 4.0%. Figure 45 presents monthly quantities of petroleum products imported into the country in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HFO	-	-	-	26.91	-	-	-	26.52	-	-	31.84	-
ATK	31.29	-	10.83	20.55	9.97	-	47.82	10.89	7.22	19.99	9.95	19.87
LPG	26.12	12.12	21.67	18.14	25.90	14.85	19.54	26.29	17.32	18.57	31.27	30.79
Gasoline	205.39	75.15	156.12	177.01	171.67	100.31	148.34	142.77	64.29	150.76	163.01	214.33
Gasoil	170.72	133.40	162.46	142.64	175.59	193.03	140.81	107.76	167.40	97.70	224.99	103.67

Figure 45: Monthly quantity of petroleum products imported into the country in 2021

Source: NPA

In 2021, gasoil saw a decrease of 6.0% in import but still recorded the highest import of 1,820 kilotonnes. Gasoline recorded the next highest import of 1,769 kilotonnes in 2021, representing an increase of 8.9% from its 2020 import. LPG import was 263 kilotonnes in 2021, a slight increase of 0.4% of import in 2020. ATK witnessed a tremendous increase in import, from 80 kilotonnes in 2020 to 188 kilotonnes in 2021. HFO, mainly used for power generation, witnessed an import of 85 kilotonnes in 2021, up from 63 kilotonnes imported in 2020.

4.3.3 Petroleum Product Consumption

In 2021, a total of 4,547.2 kilotonnes of petroleum products was consumed in the country, the highest over the last decade. The consumption increased by some 10.2% from 2020 and 1.9% of projected consumption for the year[12]. With the exception of 2014, 2016 and 2017 which witnessed a fall, consumption followed an upward trend at a growth rate of 6.9% (Figure 46). Major petroleum products considered include gasoil, gasoline, LPG, ATK, kerosene, premix, RFO and marine gas oil (MGO).

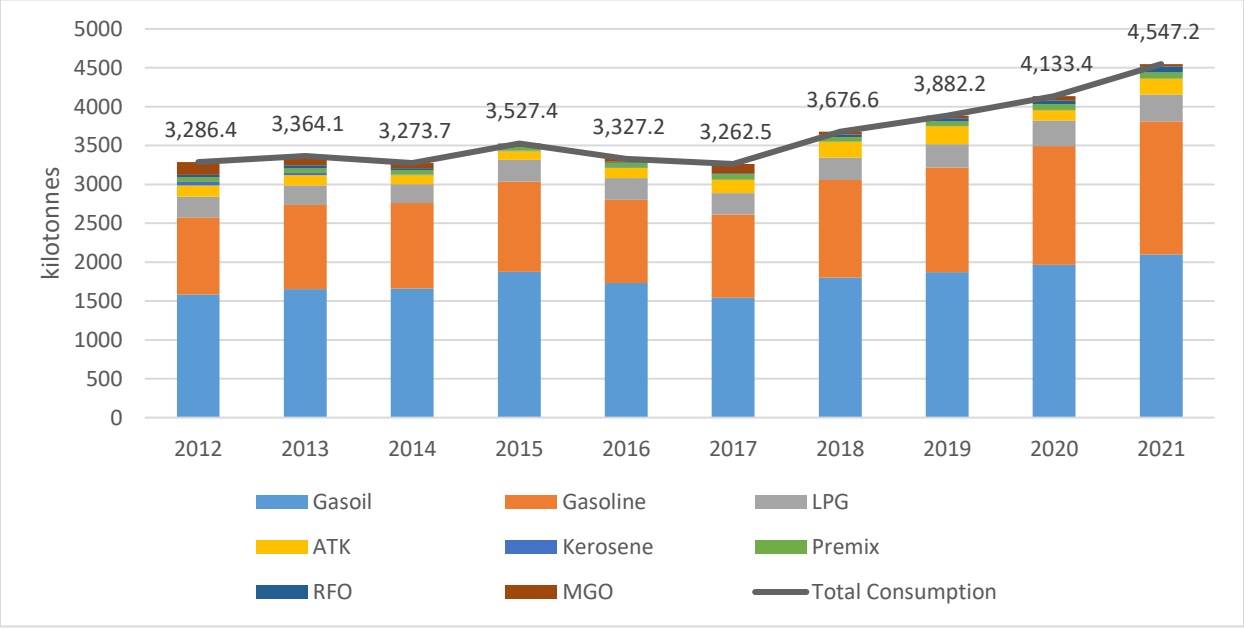
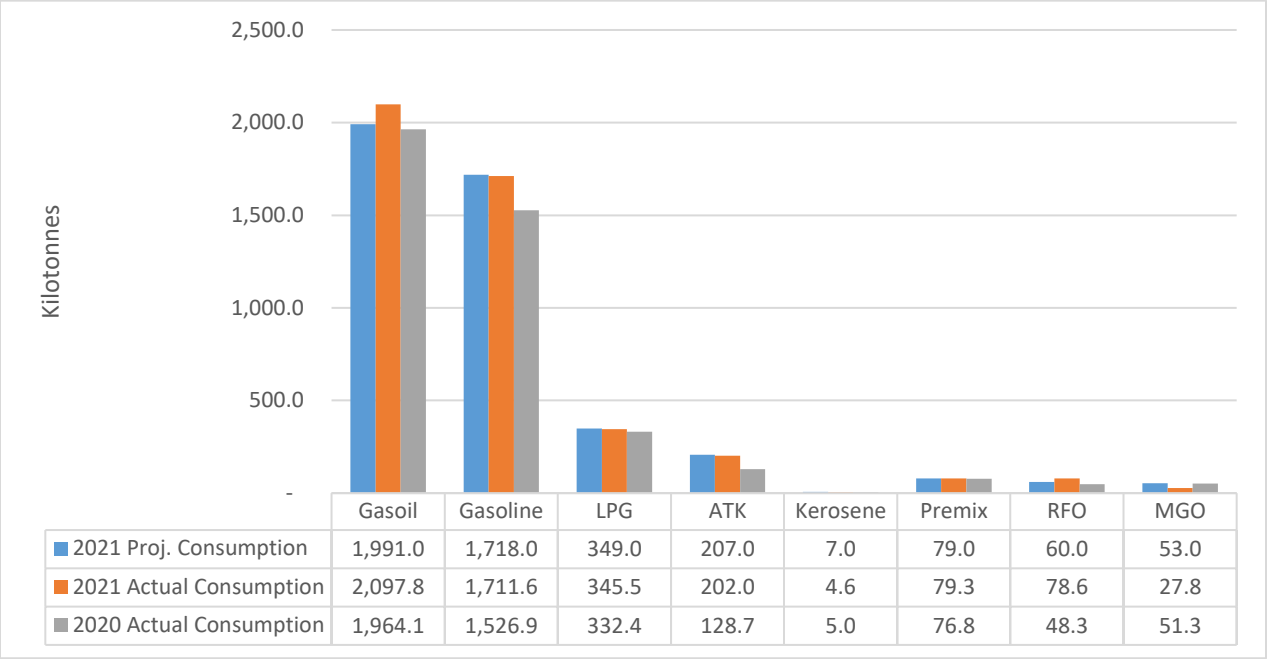


Figure 46: Trend in petroleum products consumption from 2012-2021

Source: NPA

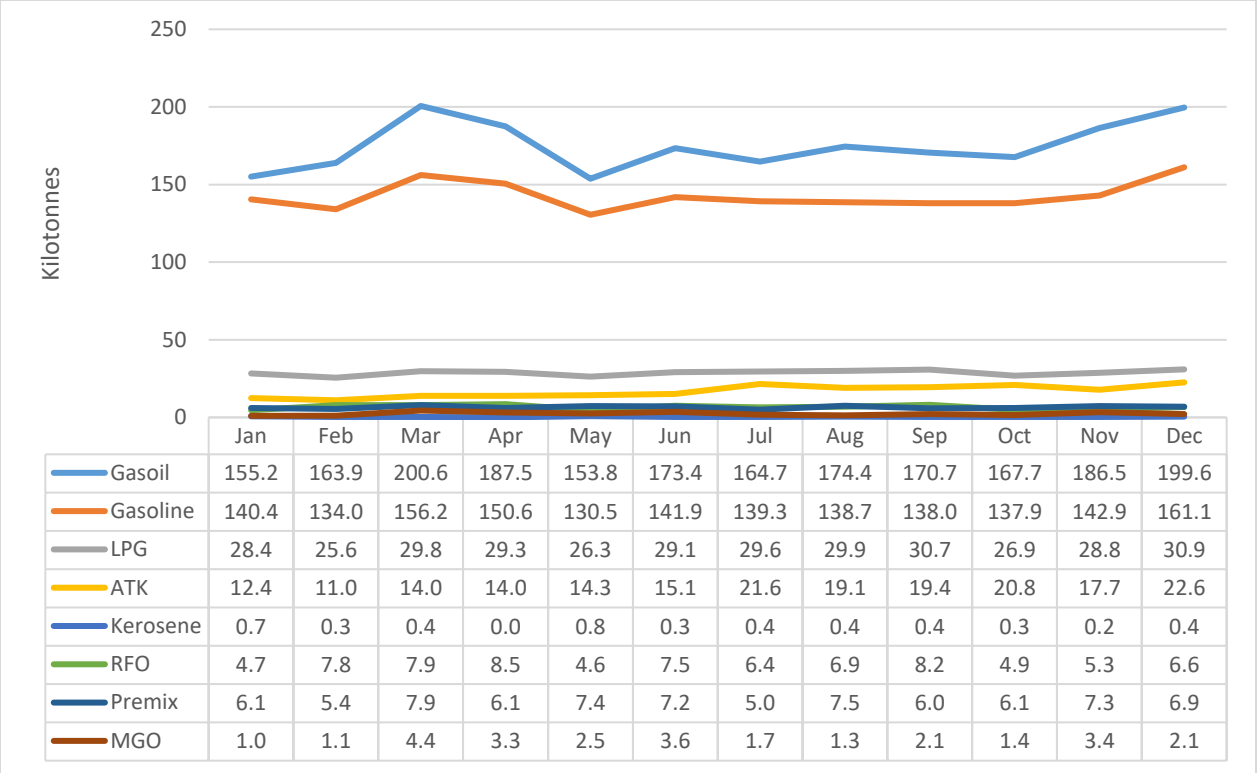
[12]2021 Energy (Supply and Demand) Outlook for Ghana: http://energycom.gov.gh/planning/data-center/energy-outlook-for-ghana



	Gasoil	Gasoline	LPG	ATK	Kerosene	Premix	RFO	MGO
2021 Proj. Consumption	1,991.0	1,718.0	349.0	207.0	7.0	79.0	60.0	53.0
2021 Actual Consumption	2,097.8	1,711.6	345.5	202.0	4.6	79.3	78.6	27.8
2020 Actual Consumption	1,964.1	1,526.9	332.4	128.7	5.0	76.8	48.3	51.3

Figure 47: Projected and actual consumption of major petroleum products in 2021

Gasoil consumption was 2,097.9 kilotonnes in 2021, an increase of 6.8% over 2020 consumption of 1,964.1 kilotonnes and 5.4% of projected consumption of 1,991.3. Similarly, gasoline consumption in 2021 was 1,711.6 kilotonnes, up from 1,526.9 kilotonnes in 2020. The consumption of gasoline in 2021 was down by only 0.4% from the projected consumption of 1,718.0 kilotonnes (Figure 47). LPG, ATK, premix, RFO and MGO consumptions also increased by 3.9%, 57.0%, 12.5%, 43.4% and 56.0% respectively from their 2020 consumptions. However, kerosene consumption witnessed a reduction by 7.5%, from 5.0 kilotonnes in the 2020 to 4.6 kilotonnes in 2021. MGO consumption also witnessed huge reduction of about 45.8%, from 51.3 kilotonnes to 27.8 kilotonnes. Figure 48 depicts the trend in monthly petroleum products consumption in 2021.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gasoil	155.2	163.9	200.6	187.5	153.8	173.4	164.7	174.4	170.7	167.7	186.5	199.6
Gasoline	140.4	134.0	156.2	150.6	130.5	141.9	139.3	138.7	138.0	137.9	142.9	161.1
LPG	28.4	25.6	29.8	29.3	26.3	29.1	29.6	29.9	30.7	26.9	28.8	30.9
ATK	12.4	11.0	14.0	14.0	14.3	15.1	21.6	19.1	19.4	20.8	17.7	22.6
Kerosene	0.7	0.3	0.4	0.0	0.8	0.3	0.4	0.4	0.4	0.3	0.2	0.4
RFO	4.7	7.8	7.9	8.5	4.6	7.5	6.4	6.9	8.2	4.9	5.3	6.6
Premix	6.1	5.4	7.9	6.1	7.4	7.2	5.0	7.5	6.0	6.1	7.3	6.9
MGO	1.0	1.1	4.4	3.3	2.5	3.6	1.7	1.3	2.1	1.4	3.4	2.1

Figure 48: Monthly consumption of petroleum products in 2021

Source: NPA

4.3.4 Petroleum Product Prices

Figure 49 shows bi-weekly price of some major petroleum products. The price of gasoline averaged GH¢5.81 per litre in 2021, up by 43.1% from the 2020 average price of GH¢4.06 per litre. Gasoil price, which follows a similar trend as gasoline averaged GH¢5.85 per litre in 2021, witnessing an increase of 44.8% from 2020 average price of GH¢4.04 per litre. The price of LPG averaged GH¢6.81 per kilogram in 2021, representing an increase of 93.5% from 2020 average price of GH¢3.52 per kilogram.

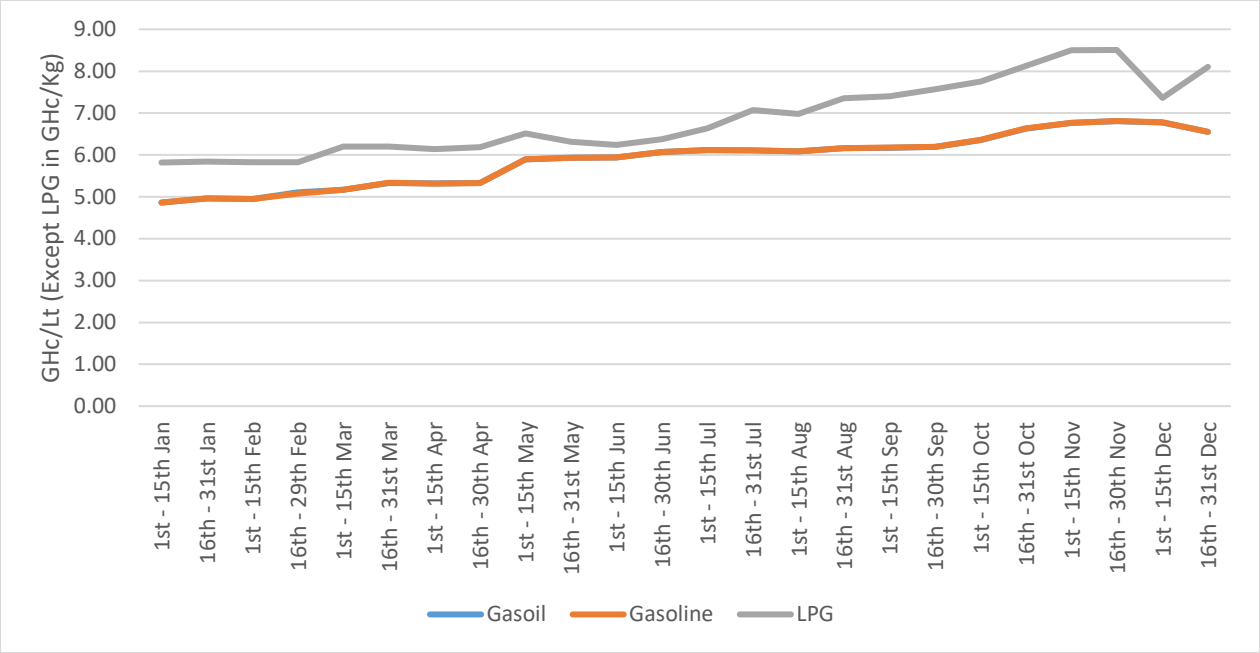


Figure 49: Trend in bi-weekly petroleum products prices

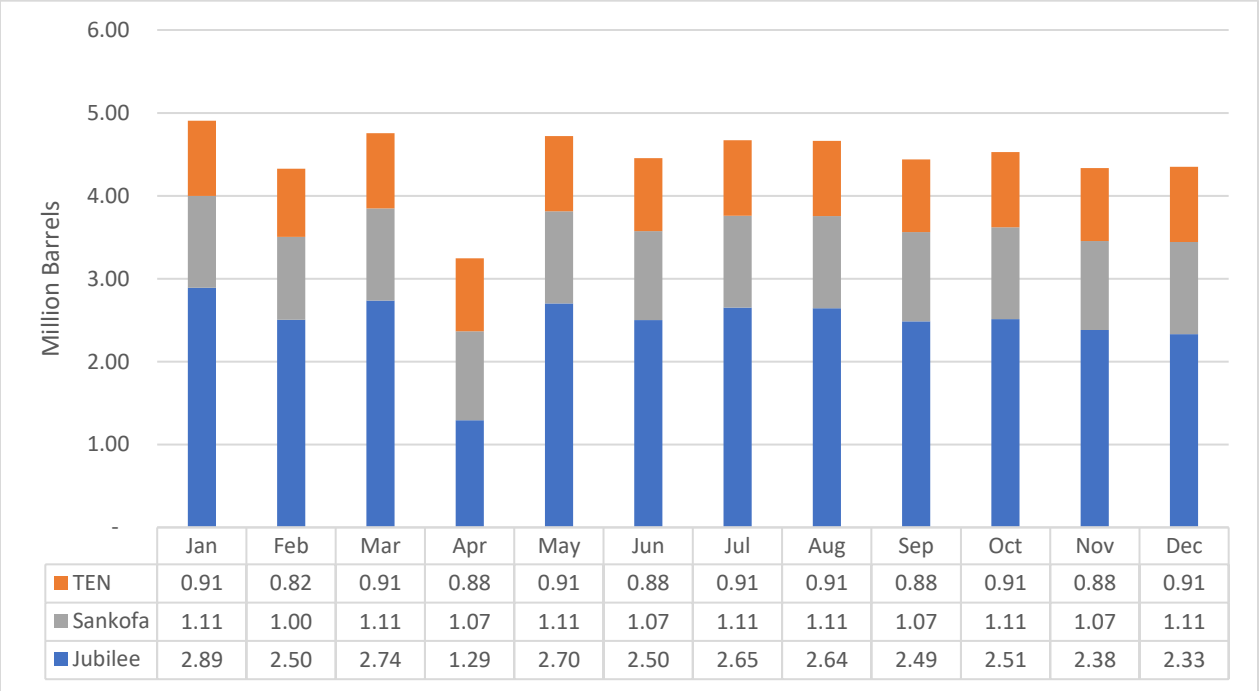
Source: NPA

Chapter Five: Petroleum Outlook 2022

5.1 Outlook for Crude Oil

5.1.1 Crude Oil Production

Since the advent of COVID-19 in 2020, total crude oil production in Ghana has witnessed a downward trend and is expected to continue in 2022. Crude oil production in 2022 is projected to be 53.40 million barrels, a 3.0% decline from 2021 production. The expected reduction is due to anticipated reduction in production from TEN and Sankofa fields. Figure 50 presents expected monthly volumes of crude oil to be produced at the three fields in 2022.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TEN	0.91	0.82	0.91	0.88	0.91	0.88	0.91	0.91	0.88	0.91	0.88	0.91
Sankofa	1.11	1.00	1.11	1.07	1.11	1.07	1.11	1.11	1.07	1.11	1.07	1.11
Jubilee	2.89	2.50	2.74	1.29	2.70	2.50	2.65	2.64	2.49	2.51	2.38	2.33

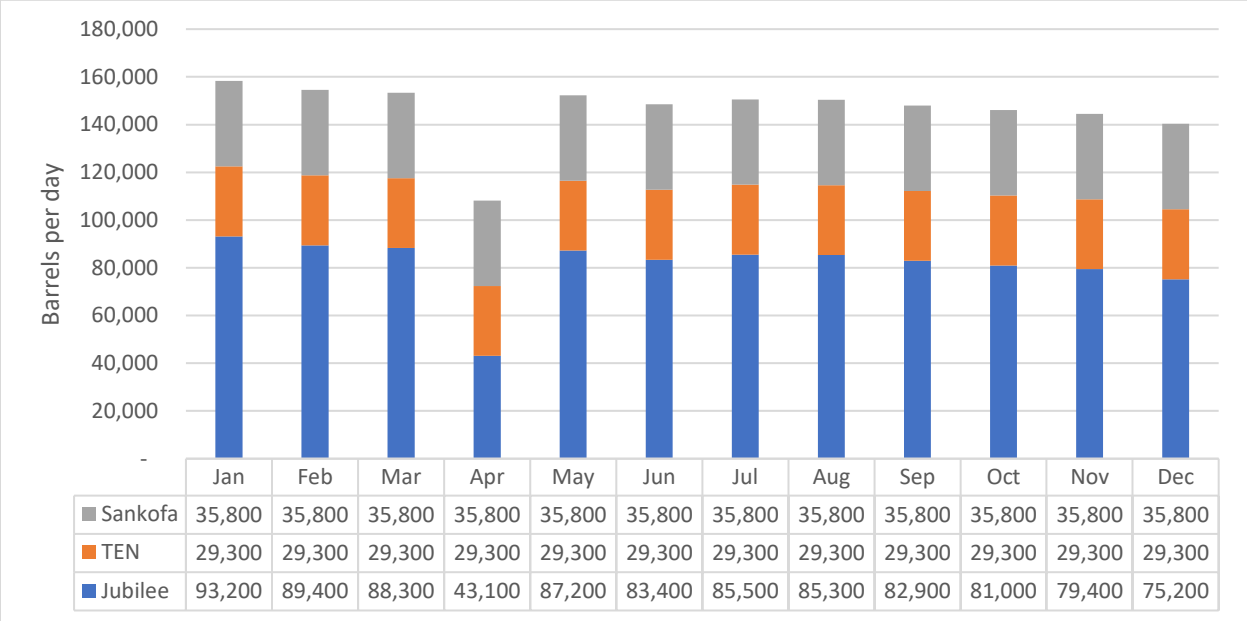
Figure 50: Monthly crude oil production outlook for 2022

Source: GNPC

The Jubilee field is expected to increase its production from 27.34 million barrels in 2021 to 29.63 million barrels in 2022. However, production from TEN and Sankofa fields are expected to reduce in 2022. The TEN field is expected to produce 10.69 million barrels in 2022, a decline

from 11.98 million barrels produced in 2021, while Sankofa production is expected to be 13.07 million barrels, down from 15.74 million barrels produced in 2021.

Average daily production from the three fields combined is expected to be lower in 2022, averaging 146,258 barrels per day, a decline of 3.0% from 2021 production. Figure 51 presents the expected monthly average daily production of crude oil in 2022.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sankofa	35,800	35,800	35,800	35,800	35,800	35,800	35,800	35,800	35,800	35,800	35,800	35,800
TEN	29,300	29,300	29,300	29,300	29,300	29,300	29,300	29,300	29,300	29,300	29,300	29,300
Jubilee	93,200	89,400	88,300	43,100	87,200	83,400	85,500	85,300	82,900	81,000	79,400	75,200

Figure 51: Projected daily average crude oil production for 2022

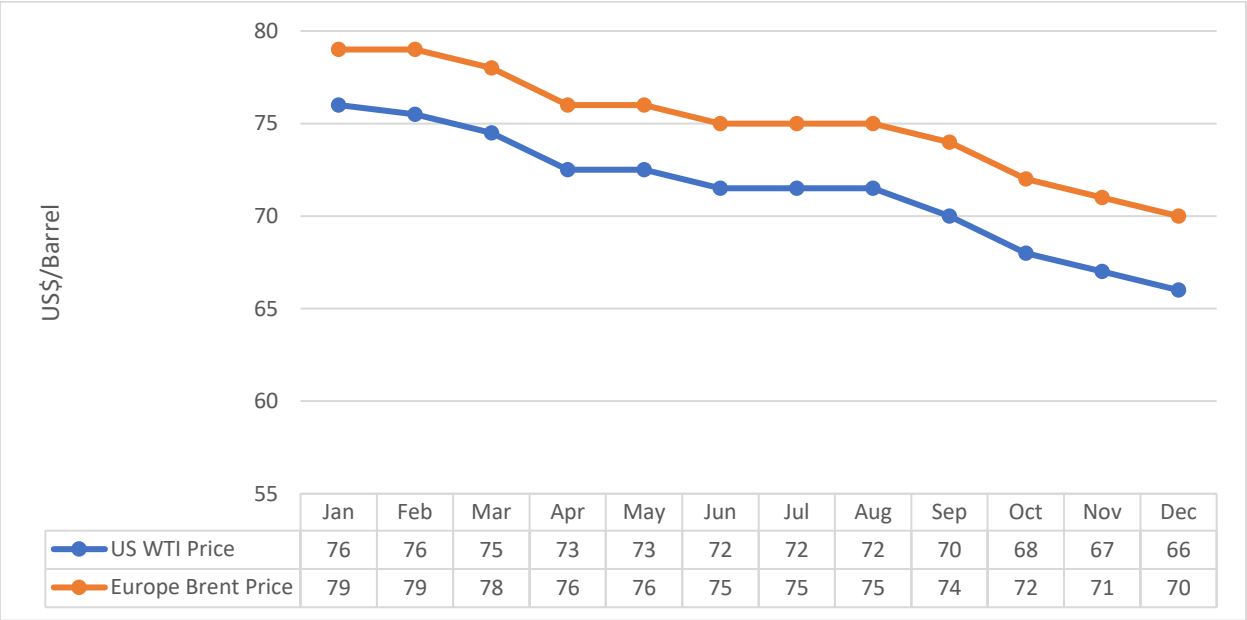
Source: GNPC

In 2022, average daily production from Jubilee field will be 81,158 barrels compared to 74,858 barrels produced in 2021. TEN's average daily production will reduce from 32,844 barrels in 2021 to 29,300 barrels in 2022. Production from Sankofa field will also reduce from an average of 43,138 barrels per day in 2021 to 35,800 barrels per day in 2022.

5.1.2 Crude Oil Price

Brent price averaged US$71 per barrel, while the price of US WTI averaged US$73 per barrel in 2021. In 2022, the US Energy Information Administration (US EIA) expects the price of Brent crude oil to average US$75 per barrel and WTI crude oil to average US$71 per barrel. Oil prices

may assume a rising trend instead of a decreasing one (Figure 52) due to heightened market concerns about the possibility of oil supply disruptions, notably related to tensions between Russia and Ukraine.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
US WTI Price	76	76	75	73	73	72	72	72	70	68	67	66
Europe Brent Price	79	79	78	76	76	75	75	75	74	72	71	70

Figure 52: Projected monthly international benchmark crude oil prices for 2022

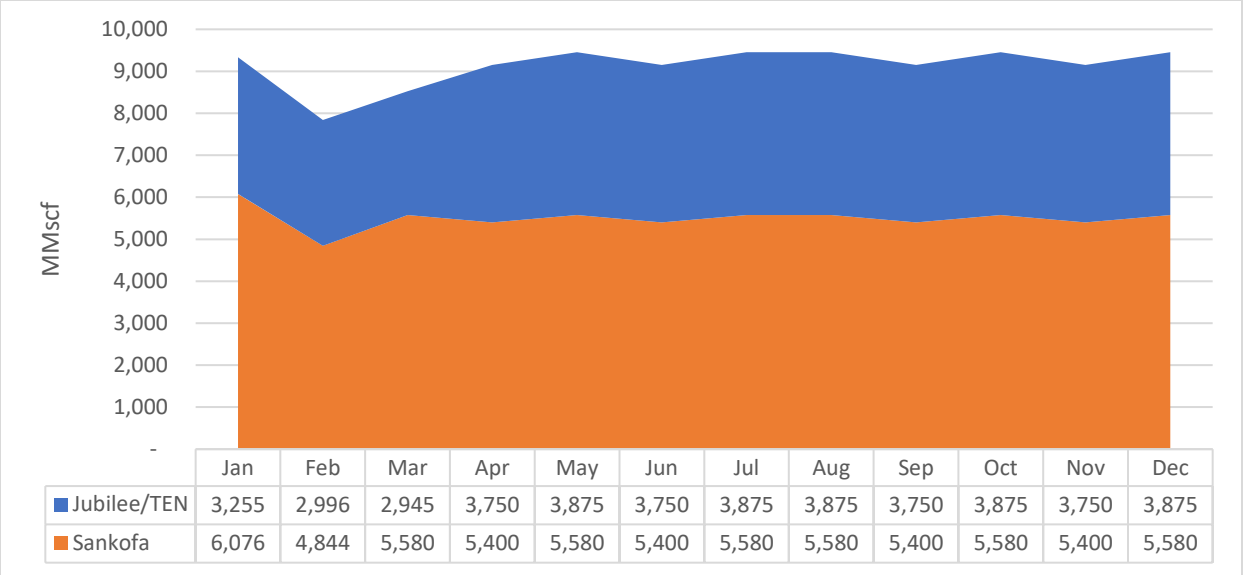
Source: US Energy Information Administration

Ghana's crude oil price is expected to follow the international benchmark price. As such, it is expected that the market price of crude oil from Ghana's fields – Jubilee, TEN and Sankofa will average US$75 per barrel.

5.2 Outlook for Natural Gas

5.2.1 Natural Gas Export from Production Fields

In 2022, raw gas export from Jubilee/TEN (associated) to the AGPP is expected to increase by 29.1% to 43,571 MMscf. Sankofa (non-associated gas) export to the ENI ORF will go up slightly by 1.3% to 66,000 MMscf in 2022. In all, a total of 109,571 MMscf of associated and non-associated gas will be exported in 2022, an increase of 10.8% over the 2021 export. Figure 53 presents expected monthly gas export from the three fields in 2022.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jubilee/TEN	3,255	2,996	2,945	3,750	3,875	3,750	3,875	3,875	3,750	3,875	3,750	3,875
Sankofa	6,076	4,844	5,580	5,400	5,580	5,400	5,580	5,580	5,400	5,580	5,400	5,580

Figure 53: Expected natural gas export from production fields in 2022

Source: GNPC

On a daily basis, Sankofa is expected to maintain its capacity to supply up to 210 MMscf/day, while Jubilee and TEN together are expected to supply 125 MMscf/day in 2022.

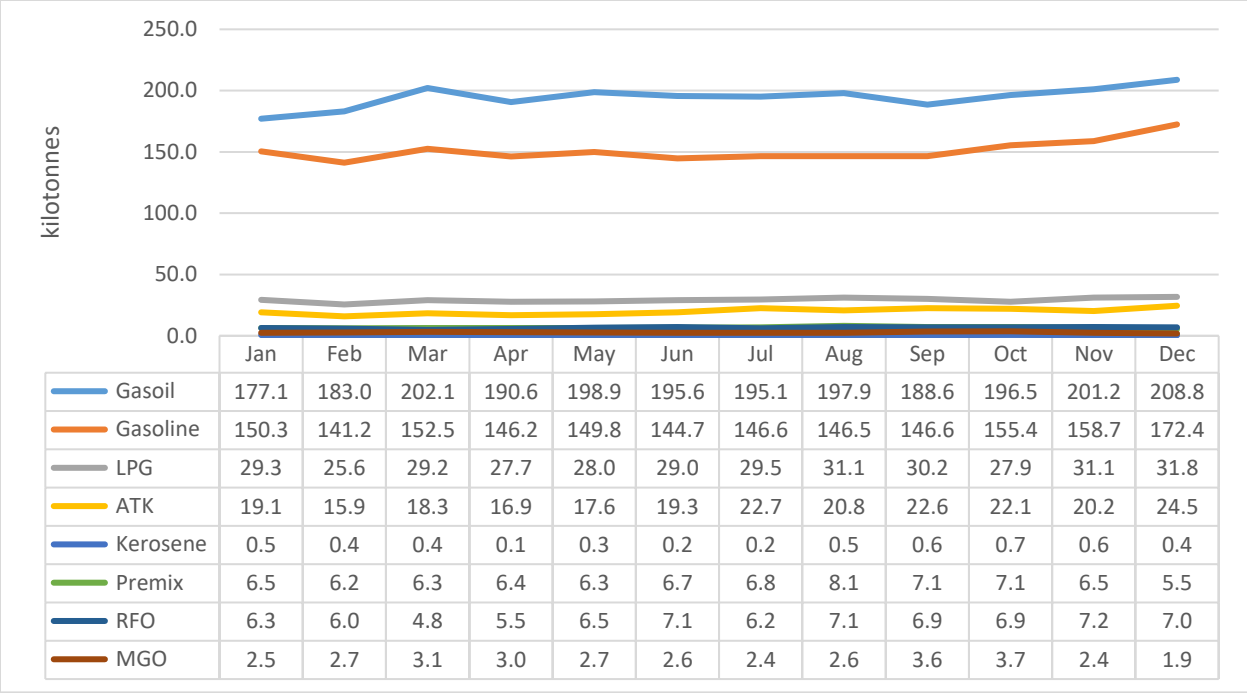
5.2.2 Natural Gas Import

Natural gas import from Nigeria is expected to be about 60 MMscf/day. Gas import is mainly for electricity generation. The Tema LNG facility was expected to receive its maiden import of LNG in 2022, but this has been postponed due to the high price of LNG in the international market.

5.3 Outlook for Petroleum Products

5.3.1 Petroleum Products Demand

Total petroleum products consumption in 2022 is projected to be 4,931.5 kilotonnes, an increase of 8.0% over 2021 consumption. Figure 54 presents the monthly forecast for petroleum products consumption for 2022.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gasoil	177.1	183.0	202.1	190.6	198.9	195.6	195.1	197.9	188.6	196.5	201.2	208.8
Gasoline	150.3	141.2	152.5	146.2	149.8	144.7	146.6	146.5	146.6	155.4	158.7	172.4
LPG	29.3	25.6	29.2	27.7	28.0	29.0	29.5	31.1	30.2	27.9	31.1	31.8
ATK	19.1	15.9	18.3	16.9	17.6	19.3	22.7	20.8	22.6	22.1	20.2	24.5
Kerosene	0.5	0.4	0.4	0.1	0.3	0.2	0.2	0.5	0.6	0.7	0.6	0.4
Premix	6.5	6.2	6.3	6.4	6.3	6.7	6.8	8.1	7.1	7.1	6.5	5.5
RFO	6.3	6.0	4.8	5.5	6.5	7.1	6.2	7.1	6.9	6.9	7.2	7.0
MGO	2.5	2.7	3.1	3.0	2.7	2.6	2.4	2.6	3.6	3.7	2.4	1.9

Figure 54: Monthly outlook for petroleum product consumption

Source: Energy Commission

Gasoil consumption is projected to be about 2,335.3 kilotonnes in 2022, an increase of about 11.3% over the 2021 consumption. Gasoline consumption on the other hand, is projected to be about 1,811.0 kilotonnes in 2022, also up by 5.8% from the 2021 consumption. LPG witnessed considerable growth in consumption in 2021. It is expected to increase by 1.4%, from 345 kilotonnes in 2021 to about 350.2 kilotonnes in 2022. ATK consumption is expected to increase substantially in 2022 to 239.99 kilotonnes. Kerosene consumption is not expected to increase significantly in 2022, about 4.96 kilotonnes. Consumption of other petroleum products such as Premix and RFO is expected to increase to 79.7 kilotonnes and 77.31 kilotonnes respectively whiles MGO is expected to decrease to 33.07 kilotonnes.

Chapter Six: Woodfuel Sub-sector

The main source of cooking and heating fuel in Ghana is woodfuel irrespective of the intense programs and activities carried out by the Government of Ghana to promote the use of LPG as the main household cooking fuel. Some small-scale enterprises such as the bread–baking, local brewery, traditional textiles industries, traditional soap making, fish smoking palm oil processing and local catering services use wood fuel as the base fuel for production.

This chapter comprises information on woodfuel production and supply, which is mainly based on estimations due to the unavailability of actual woodfuel data. More so, the chapter presents charcoal price data as it's the most commonly used fuelwood from a survey conducted in 2021.

6.1 Woodfuel Production and Consumption

6.1.1 Woodfuel Production

The total estimated wood fuel production for all purposes was 4,190 Ktoe in 2021 from 3,371 Ktoe in 2011 at an average annual growth rate of 2.2% and is expected to reach 4,224 Ktoe in 2022 (Figure 55).

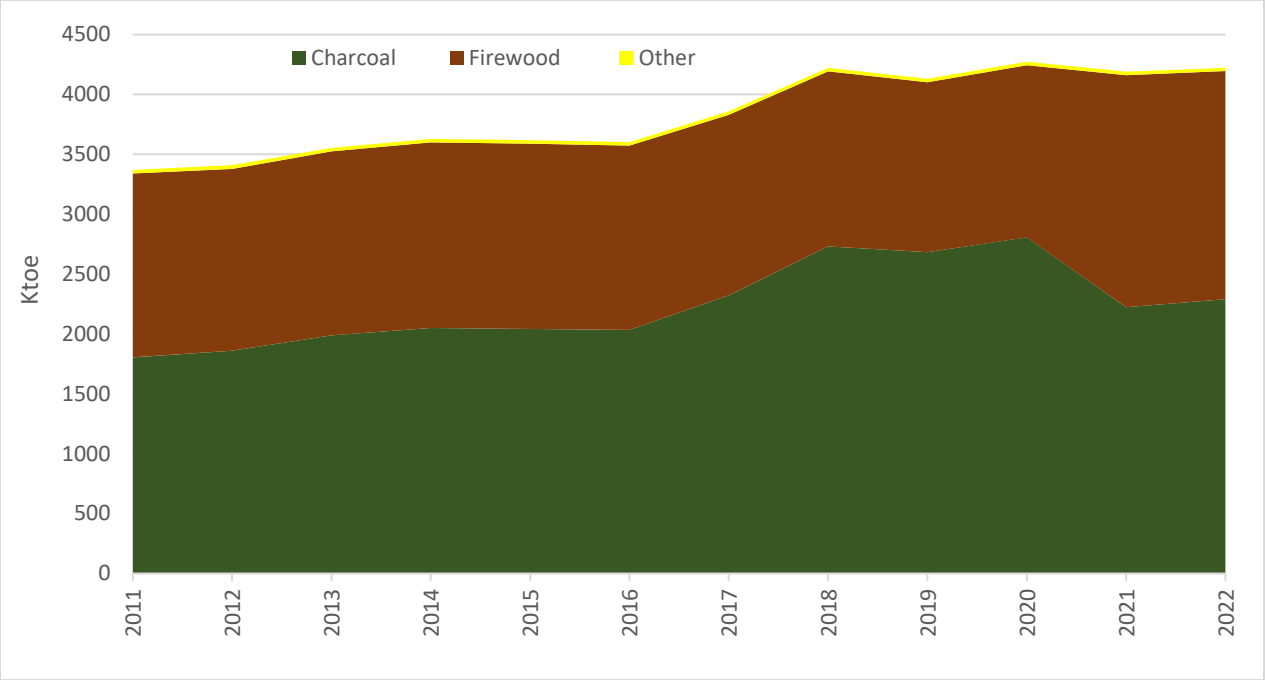


Figure 55: Woodfuel production[13]

Charcoal Production

The chuck of wood used as fuel in the various sectors of the economy is mainly use in the form of charcoal for cooking and in other local small-scale industries. In 2011, charcoal supply was estimated at 1,805 Ktoe which grew steadily at a rate of 2.1% to 2,225 Ktoe in 2021. The 2021 charcoal supply experienced about a 20.1% drop from the 2020 value of 2,807 Ktoe to 2,225 Ktoe which could be due to woodcutting regulations. Charcoal production is expected to increase further by 3.0% to 2,290 Ktoe in 2022.

Firewood production

In 2011, the total estimated firewood production was 1,535 Ktoe and increased steadily to 1,937 Ktoe in 2021 at an annual growth rate of 2.4%. The trend in firewood supply increased sharply from 1,438 Ktoe in 2020 to 1,937 Ktoe in 2021. These estimated values are anticipated to drop by about 1.6% to 1,906Ktoe in 2022.

[13] 2021 National Energy Statistics: http://energycom.gov.gh/files/2020%20ENERGY%20STATISTICS-revised.pdf

Crop Residue and others

The production of other biomass (mainly crop residue) was estimated at 30 Ktoe in 2011, and it's expected to remain around this quantity till 2022.

6.1.2 Biomass Consumption

The total biomass consumed in the economy was estimated at 3,162Ktoe in 2021. The residential sector is the largest consumer of biomass with a share of 87.2%, followed by the industrial sector with a share of 8.6% and the least biomass sector consumer is 4.1% which is the service sector (Figure 56).

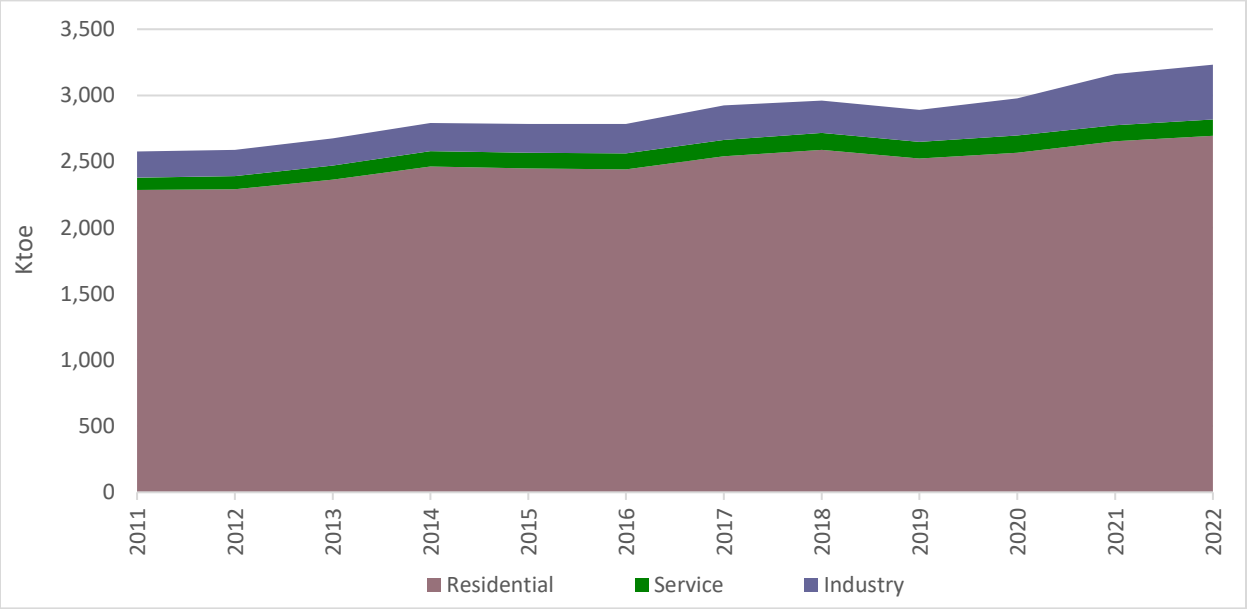


Figure 56: Biomass consumption by sectors[14]

Residential Sector

This sector has always been the highest consumer of biomass, consuming on average 2469 Ktoe between 2011 and 2021. The annual growth rate of biomass consumed within this period was 1.5%. Biomass consumption is further expected to increase by 40 Ktoe to 2,695 Ktoe in 2022.

Industrial Sector

[14] 2021 National Energy Statistics: http://energycom.gov.gh/files/2020%20ENERGY%20STATISTICS-revised.pdf

This sector has the fastest growing rate of 7.0% per annum. In 2011, the consumption by the industrial sector was 197 Ktoe and rose to an estimated value of 387 Ktoe and it is further expected to increase to 414 Ktoe in 2022.

Service Sector

Biomass consumption by the service sector is the least among the major sectors of the economy. The average annual consumption was projected at 117 Ktoe from 2011 through to 2021 at an annual growth rate of 2.6%. The service sector in 2022 is estimated at 123 Ktoe.

6.2 Woodfuel Prices

Charcoal is bagged and traded in maxi and mini bags. The average weight of a maxi and mini bag of charcoal are 50.2 and 38.8 kg respectively. A summary of the average price of charcoal in selected cities across the country is illustrated in Figure 57.

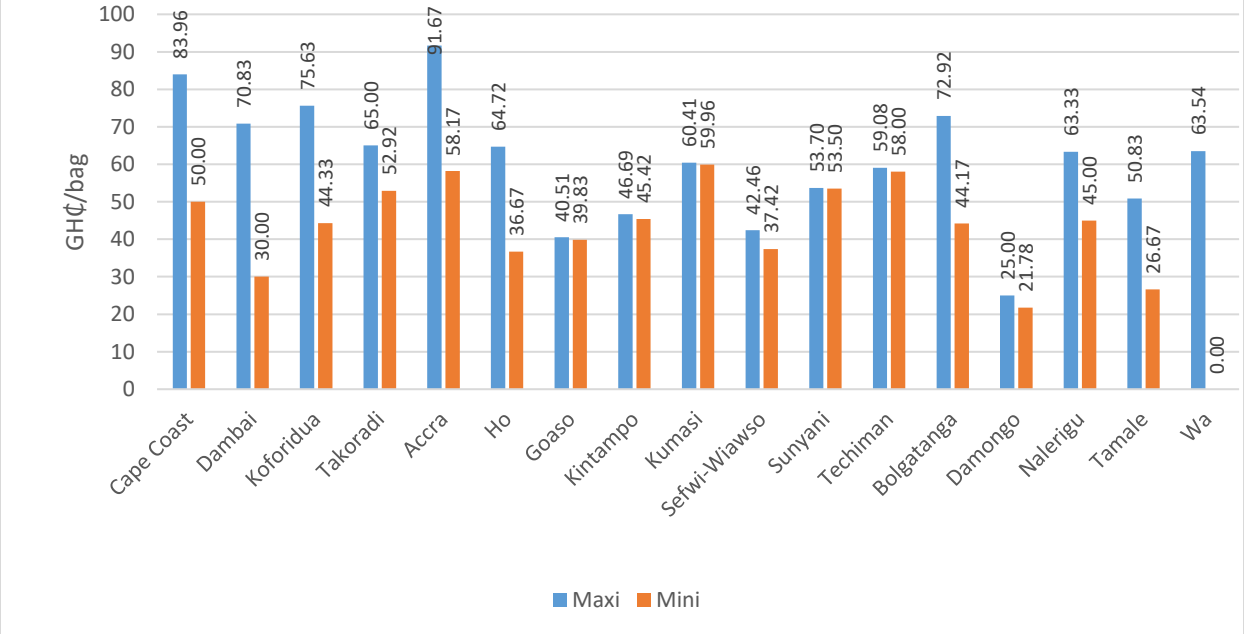


Figure 57: Charcoal price from major market centres across the country

Source: Survey data

The national mean price for a maxi bag of charcoal in 2021 was GH¢62, and that of the mini bag was GH¢44. The price of a maxi bag was highest in Accra, followed by Cape Coast and Koforidua,

respectively. The mini bag had its highest price in Kumasi, followed closely by Accra and Techiman, respectively. Damongo had the least price of both maxi and mini bags. In 2022, charcoal price is expected to grow at the same rate as the national inflation rate for the country.

The average unit price of charcoal (cedi/kg) in 2021 is estimated and presented in Figure 58.

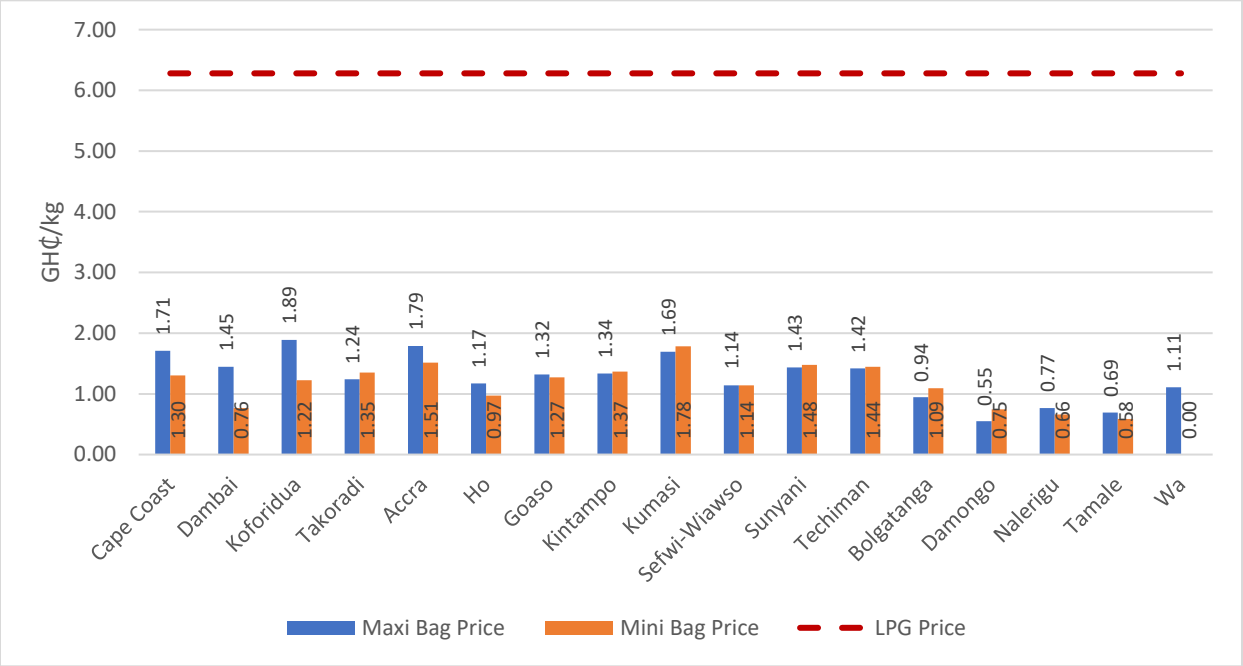


Figure 58: Average price per kilogram of charcoal across major market centres in Ghana in 2021

Source: Survey data

Chapter Seven: Conclusions and Recommendations

7.1 Conclusions

7.1.1 Electricity

The system peak demand in 2022 is projected to increase by 9.2% to 3,545 MW. The corresponding projected energy consumption for 2022 is projected to be 23,579 GWh, an increase of 9.8% over 2021 consumption. Domestic consumption (including VALCO and losses) will constitute 91.7% of total consumption, while energy export will constitute 8.3% of total consumption. VALCO is expected to operate on two potlines in 2022.

To meet anticipated demand, the hydro and thermal plants are projected to generate 7,394 GWh (31.4%) and 16,000 GWh (67.9%) respectively. The remaining energy of 184 GWh, representing 0.8%, is expected to be met by the embedded generation mostly renewables, including solar PV and biogas.

Power generation capacity of 5,449.1 MW with a total dependable capacity of 4,975.2 MW will be available for power generation in 2022. However, considering planned units' maintenance and fuel supply situation, it is anticipated that up to 4,044 MW of the total dependable capacity will be made available to meet the expected system peak demand of 3,545 MW with a reserve margin of 14%.

Fuel for thermal power plants in 2022 will be mainly natural gas to be procured from indigenous and import sources. The total natural gas consumption for 2022 is projected to be 139.2 TBtu. An estimated 548,657 barrels of HFO will be required by AKSA plant in 2022. The total cost of fuel is estimated to be $872.83 million in 2022. About $834.43 will be used to procure natural gas and the remainder for the procurement of HFO to fuel the AKSA plant.

7.1.2 Petroleum

In 2022, total crude oil production is expected to decline further to 53.40 million barrels due to anticipated reduction in production from TEN and Sankofa fields. The Jubilee field is expected to increase its production to 29.63 million barrels in 2022, while TEN and Sankofa fields are expected to reduce their production to 10.69 million barrels and 3.07 million barrels, respectively. Average daily production from the three fields is expected to be 146,258 barrels. Jubilee field will contribute the highest of 81,158 barrels/day, while TEN and Sankofa are each expected to contribute 29,300 barrels/day and 35,800 barrels/day, respectively.

Crude oil price is expected to continue rising in 2022. The US EIA put Brent crude oil prices to average US$75 per barrel in 2022. It is expected that the average achieved price of Ghana's crude oil from the three fields – Jubilee, TEN and Sankofa will hover around the international benchmark price.

In 2022, raw gas export from Jubilee/TEN (associated) to the AGPP is expected to increase to 43,571 MMscf. Sankofa (non-associated gas) export to the ENI ORF will go up slightly to 66,000 MMscf in 2022. In all, a total of 109,571 MMscf of associated and non-associated gas will be exported to the AGPP and ENI ORF, respectively, in 2022. On a daily basis, Sankofa is expected to maintain its capacity to supply up to 210 MMscf/day to the ORF in 2022. Jubilee and TEN together are expected to supply up to 125 MMscf/day to the AGPP. Gas import from Nigeria and LNG import are also expected in 2022. The expected import from Nigeria is pegged at 50 MMscf/day. LNG import is forecast to be about 50 MMscf/day.

Total petroleum products consumption in 2022 is projected to be 4,931.5 kilotonnes, an increase of 8.0% over 2021 consumption. Out of this, gasoil consumption is forecast to be about 2,335.3 kilotonnes, increasing by 11.3% over the 2021 consumption, while gasoline will be 1,811.0 kilotonnes in 2022, up by 5.8% from the 2021 consumption. LPG consumption is expected to grow by 1.4% from 345.5 kilotonnes in 2021 to about 350.2 kilotonnes in 2022. ATK and kerosene consumption for 2022 are expected to be 240.0 kilotonnes and 5.0 kilotonnes, respectively. Other petroleum products such as Premix, RFO and MGO will have a combined consumption of 190.1 kilotonnes in 2022.

7.1.3 Woodfuel

Wood to be extracted for use as firewood in 2022 is estimated to be 1,906 Ktoe, a decrease of 1.6% from the estimated extraction in 2021. Also, wood to be extracted for charcoal production would be 2,990 Ktoe, increasing by 3.0% overestimated extraction in 2021. The production of other biomass (mainly crop residue) would be about 30 ktoe in 2022.

Household consumption of biomass is expected to rise to an estimated value of 2,695 Ktoe in 2022, while the services and industrial sectors are each expected to consume 414 Ktoe and 123 Ktoe, respectively.

The national mean price for a maxi bag of charcoal in 2021 was GH¢62.00, while the mean price for a mini bag of charcoal was GH¢44.00. In 2022, charcoal consumption is expected to rise, due to relatively high price of LPG. As a result, charcoal price is also expected to increase in 2022, but marginally. At worst, it would grow at the same rate as the national inflation for the year.

7.2 Recommendations

The following recommendations are made.

7.2.1 Electricity

1. Projected hydro generation levels are to be adhered to in order to keep fuel costs at projected levels and also to reduce the likelihood of spilling at Akosombo GS.

2. Thermal plants fuel supply security and adequacy remain the single most important risk to power supply reliability in Ghana. In this regard, it is strongly recommended that all stakeholders work together to ensure that fuel supply is adequate and secure at all times.

3. Following from 2, quantities of liquid fuel (LCO, HFO and Diesel) therefore need to be procured and stored to serve as strategic stocks for thermal generation for use at the respective dual-fired thermal power plants in case of instances of gas supply interruption.

4. Due to the growing electricity demand in Ghana, there is the need to make arrangements to increase gas supply volumes to enable more thermal generation in order to avoid excessive draw down on Akosombo and Bui hydro facilities. In addition, government should make necessary investments towards an improved gas supply reliability owing to the increasing dependency on natural gas for power generation.

5. The government should expedite the creation of a generation enclave in Kumasi for network stability. This will help address voltage limit violations in the mid-sections of the power system in situations where Bui units are not in service and to reduce line loadings between Kumasi and the Tema Enclave (South East) as well as the Takoradi Enclave (South West) generation enclaves. This will boost supply reliability to bulk customers such as the mines in the West and also give Ghana a competitive advantage for power export to Burkina, Mali and other potential customers north of Ghana.

7.2.2 Petroleum

1. Set-up a strategic stock for crude oil (which can be refined when the need arises) to ensure fuel supply security in the country.

2. The government should expand crude oil refinery capacity and make existing ones fully functional (i.e., resourcing TOR to procure crude oil) to reduce dependence on imported finished petroleum products.

3. The government is targeting 50% LPG penetration in households by 2030, but the achievement of this target might be a challenge if limited distribution outlets nationwide remain the same and LPG prices continue to remain high. In this light, the government needs to consider investment incentives to encourage OMCs and other interested investors to set up more LPG storage and distribution outlets nationwide to increase access and affordability. Also, government should expedite the roll out of the cylinder

recirculation model to help increase access.

7.2.3 Woodfuel

1. Biomass consumption has been estimated to be increasing over the last decade. It is recommended that government intensify measures that will increase LPG penetration, especially in rural areas, to reverse the increasing demand for woody biomass.

Appendices

Appendix A: 2022 Projected Monthly Peak (MW) Demand –Base Case Scenario

Off-taker	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ECG	2,148.73	2,205.14	2,199.55	2,197.32	2,239.20	2,166.32	2,032.85	2,076.97	2,068.59	2,171.35	2,272.99	2,328.00
NEDCo	291.13	296.97	300.36	305.08	301.33	288.94	266.98	276.39	285.02	294.43	313.25	306.04
Enclave Power Company	56.05	54.64	55.67	57.62	58.32	62.25	65.52	62.07	61.47	59.22	57.53	58.99
MINES	217.17	217.20	217.23	217.24	217.22	217.26	217.21	217.27	217.04	216.75	216.47	216.21
Other Bulk Customers	58.08	56.15	60.29	79.44	79.09	78.05	77.83	76.45	75.29	78.86	78.38	78.04
VALCO	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00
CEB(Togo/Benin)	120.00	120.00	120.00	120.00	120.00	110.00	100.00	100.00	100.00	100.00	100.00	100.00
SONABEL(Burkina)	150.00	150.00	160.00	160.00	160.00	160.00	160.00	160.00	160.00	155.00	160.00	150.00
CIE(Ivory Coast)	50.00	50.00	50.00	50.00	50.00	40.00	40.00	40.00	40.00	40.00	40.00	50.00
Network Usage	1.88	1.92	1.93	1.94	1.96	1.90	1.81	1.83	1.83	1.90	1.97	2.00
LOSSES	167.54	170.64	171.32	172.56	174.59	169.21	160.66	163.23	163.14	169.09	158.68	161.00
System Peak (Coincident)	**3,355.59**	**3,417.67**	**3,431.35**	**3,456.21**	**3,496.71**	**3,388.94**	**3,217.86**	**3,269.21**	**3,267.38**	**3,381.59**	**3,494.28**	**3,545.27**

Appendix B: 2022 Projected Monthly Energy (GWh) Consumption –Base Case Scenario

Off-taker	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ECG	1358.74	1271.53	1389.88	1361.80	1357.21	1234.71	1225.92	1241.72	1232.14	1332.23	1373.76	1437.64	**15,817.28**
NEDCo	146.04	153.03	153.53	177.31	155.66	154.18	147.60	149.09	150.53	168.55	174.11	174.11	**1,903.73**
Enclave Power Company	19.20	21.08	20.64	24.20	25.54	24.48	24.89	23.78	25.36	27.00	26.33	21.31	**283.80**
MINES	122.59	107.79	119.43	115.25	119.05	109.92	119.85	116.76	117.79	120.39	117.47	119.78	**1,406.06**
Other Bulk Customers	21.85	20.73	21.70	34.07	34.18	33.55	37.15	36.27	34.03	36.38	34.16	35.19	**379.25**
VALCO	64.02	57.48	62.47	62.14	65.91	63.44	61.97	66.76	66.22	65.91	64.82	64.26	**765.39**
CEB(Togo/Benin)	94.81	86.06	73.12	54.39	51.01	44.35	38.33	29.60	30.31	46.38	45.07	56.57	**650.00**
SONABEL(Burkina)	87.20	80.80	89.60	86.40	89.60	86.40	89.60	89.60	86.40	89.60	86.40	89.60	**1,051.20**
CIE(Ivory Coast)	31.00	28.00	31.00	30.00	31.00	20.00	15.00	10.00	10.00	10.00	14.00	22.00	**252.00**
Network Usage	0.95	0.89	0.96	0.96	0.95	0.87	0.87	0.87	0.87	0.94	0.96	0.99	**11.07**
LOSSES	95.27	89.44	96.05	95.27	94.47	86.73	86.20	86.36	85.83	92.87	73.52	76.72	**1,058.71**
Total	**2,041.66**	**1,916.82**	**2,058.37**	**2,041.78**	**2,024.57**	**1,858.63**	**1,847.38**	**1,850.81**	**1,839.47**	**1,990.25**	**2,010.59**	**2,098.18**	**23,578.51**

Appendix C: 2022 Projected monthly electricity demand and supply balance, GWh

Customer Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Domestic	1,764.60	1,664.50	1,802.20	1,808.90	1,787.10	1,644.40	1,642.50	1,654.90	1,646.60	1,778.40	1,800.30	1,865.70	20,860.00
VALCO	64	57.5	62.5	62.1	65.9	63.4	62	66.8	66.2	65.9	64.8	64.3	765.4
Export (CEB+SONABEL+CIE)	213	194.9	193.7	170.8	171.6	150.8	142.9	129.2	126.7	146	145.5	168.2	1,953.20
Projected Energy Consumption	2,041.70	1,916.80	2,058.40	2,041.80	2,024.60	1,858.60	1,847.40	1,850.80	1,839.50	1,990.30	2,010.60	2,098.20	23,578.57
Generation Sources													
Akosombo GS	486.4	444.2	486.5	467.7	482.1	422.9	437	436.9	452.7	470.7	455.5	470.7	5,513.30
Kpong GS	83.5	75.9	83.5	81	83.6	81.1	83.6	83.6	81	84.3	81.5	84.3	986.9
TAPCO	195.2	177.9	195.2	189.5	195.2	189.5	183.7	74.3	81.9	195.2	189.5	135.7	2,002.90
TICO	195.2	176.3	195.2	188.9	195.2	188.9	195.2	195.2	188.9	195.2	188.9	195.2	2,298.60
TT1PP	-	53.8	-	57.6	-	57.6	-	59.5	-	59.5	-	59.5	347.5
KTPP	63.2	-	63.2	-	63.2	-	63.2	-	61.2	-	61.2	-	375.4
TT2PP	9.5	8.6	9.5	9.2	9.5	9.2	9.5	9.5	9.2	9.5	9.2	9.5	111.7
AMERI Power Plant	-	-	-	-	-	-	-	-	140.8	145.5	140.8	145.5	572.4
VRA Solar (Navrongo)	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	3
VRA Solar (Kaleo)	2.3	2	2.2	1.8	1.5	1.5	1.6	1.7	1.8	1.8	2	1.9	21.9
VRA Solar (Lawra)	0.9	0.8	0.9	0.9	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	9.9
Imports From Cote d'Ivoire	-	-	-	-	-	-	-	-	-	-	-	-	-
Bui GS	92	83	92	56	57	51	52	52	60	81	107	111	894
Bui Solar Farm	5.4	5.4	5.4	5.4	5.4	5.4	10.4	10.4	10.4	10.4	10.4	10.4	94.8
SAPP	172.1	221.1	185.4	314.3	239.3	181.4	118.6	235.1	81.2	44.3	94.2	181.8	2,068.70
CENIT	63.2	57.1	63.2	61.2	63.2	61.2	63.2	63.2	61.2	63.2	61.2	63.2	744.6
Karpowership	281.1	257	284.6	275.4	284.6	275.4	284.6	284.6	275.4	284.6	275.4	284.6	3,347.30
AKSA	56.9	51.4	56.9	9.2	9.5	9.2	9.5	9.5	9.2	9.5	9.2	9.5	249.4
Cenpower	209.5	189.2	209.5	202.8	209.5	202.8	209.5	209.5	202.8	209.5	202.8	209.5	2,466.80
Twin City	120.2	108.5	120.2	116.3	120.2	116.3	120.2	120.2	116.3	120.2	116.3	120.2	1,414.70
Early Power	-	-	-	-	-	-	-	-	-	-	-	-	-

Customer Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BXC Solar	2.3	2.1	2.3	2.2	2.3	2.2	2.3	2.3	2.2	2.3	2.2	2.3	27
Meinergy	2.3	2.1	2.3	2.2	2.3	2.2	2.3	2.3	2.2	2.3	2.2	2.3	27
Safisana	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7
Total Supply	2,041.70	1,916.80	2,058.40	2,041.80	2,024.60	1,858.60	1,847.40	1,850.80	1,839.50	1,990.30	2,010.60	2,098.20	23,578.57

Appendix D: 2022 projected monthly capacity situation, MW

Customer Category	2022 Projected System Peak (MW)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Domestic	3,150	2,941	3,003	3,006	3,031	3,072	2,984	2,823	2,874	2,872	2,992	3,099	3,150
VALCO	95	95	95	95	95	95	95	95	95	95	95	95	95
Export (CEB+SONABEL+CIE)	300	320	320	330	330	330	310	300	300	300	295	300	300
Projected System Demand	3,545	3,356	3,418	3,431	3,456	3,497	3,389	3,218	3,269	3,267	3,382	3,494	3,545
Generation Sources	**Dependable Gen. Capacity (MW)**												
Akosombo	900	900	900	900	900	750	750	750	750	750	750	750	750
Kpong GS	140	140	140	140	140	140	140	140	140	140	140	140	140
TAPCO	300	300	300	300	300	300	300	300	100	100	300	300	300
TICO	320	320	320	320	320	320	320	320	320	320	320	320	320
TT1PP	100	100	0	100	0	100	0	100	0	100	0	100	0
KTPP	200	-	100	0	100	0	100	0	100	0	100	0	100
TT2PP	70	22	22	22	22	22	22	22	22	22	22	22	22
AMERI Power Plant	230	0	0	0	0	0	0	0	0	230	230	230	230
T3 Power Plant	120	0	0	0	0	0	0	0	0	0	0	0	0
VRA Solar Plants	22	0	0	0	0	0	0	0	0	0	0	0	0
Imports From Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0
Bui GS	345	220	220	220	220	220	220	220	220	220	220	220	220
Bui Mini Unit	4	4	4	4	4	4	4	4	4	4	4	4	4
SAPP 161	180	180	180	180	180	180	180	150	180	180	180	180	180
SAPP 330	350	350	350	350	350	350	350	350	350	350	350	350	350
CENIT	100	100	100	100	100	100	100	100	100	100	100	100	100
Karpowership	450	450	450	450	450	450	450	450	450	450	450	450	450
AKSA	330	330	330	330	330	330	330	330	330	330	330	330	330
Cenpower	350	350	350	350	350	350	350	350	350	350	350	350	350
Twin City	198	198	198	198	198	198	198	198	198	198	198	198	198

Customer Category	2022 Projected System Peak (MW)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Early Power	200	0	0	0	0	0	0	0	0	0	0	0	0
Trojan	0	0	0	0	0	0	0	0	0	0	0	0	0
Safisana	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Meinergy	20												
Solar (Central Region)	20												
Total Available Generation (MW)	4,949	3,964	3,964	3,964	3,964	3,814	3,814	3,784	3,614	3,844	4,044	4,044	4,044
Surplus/deficit (MW)	1,394	609	546	533	508	317	425	566	345	577	658	550	489
Required Reserve (18%)	640	604	615	618	622	629	610	579	588	588	610	629	640
Actual Reserve Margin	39%	18%	16%	16%	15%	9%	13%	18%	11%	18%	19%	16%	14%

Appendix E: Projected monthly fuel requirements and associated costs for thermal power plants in 2022

Estimated Thermal Fuel Requirement	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TAPCO-Gas	Tbtu	1.75	1.59	1.75	1.69	1.75	1.69	1.64	0.66	0.73	1.75	1.69	1.21	**17.91**
TICO-Gas	Tbtu	1.54	1.39	1.54	1.49	1.54	1.49	1.54	1.54	1.49	1.54	1.49	1.54	**18.17**
TT1PP-Gas	Tbtu	-	0.63	-	0.67	-	0.67	-	0.70	-	0.70	-	0.70	**4.07**
KTPP-Gas	Tbtu	0.74	-	0.74	-	0.74	-	0.74	-	0.72	-	0.72	-	**4.42**
TT2PP-Gas	Tbtu	0.11	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	**1.32**
AMWERI Power Plant-Gas	Tbtu	-	-	-	-	-	-	-	-	1.59	1.64	1.59	1.64	**6.46**
Karpower Barge-Gas	Tbtu	2.27	2.08	2.30	2.22	2.30	2.22	2.30	2.30	2.22	2.30	2.22	2.30	**27.04**
SAPP-Gas	Tbtu	1.43	1.83	1.54	2.60	1.98	1.50	0.98	1.95	0.67	0.37	0.78	1.51	**17.14**
CEINT-Gas	Tbtu	0.75	0.67	0.75	0.72	0.75	0.72	0.75	0.75	0.72	0.75	0.72	0.75	**8.79**
TWIN CITY-Gas	Tbtu	0.99	0.89	0.99	0.96	0.99	0.96	0.99	0.99	0.96	0.99	0.96	0.99	**11.65**
CENPOWER-Gas	Tbtu	1.72	1.56	1.72	1.67	1.72	1.67	1.72	1.72	1.67	1.72	1.67	1.72	**20.29**
Early Power-Gas	Tbtu	-	-	-	-	-	-	-	-	-	-	-	-	-
AKSA-HFO	barrels	125,215	113,098	125,215	20,196	20,869	20,196	20,869	20,869	20,196	20,869	20,196	20,869	**548,657**
Total Natural Gas	Tbtu	11.30	10.75	11.44	12.15	11.89	11.04	10.78	10.72	10.89	11.86	11.96	12.47	**137.24**
Estimated Fuel Cost														
Total Natural Gas Cost@US$6.08/mmbtu	MMUS$	68.71	65.34	69.55	73.84	72.27	67.15	65.56	65.18	66.20	72.12	72.70	75.81	**834.43**
Total HFO Cost@ US$70/bbl	MMUS$	8.77	7.92	8.77	1.41	1.46	1.41	1.46	1.46	1.41	1.46	1.41	1.46	**38.40**
Total Fuel Cost (US$ Million)	MMUS$	77.48	73.26	78.32	75.25	73.73	68.56	67.02	66.64	67.61	73.58	74.11	77.27	**872.83**

Appendix D: Historical petroleum products consumption, tonnes

Year	Gasoil	Gasoline	LPG	ATK	Kerosene	Premix	RFO	MGO	Total
1999	693,836	451,329	43,503	91,498	127,365	32,197	63,797	48,445	**1,551,970**
2000	668,139	527,371	45,000	96,732	67,437	31,429	60,608	50,336	**1,547,052**
2001	687,769	538,172	42,519	76,230	70,391	27,707	55,227	33,639	**1,531,653**
2002	720,374	573,474	49,955	90,277	74,695	27,507	55,101	34,420	**1,625,804**
2003	757,930	482,583	56,708	89,618	68,640	29,697	48,498	33,867	**1,567,541**
2004	851,878	578,931	65,667	107,201	73,015	28,313	48,041	18,787	**1,771,833**
2005	883,507	540,889	70,461	119,033	74,178	32,234	50,829	37,234	**1,808,366**
2006	937,332	514,875	87,957	114,456	76,373	34,665	60,309	39,199	**1,865,165**
2007	1,151,023	547,363	93,286	122,582	63,213	42,124	54,454	44,344	**2,118,388**
2008	1,095,900	548,146	117,577	118,965	34,506	52,108	50,867	57,074	**2,075,143**
2009	1,284,926	705,422	220,603	124,438	89,068	56,651	42,779	38,395	**2,562,281**
2010	1,222,005	743,017	177,192	108,188	49,243	33,287	32,788	13,436	**2,379,157**
2011	1,360,491	807,007	214,430	135,315	62,315	45,564	37,529	150,872	**2,813,524**
2012	1,583,132	992,726	268,486	141,344	45,632	58,883	33,500	162,651	**3,286,356**
2013	1,654,325	1,080,646	251,759	131,928	27,786	58,337	39,328	120,011	**3,364,120**
2014	1,659,295	1,102,263	241,548	113,903	9,143	56,248	26,812	64,536	**3,273,749**
2015	1,873,224	1,162,088	279,020	112,026	6,852	47,190	13,425	33,547	**3,527,373**
2016	1,731,072	1,069,175	281,474	132,211	8,061	55,980	12,943	36,310	**3,327,226**
2017	1,540,405	1,072,567	276,703	166,645	5,586	68,755	10,786	121,069	**3,262,516**
2018	1,802,372	1,255,143	288,329	200,337	4,966	55,335	35,754	34,319	**3,676,554**
2019	1,872,760	1,345,633	299,575	231,729	3,783	54,408	41,433	32,886	**3,882,208**
2020	1,964,085	1,526,890	332,370	128,660	4,958	76,821	48,344	51,312	**4,133,440**
2021	2,097,846	1,711,585	345,478	201,958	4,585	78,595	79,317	27,814	**4,547,177**