Update of West African Power Pool Grid Emission Factor

GEF Analysis Report

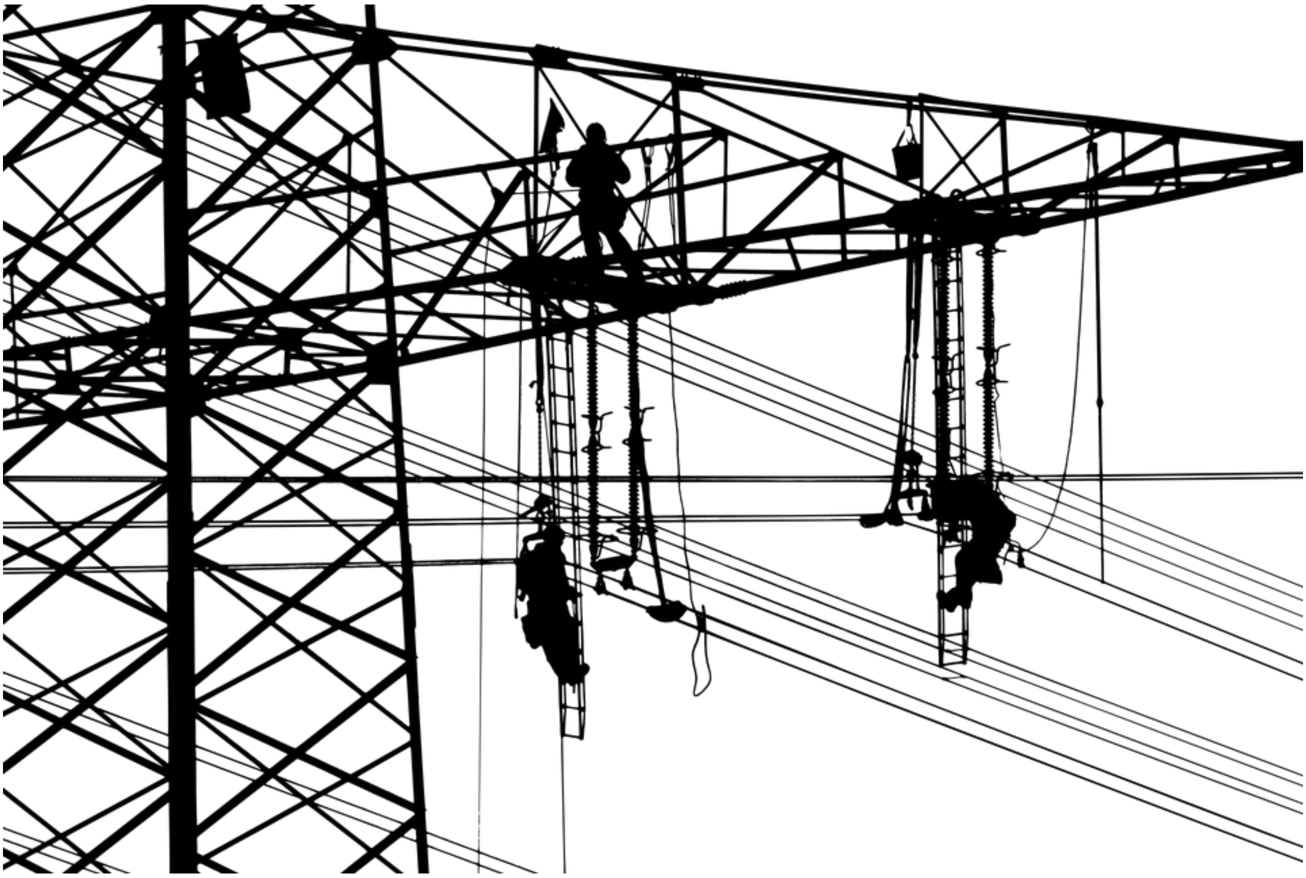

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Table of Contents

List of Abbreviations

BOAD	Banque Ouest Africaine de Développement
BM	Build Margin
CDM	Clean Development Mechanism
CDM EB	CDM Executive Board
CM	Combined Margin Emission Factor
CAR	Corrective Action Request
CL	Clarification Request
CM	Combined Margin
DNA	Designated National Authority
ECOWAS	Economic Community of West African States
GEF	Grid Emission Factor
EOC	Engineering and Operating Committee
GEF	Grid Emission Factor
GHG	Greenhouse Gas
HV	High Voltage
IPP	Independent Power Producer
IGES	Institute for Global Environmental Strategies
LCOE	Levelized cost of electricity generation
NCV	Net Calorific Value
NDC	Nationally Determined Contribution
NMR	Non-Must-Runs
MWh	Mega Watthour
MR	Low-Cost/Must-Runs
OM	Operating Margin
PES	Project Electricity System
QA/QC	Quality Assurance / Quality Control
RCC	Regional Collaboration Centre of the UNFCCC
SB	Standardized Baseline
SPEC	Strategic Planning and Environmental Committee
UNFCCC	United Nations Framework Convention on Climate Change
WAPP	West African Power Pool

1. Introduction

The West African Power Pool (WAPP) was created in 1999 through Decision A/DEC.5/12/99 of the Authority of the ECOWAS Heads of State and Government and established in 2006 through Decisions A/DEC.18/01/06 and A/DEC.20/01/06 as a Specialized Institution of ECOWAS. The WAPP integrates the national power systems into a unified regional electricity market and promotes trade of electricity among the ECOWAS member States. Currently nine (9#) countries (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, Senegal and Togo) are interconnected and construction is ongoing to interconnect the remaining mainland ECOWAS countries namely Sierra Leone, Liberia, Guinea, Guinea Bissau and The Gambia.

The WAPP member utilities comprise of ONEE (Morocco), VRA (Ghana), TCN (Nigeria), SONABEL (Burkina Faso), SOGEM (Mali), Senelec (Senegal), SBEE (Benin), NIGELEC (Niger), NAWEC (Gambia), MAINSTREAM ENERGY (Nigeria), LEC (Liberia), KARPOWERSHIP (Ghana), GRIDCO (Ghana), EDSA (Sierra Leone), EDM-SA (Mali), ECG (Ghana), CONTOURGLOBAL (Togo), CI-ENERGIES (Cote d'Ivoire), CIE (Cote d'Ivoire), CENPOWER (Ghana), CENIT (Ghana), CEET (Togo), CEB (Benin), EDG (Guinea), EAGB (Guinea Bissau), NEDCO (Ghana), SUNON ASOGLI (Ghana), NORTH SOUTH POWER (Nigeria), PACIFIC ENERGY (Nigeria), SAHARA POWER (Nigeria), PARAS ENERGY (Nigeria), AKSA ENERGY (Ghana), SAPELE POWER (Nigeria), APR ENERGY (Senegal), TRANSCORP POWER (Nigeria), CUMMIN POWER (Nigeria). The members are grouped into five Organisational Committees namely the Strategic Planning and Environmental Committee (SPEC), Engineering and Operations Committee (EOC), Finance Committee (FC), the Human Resource and Governance Committee (HRGC) and the Distribution and Commercial Committee (DCC).

The WAPP, in collaboration with UNEP RISOE, developed a Grid Emission Factor (GEF)[1] Standardized Baseline (SB) for the regional power sector which was approved on 27th February 2017 as "ASB0034: Grid emission factor for West African Power Pool". The SB is envisaged to expire on February 26, 2021 after a one-year extension of original validity period approved by the Executive Board of UNFCCC.

Currently, within the framework of updating the SBL, the WAPP Secretariat is supported by the World Bank, who conducted analyses towards preparation of the GEF Analysis Report, and the Regional Collaboration Centre (RCC) Lomé of the United Nation Framework Convention on Climate Change (UNFCCC), hosted by the Banque Ouest Africaine de Développement (BOAD).

This study findings shall allow for the update of the Approved Standardized Baseline ASB0034, which was approved by the Clean Development Mechanism (CDM) Executive Board in 2017. The calculation of the current GEF is based on (i) the most recent version of UNFCCC's Tool for calculating the emission factor for an electricity system (Version 7.0, hereafter referred to as the "tool"), and (ii) the data collection excel file developed by the Institute for Global Environmental Strategies (IGES) for the calculation of the Grid Emission Factor (GEF).

1.1. The Benefits of a Regional Grid Emission Factor

The WAPP Regional GEF serves as an important stepping-stone for structuring climate investments and carbon payments for energy sector projects. The regional GEF also has the potential to reduce project costs while facilitating access to carbon finance. The absence of a regional GEF will negatively impact registered CDM projects during the monitoring and verification of results.

[1] GEF refers to the specific CO_2-intensity of a power system, expressed in tCO2/MWh

1.2. Scope and Objective

The concept of the GEF Standardized Baseline (SB) was developed under the UNFCCC's CDM, as an instrument to standardize GHG emission estimation. Against this background, the WAPP, with support from the German Federal Ministry for the Environment, developed a regional GEF that was approved and published by the UNFCCC in February 2017. The approved and existing GEF features the following scope: (i) Valid for the interconnected ECOWAS countries comprising of Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, Senegal, and Togo; (ii) Can be used to estimate the emission reductions for grid-connected, renewable electricity generation and for grid-connected energy efficiency measures; (ii) Valid until 26 February 2021.

Against this background, the overall objective of this assignment is to update the regional GEF before its expiration on 26 February 2021 based on 2017 to 2019 data vintage.

1.3. Data Collection and Analysis

During the inception phase, the WAPP Secretariat organized from September 17 to 18, 2020 a meeting of the WAPP SPEC, with participation of the WAPP EOC among others, to kick-off of the assignment. During the Kick-off Meeting, the WAPP member utilities agreed on a data collection schedule for the data collection exercise. The outcome of the meeting was adopted by all participants including the DNAs that also participated in the Meeting. The WAPP Secretariat then conducted bilateral meeting and data collection exercise with all WAPP member utilities. For utilities which are not members of the WAPP, a secondary source data were obtained from the Electricity Sector Regulatory Bodies. The data was provided by:

- Cenpower Generation Company Limited (Ghana)
- Côte d'Ivoire Energies (Côte d'Ivoire)
- Communauté Electrique du Benin (Benin, Togo)
- Compagnie Ivoirienne d'Electricité (Côte d'Ivoire),
- Energie du Mali - SA (EDM-SA),
- Electricity Distribution and Supply Authority (Sierra Leone)
- Ghana Grid Company Limited (Ghana)
- Cenit Energy Limited (Ghana)
- Ghana Energy Commission (Ghana)
- Liberia Electricity Corporation (Liberia)
- Energy Commission of Nigeria (Nigeria)
- Société Nigérienne d'Electricité (Niger)
- Paras Energy & Natural Resources Development Limited (Nigeria)
- Mainstream Energy Solution (Nigeria)
- Transmission Company of Nigeria (Nigeria)
- Société Beninoise d'Energie Electrique (Benin)
- Société de Gestion de l'Energie de Manantali (OMVS)
- Société Nationale d'Electricité du Burkina (Burkina Faso)
- Société Nationale d'Electricité du Sénégal (Senegal)
- Volta River Authority (Ghana).
- Niger Delta power holding company

Without the commitment of WAPP member utilities to effectively share their operational data, this analysis would not have been possible. The Designated National Authorities (DNA) also participated actively in this process. Some DNAs participated in the WAPP meetings. Equally, the RCC organized a series of individual consultations with DNAs to discuss the data collection and submission process. DNAs also engaged with national stakeholders to close data gaps.

2. Calculating the WAPP Grid Emission Factor

The following section describes the steps used for the calculation of the WAPP GEF:

STEP 1. Identify the Relevant Electricity Systems

The WAPP comprises nine interconnected countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, Senegal and Togo. Currently transmission lines connecting Guinea, Liberia and Sierra Leone are being built (Figure 1).

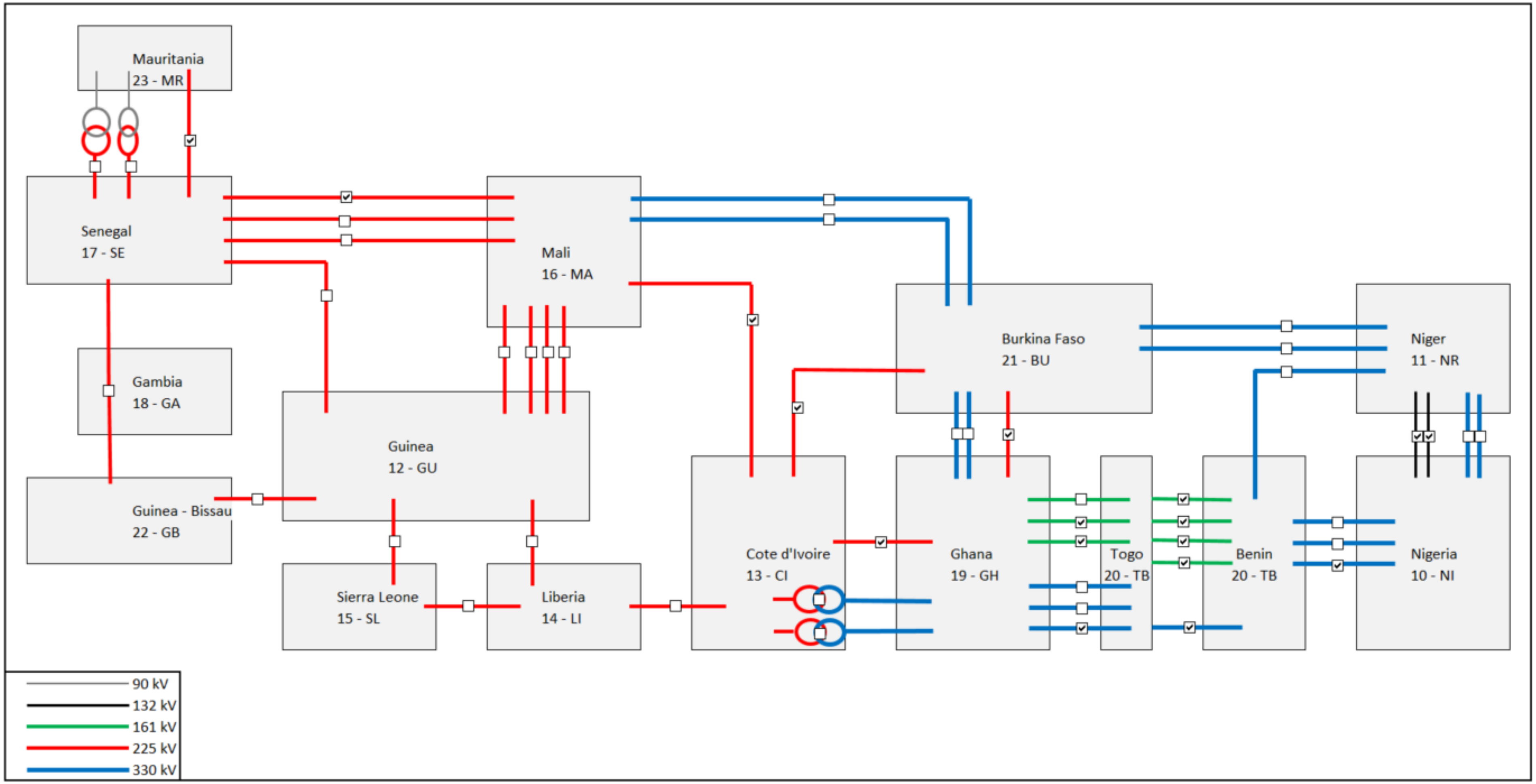
The interconnected countries feature transmission lines allowing for substantial electricity trades between their national power companies as well as between Independent Power Producers. Given this setup, the Project Electricity System (PES) is defined as the electricity grid shared by the nine (9#) member countries (Fig 1 refers).

The Build Margin (BM), the Operating Margin (OM) as well as the resulting Combined Margin (CM) are determined for the joint PES. This is consistent with general guidance of the CDM executive Board on regional electricity systems (CDM EB 28, §14) and with the current version of the tool.

Tool 7 §17a (Option 1) enables DNAs to decide on the spatial scope of the PES. In line with the technical scope of the WAPP transmission system, the DNAs decide that the PES comprises all interconnected WAPP member countries.

Liberia, Sierra Leone and Guinea expressed their interest to join the regional GEF, once the tie lines are commissioned.

Figure 1: Current and planned Transmission Line Design Capacities in West Africa



Source: WAPP Secretariat

STEP 2. CHOOSE WHETHER TO INCLUDE OFF-GRID POWER PLANTS

The tool offers two options to calculate the OM and BM emission factor:

- Option I: Only grid power plants are included in the calculation;
- Option II: Both grid power plants and off-grid power plants are included in the calculation.

The project participant may choose whether to include off-grid emissions. After careful evaluation, it was decided not to consider off-grid emissions and Option I was chosen.

STEP 3. SELECT A METHOD TO DETERMINE THE OPERATING MARGIN

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on the simple OM approach as per Figure 2 of the tool. This section shows the share of Low-Cost/Must-Runs (MR) is below 50% and therefore, the simple OM method is applicable.

In a first step, the share of Non-Must-Runs (NMR) in the PES is determined. For this case, NMRs are defined as steam power plants, gas turbines, combined cycle power, and diesel plants. Annex II provides a list of all power plants located in the nine countries. The far-left column shows the fuel type. Using above definition allows for classifying all power plants in MR and NMR. This definition is based on the guidance of the tool.

Applying the standard definition of NMRs and MRs to the power plants in the WAPP region allows to determine the share of MRs. The Table 1 below shows that the five-year average total generation amounts to 68.08 TWh/yr whereas the average share of MR amounts to 22.51 TWh/yr. The share of MR amounts to 32.60%.

Table 1: Determination of the Low-Cost/Must-Run Share

Year	2015	2016	2017	2018	2019
Total electricity generation	62,637,545	63,009,520	69,279,113	72,404,720	77,892,098
Average annual electricity generation in five years	68,082,253				
Generation from low-cost/must-run power units	19,030,007	21,247,394	21,867,669	23,334,515	27,060,859
Average generation from total grid generation	22,508,689				
Low-Cost/Must-Run Resource share	32.60%				
Applicability of Simple OM or Average OM	**Simple OM**				

It is concluded that as the share of MR is below 50%, the simple OM can be applied.

STEP 4. CALCULATE THE OPERATING MARGIN EMISSION FACTOR

In a next step the simple OM was calculated. The following input data was used:

- Primary and secondary fuel consumption data, net calorific values was collected directly from the power companies, provided by transmission companies and (in the case of Ghana and Nigeria) the energy regulatory authorities. Annex II provides a list of all power plants, their fuel consumption as well as their electricity generation for three most recent years, i.e. the historic reference period 2017 – 2019.

- For those plants, where no Net Calorific Value (NCV) data could be collected, we used the lower boundary of the 95% confidence intervals of IPCC default parameters. Annex V provides a list of NCVs used for different fuel types.
- SENELEC provided ranges for NCVs for residual fuel oil; we used the lower range indicated, which is considered to be conservative.
- Annex VI provides a list of IPCC default emission factors for the various fuels. We applied the lower boundary of 95% confidence interval in order to produce a conservative estimate.
- For some power plants, the actual fuel data could not be collected, or data provided produced impossible results. For those plants, the A2 option for detraining plant specific emission factors was applied. These plants are listed in Table 3 below. For the determination of plants' overall emission levels, CDM EB's default efficiency factors were applied.

Below, Table 2 lists those 17 power units out of 282, where fuel consumption data could not be collected. The related emission levels were determined following Option A2 under paragraph 49 of the tool outlined below.

Table 2: List of Power Plants Following the A2 Calculation Approach

No.	Power Plant Name	Option
57	Trojan	A2
62	Genser	A2
205	AZURA GT 11	A2
206	AZURA GT 12	A2
116	AZURA GT 13	A2
232	PARAS ENERGY GT1	A2
233	PARAS ENERGY GT2	A2
234	PARAS ENERGY GT3	A2
235	PARAS ENERGY GT4	A2
236	PARAS ENERGY GT5	A2
237	PARAS ENERGY GT6	A2
238	PARAS ENERGY GT7	A2
239	PARAS ENERGY GT8	A2
240	PARAS ENERGY GT9	A2
241	PARAS ENERGY GT10	A2
242	PARAS ENERGY GT11	A2
265	Autoproduction (ICS/Dangoté/SOCOCIM)	A2

Based on the above outlined input data, the OM emission factor was determined. Following the tool, Equation (3), this allows in a subsequent step to calculate the OM emission level:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y}\ x\ EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO2 emission factor in year y (tCO2/MWh)
$EF_{CO2,i,y}$	CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)
$EG_{,y}$	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)
y	Most recent historical year for which power generation data is available

For those power plants, where the fuel consumption data for the years 2017-2019 was available, we applied the A1 calculation approach (Tool, Equation 4). These are all power plants listed in Annex I, besides those listed Table 2 above).

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \ x \ NCV_{i,y} \ x \ EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (tCO2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCVi,y$	Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)
$EG_{,m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
I	All fossil fuel types combusted in power unit m in year y
Y	Most recent historical year for which power generation data is available

For those power plants, where the fuel consumption data was not available (listed in Table 2 above), the A2 Option was applied (Tool, Equation 5):

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} x \ 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (tCO2/MWh)
$EF_{CO2,m,i,y}$	Average CO2 emission factor of fuel type i used in power unit m in year y (tCO2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit m in year y (ratio)
m	All power units serving the grid in year y except low-cost/must-run power units
y	Most recent historical year for which power generation data is available

The calculation of the emissions considering primary and secondary fuels per power plant and unit is included in Annex II. Based on these calculations, the OM was determined.

The findings are presented in Table 3 below.

Table 3: Calculation of the Simple OM	
2017 Electricity Generation (in MWh)	23,567,235
$EF_{grid,OMsimple,\ 2017}$ (in tCO2)	0.5505
2018 Electricity Generation (in MWh)	25,037,148
$EF_{grid,\ OMsimple,\ 2018}$ (in tCO2)	0.6047
2019 Electricity Generation (in MWh)	25,003,894
$EF_{grid,\ OMsimple,\ 2019}$	0.6394
Operating Margin Emission Factor(t-CO_2/MWh)	**0.5991**

STEP 5. CALCULATE THE BUILD MARGIN EMISSION FACTOR

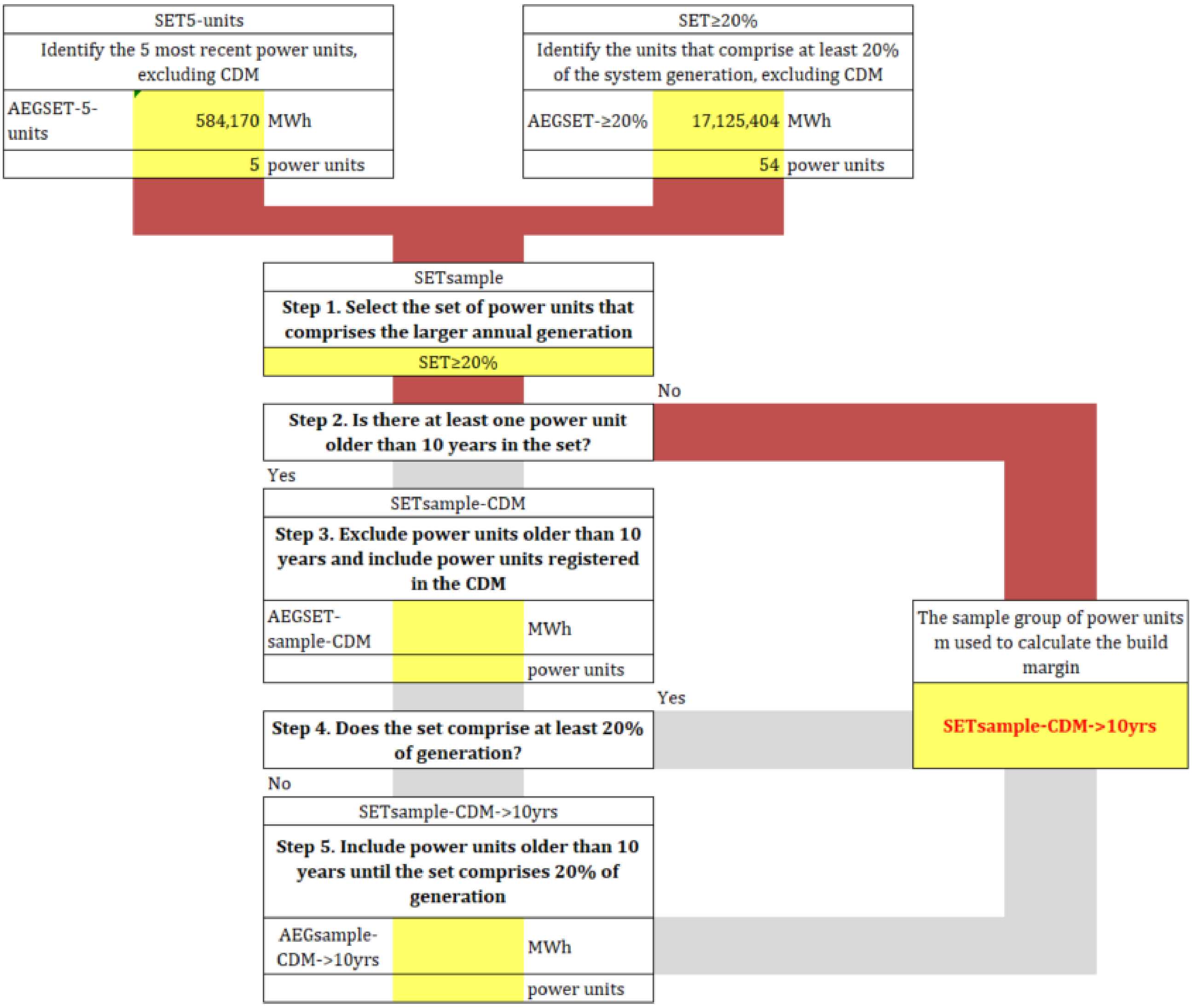
Following the tool, Step 5, §75a-f, the sample group of power units used to calculate the build margin consists of either:

- The set of five power units that have been built most recently; or
- The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Following the guidance of the tool, this analysis was conducted for the most recent year (i.e. 2019). The most recent five power plants generate 584,170 MWh (0.8% of total generation). The set, which comprises the last 20% of the system generation, excluding those registered under the CDM covers 71 power units. These plants generate 15,187,021 MWh in 2019 (20.00% of total generation). Therefore, the latter option was applied, as it encompasses the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

As this set does not comprise power plants, which are older than 10 years, registered CDM plants were included. This results in a set of 15,187,021 MWh in 2019. This procedure is illustrated by the graph (Figure 2) below.

Figure 2: Procedure for selecting Built Margin Power Plants



Following this approach results in a BM, which comprises 54 facilities commissioned between 2014 and 2019.

According to the tool, the build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m identified in step 5 above. To calculate the BM, the following Equation was applied (Tool, Equation 15):

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} x\, EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

Following this approach leads to the determination of the BM emission level for 2019. The assessment of the BM is included in Annex III. The results are presented in **Error! Reference source not found.**.

Table 4: Determination of the Built Margin Emission Factor	
Number of Power Units	54
BM Generation 2019 (in MWh)	15,779,234
BM Emissions 2019 (in tCO2)	9,810,568
Built Margin Emission Factor (in tCO2/MWh)	0.6217

STEP 6. CALCULATE THE COMBINED MARGIN EMISSIONS FACTOR

Based on standard weighting of the BM and the OM, the West African power system offers a GEF of 0.601 tCO2/MWh. Details are found in Table 5. Guidance on the selection of alternative weights can be found in the tool.

Table 5: Summary of the Emission Factor for the West African Power System			
OM Emission Factor (in t-CO_2/MWh)	0.5991		
BM Emission Factor (in t-CO_2/MWh)	0.6217		
	Weight of the OM	Weight of the BM	CM Emission Factor (in t-CO2/MWh)
Wind and solar power generation project activities for the first crediting period and for subsequent crediting periods	0.75	0.25	**0.6048**
All other projects for the first crediting period	0.5	0.5	**0.6104**
All other projects for the second and third crediting period	0.25	0.75	**0.6161**

ANNEX I: FUEL CONSUMPTION, FUEL QUALITY AND GENERATION DATA

The Table 6 below provides the key raw data for the determination of OM and BM. The data is colour coded to indicate data sources. Green refers to data provided by WAPP member utilities; orange refers to data provided by transmission companies and regulatory authorities. The table below provides only data from utilities. If information on e.g. NCVs is not available / could not be disclosed, the model chooses the conservative limit of the 95% confidence intervals of corresponding default values, as provided in Annex V and VI. Please note that for the Net Generation columns and Fuel Consumption columns: empty cells indicate that there is no data for the plant for that year, as the plant was not commissioned yet; a '0' indicates that data was provided but the generation / consumption was zero. This equally applies to Annex III and IV.

Table 6: Fuel Consumption, Fuel Quality and Net Generation Data by Power Plant and Year

No.	Name of Power Unit	Comissioning Date		Installed Capacity (in MW)	Net Electricity Generation (MWh			Main Fuel Type/ Energey Source	Main Fuel Consumption (in t)			Net Calorific Value of Main Fuel (in GJ/t)			Scondary Fuel Type/ Energey Source	Secondary Fuel Consumption (in t)			Net Calorific Value of Secondary Fuel (in GJ/t)		
		Year	Month		2017	2018	2019		2017	2018	2019	2017	2018	2019		2017	2018	2019	2017	2018	2019
1																					
2	MARIA-GLETA CAI Decomissione	2013				80.00	6,704					Jet Kerosene									
3	Porto Novo	2005				12.00	25	14	295	240	601	Gas/Diesel Oil	70	54	133			41.00			
4	Parakou	2004				14.00	31	0	151	461	629	Gas/Diesel Oil	38	113	138			41.00			
5	Natitingou	2005				12.00	1,125	1,149	32	207	426	Gas/Diesel Oil	11	49	95			41.00			
6	Maria-Gleta 1	2019	8			120.00					252,306	Natural Gas			56,410			28.00	Residual Fuel Oil		
7	Yeripao	2007				0.50	0	0	1,215	72	0	Hydro									
8	TAG MGL	1998	9	10		25.00	110,750	6,883	139,922	62,692	7,582	Natural Gas	39,042	19,476	2,364	30.45	30.74	30.49			
9	OUAGA I	1991	1	1		5.40	10,272	5,339	8,500	10,417	6,255	Gas/Diesel Oil	1,939	2,390	1,438	42.00	42.00	42.00			
10	OUAGA II	1978	1	1		29.30	41,539	18,037	30,200	35,874	23,284	Residual Fuel Oil	5,382	6,662	4,820	40.00	40.00	40.00	Gas/Diesel Oil	1,971	2,060
11	KOSSODO	2000	1	1		64.09	146,637	141,506	193,325	174,633	124,899	Residual Fuel Oil	36,267	32,651	23,656	40.00	40.00	40.00	Gas/Diesel Oil	5,373	5,471
12	KOMSILGA	2012	6	14		93.59	416,924	358,880	426,991	401,621	241,905	Residual Fuel Oil	84,480	80,229	45,885					3,695	3,428
13	BOBO I	1974	1	1		4.10	490	5,339	0	0	0	Gas/Diesel Oil	0	0	0						
14	BOBO II	1988	1	1		69.40	232,089	18,037	278,133	234,417	177,239	Residual Fuel Oil	53,304	44,089	34,154				Gas/Diesel Oil	5,068	5,529
15	GAOUA	2003	1	1		4.18	5,408	141,506	1,274	1,574	4,123	Gas/Diesel Oil	329	385	958	42.00	42.00	42.00			
16	OUAHIGOUYA	2005	1	1		5.20	22,515	358,880	6,179	4,773	2,427	Gas/Diesel Oil	1,392	1,056	539	42.00	42.00	42.00			

17	DEDOUGOU	2007	1	1		5.68	10,693	6,013	3,928	5,917	2,543	Gas/Diesel Oil	908	1,385	600	42.00	42.00	42.00			
18	DJIBO	1999	1	1		0.61	4,156	4,145	430	0	0	Gas/Diesel Oil	110	1	0	42.00	42.00	42.00			
19	FADA	1986	1	1		2.00	433	18	560	255	107	Gas/Diesel Oil	145	67	28	42.00	42.00	42.00			
20	DORI	1998	1	1		6.20	10,308	11,594	4,057	925	978	Gas/Diesel Oil	1,024	221	244	42.00	42.00	42.00			
21	KOMPIENGA	1988	1	1		14.00	32,281	37,516	56,974	34,196	28,594	Hydro									
22	BAGRE	1993	1	1		16.00	55,507	96,013	67,329	51,982	71,259	Hydro									
23	TOURNI	1996	1	1		0.50	1,406	1,398	747	878	1,312	Hydro									
24	NIOFILA	1996	1	1		1.50	4,269	4,559	2,882	4,392	4,153	Hydro									
25	KOMPIENGA THERMIQUE	1988	1	1		0.52	16	20	51	20	30	Gas/Diesel Oil	17	8	13						
26	ZIGA	2017	4	10		1.00			1,189	1,662	1,558	Solar									
27	ZAGTOULI	2017	9	1		33.00			8,258	52,430	57,283	Solar									
28	AGGREKO THERMIQUE (location)	2019	6	13		50.00					149,549	Residual Fuel Oil			34,592						
29	Vridi TAG	1984				100.00	295,414	236,875	184,998	111,596	80,234	Natural Gas	63,647	39,541	24,772	26.60	26.41	26.60	Residual Fuel Oil	0	58
30	Ciprel 1	1995				105.00	560,353	573,501	429,346	424,585	445,719	Natural Gas	83,916	85,127	87,253	26.60	26.41	26.60	Residual Fuel Oil	31	166
31	Ciprel 2	1998				115.00	741,951	599,841	473,642	392,324	430,134	Natural Gas	92,574	78,659	84,202	26.60	26.41	26.60	Residual Fuel Oil	35	154
32	Ciprel 3	2009				115.00	603,202	874,207	778,213	744,997	867,363	Natural Gas	152,102	149,367	169,794	26.60	26.41	26.60	Residual Fuel Oil	57	292
33	Ciprel 4	2013				115.00	613,788	760,699	863,041	806,817	749,159	Natural Gas	168,682	161,762	146,654	26.60	26.41	26.60			
34	Ciprel TAV	2015	12			115.00	11,911	761,037	723,153	649,488	789,246	Natural Gas	141,341	130,218	154,502	26.60	26.41	26.60			
35	Azito 1	1999				165.00	1,078,801	1,038,283	1,046,010	979,813	1,004,454	Natural Gas	169,210	162,524	157,794	26.60	26.41	26.60			
36	Azito 2	2000				165.00	1,002,570	965,682	1,014,965	941,220	888,109	Natural Gas	164,188	156,122	139,516	26.60	26.41	26.60			
37	Azito TAV	2015	6			144.00	662,430	1,053,288	1,067,047	968,046	911,321	Natural Gas	172,613	160,572	143,163	26.60	26.41	26.60			
38	Aggreko 1	2010				74.00	559,921	561,225	425,161	335,677	362,275	Natural Gas	87,433	69,528	74,776	26.60	26.41	26.60			
39	Aggreko 2	2012				37.00	301,782	312,037	251,423	199,712	206,746	Natural Gas	51,704	41,366	42,674	26.60	26.41	26.60			
40	Aggreko 3	2013				100.00	823,261	806,653	636,645	473,556	389,822	Natural Gas	130,924	98,086	80,462	26.60	26.41	26.60			

41	Ayamé 1	1959				20.00	63,351	75,244	73,814	101,686	117,367	Hydro									
42	Ayamé 2	1965				30.00	99,854	111,511	102,990	114,774	110,921	Hydro									
43	Kossou	1972				174.00	52,209	56,146	84,179	87,838	200,878	Hydro									
44	Taabo	1979				210.00	389,681	453,899	405,176	610,360	781,770	Hydro									
45	Buyo	1980				165.00	738,520	823,876	749,564	729,803	664,889	Hydro									
46	Fayé	1984				5.00	7,147	8,397	925	0	0	Hydro									
47	Soubre	2017				275.00			630,547	1,317,542	1,604,715	Hydro									
48	TAPCO - Takoradi 1 Thermal Power Plant (T1)	1998	3	12		330.00	1,783,884	1,204,247	685,515	730,046	1,067,430	Natural Gas	82,158	166,537	209,153						
49	TICO - Takoradi 2 Thermal Power Plant (T2)	2000	6	1		220.00	1,336,161	1,926,111	1,880,155	2,210,950	1,616,298	Natural Gas	215,348	301,315	254,854						
50	Takoradi 3 Thermal Power Plant (T3)	2013				132.00	30,630	0	0	0	0	Natural Gas	0	0	0						
51	Tema Thermal 1 Plant TT1PP	2009	6	1		110.00	540,986	177,938	365,348	314,341	377,283	Natural Gas	56,449	65,936	82,736						
52	Tema Thermal 2 Plant TT2PP	2010	6	1		87.00	215,452	19,216	492	2,680	138,430	Natural Gas	87	472	24,397						
53	Kpone Thermal Power Plant KTPP	2016				220.00		198,008	124,330	317,441	392,966	Gas/Diesel Oil	32,786	413,576	546,533						
54	Ameri	2016				250.00		1,233,236	1,228,725	872,607	1,483,400	Natural Gas	218,872	165,967	298,399						
55	VRA Solar	2013	1	1		2.50	3,000	3,000	3,000	3,000	3,000	Solar									
56	Akosombo	1966	1	22		1,020.00	4,156,000	3,854,000	4,282,000	4,273,000	5,366,000	Hydro									
57	Kpong	1982	1	15		160.00	819,000	763,000	752,000	771,000	842,000	Hydro									
58	Tema CENIT Thermal Power Plant	2012	10	17		126.00	317,127	418,720	59,183	2,221	179,060	Gas/Diesel Oil	129,779	4,870					Natural Gas		
59	Akosombo	1966	1	22		1,020.0	4,156,000	3,854,000	4,282,000	4,273,000	5,366,000	Hydro									
60	Kpong	1982	1	15		160.0	819,000	763,000	752,000	771,000	842,000	Hydro									
61	Bui	2013	6	14		400.0	870,000	944,000	582,000	974,000	1,044,000	Hydro									
62	Sunon Asogli	2011	9	1		560.0	1,185,000	377,000	1,417,000	1,970,000	2,622,000	Natural Gas	211,948	304,486	377,400						
63	Karpowership	2015	12	4		470.0	64,000	1,822,000	1,814,000	2,556,000	1,510,000	Residual Fuel Oil	805,166	885,949	440,726				Natural Gas		
64	Trojan	2016				44.0		54	51	0	0	Natural Gas									

65	AKSA	2017	11	1		370.0			799,000	748,000	608,000	Residual Fuel Oil	309,807	268,500	200,542						
66	Cenpower GT1	2019	6	10		131.70					58,763	Natural Gas			13			45.48	Crude Oil		
67	Cenpower GT2	2019	6	10		131.70					59,675	Natural Gas			12			45.48	Crude Oil		
68	Cenpower ST1	2019	6	10		134.30					63,878	Natural Gas									
69	Genser	2016	12	1		95.0			0	392	377	Liquefied Petroleum Gases									
70	Amandi	2019	10	1		203.0					149,000	Crude Oil			43,129.4						
71	Safisana	2016	9	10		0.1		0	0	320	317	Other Biogas									
72	BXC Solar	2016	1	15		20.0		24,000	25,000	27,000	27,000	Solar									
75	Mienergy Solar Plant	2018	9	17		20.0				4,000	21,000	Solar									
76	Darsalam	1999	6	1		33.40	0	17,504	61,642	30,160	34,863	Residual Fuel Oil	10,847	7,402	8,814				Gas/Diesel Oil	3,078	151
77	Balingué Diesel	2000	4	1		21.72	25,240	23,920	18,734	16,690	39,193	Residual Fuel Oil	1,922	2,934	8,295				Gas/Diesel Oil	2,357	910
78	Balingué BID	2011	4	1		48.63	178,429	337,147	380,701	308,291	297,858	Residual Fuel Oil	81,176	66,601	64,675				Gas/Diesel Oil	1,040	281
79	SOPAM (IPP)	2011	1	1		56.00	157,472	56,150	21,317	0	0	Residual Fuel Oil	4,297	0	0				Gas/Diesel Oil	48	
80	Selingué	1980	12	2		47.00	170,229	176,923	201,727	193,312	198,754	Hydro									
81	Sotuba	1966	4	2		5.70	31,653	30,868	25,792	17,961	12,948	Hydro									
82	Aksa enerji (Location)	2017	8			40.00			71,407	146,559	142,149	Residual Fuel Oil	15,402	33,929	33,895						
83	Albatros Energy Mali (IPP)	2018	10	31		90.00				49,109	118,814	Residual Fuel Oil	0	10,117	22,968						
84	Aggreko (Location)	2014	5			60.00	82,595	194,608	80,090	110,316	119,121	Residual Fuel Oil	18,034	24,878	26,080						
85	SES (Location)	2016	5			50.00		15,135	52,979	35,383	70,467	Residual Fuel Oil	11,756	7,951	15,795						
86	Manantali	2002	1			200.00	851,251	947,706	888,077	841,876	872,317	Hydro									
87	Félou	2013	7			60.00	336,992	342,039	308,236	323,646	281,205	Hydro									
88	DIFFA	1979				1.69	9,541	16,569	17,756	18,640	19,171	Residual Fuel Oil	3,785	4,001	4,096						
89	DOSSO	1973				1.31	100	176	132	119	60	Residual Fuel Oil	35	30	16						
90	GAYA	1985				0.62	450	501	363	416	605	Residual Fuel Oil	83	99	147						

91	GOUDEL	1985				21.90	22,664	34,773	17,728	8,713	7,978	Residual Fuel Oil	4,062	2,042	1,664						
92	MAINE	1980				0.29	2,201	25	0	0	0	Residual Fuel Oil	0	0	0						
93	MALBAZA	1976				2.35	2,398	6,538	752	686	11,550	Residual Fuel Oil	161	138	2,445						
94	MARADI	1962				5.40	341	2,560	328	318	233	Residual Fuel Oil	79	80	59						
95	N'GUIGMI	1991				0.32	2,458	2,408	3,126	2,446	3,021	Residual Fuel Oil	761	586	704						
96	NIAMEYII	1966				18.09	5,163	14,174	2,077	0	0	Residual Fuel Oil	702	0	0						
97	TAHOUA	1968				2.30	1,599	1,052	166	347	1,651	Residual Fuel Oil	42	82	368						
98	TILLABERY	1976				1.20	0	0	0	0	0	Residual Fuel Oil	0	0	0						
99	ZINDER	1957				5.84	1,245	2,076	326	367	528	Residual Fuel Oil	79	87	122						
100	GOROU BANDA	2016				80.00		990	172,378	134,403	164,437	Residual Fuel Oil	36,032	26,489	32,813						
101	SONICHAR	1981				18.80	109,182	104,532	103,259	117,346	105,635	Anthracite	113,587	135,605	99,763				Gas/Diesel Oil	4,144	2,142
102	SONICHAR	1982				18.80	111,485	110,258	103,644	70,377	98,194	Anthracite	108,439	77,776	101,098						
103	SONICHAR	1982				2.20	67	63	73	76	42	Gas/Diesel Oil	83	99	13						
104	SONICHAR	1982				1.80	340	115	90	89	36	Gas/Diesel Oil	4,062	2,042	10				Gas/Diesel Oil	4,144	2,142
105	KAINJI 1G2	1978	7	21		120.00	253,007	382,968	425,891	419,809	468,114	Hydro									
106	KAINJI 1G6	1978	7	21		120.00	253,007	382,968	425,891	419,809	468,114	Hydro									
107	KAINJI 1G7	1968	12	22		80.00	168,671	255,312	283,927	279,872	312,076	Hydro									
108	KAINJI 1G8	1968	12	23		80.00	168,671	255,312	283,927	279,872	312,076	Hydro									
109	KAINJI 1G9	1969	12	13		80.00	168,671	255,312	283,927	279,872	312,076	Hydro									
110	KAINJI 1G10	1969	6	18		80.00	168,671	255,312	283,927	279,872	312,076	Hydro									
111	KAINJI 1G11	1969	1	20		100.00	210,839	319,140	354,909	349,841	390,095	Hydro									
112	KAINJI 1G12	1977	7	31		100.00	210,839	319,140	354,909	349,841	390,095	Hydro									
113	JEBBA 2G1	1983	12	5		96.40	14,379	19,804	18,286	17,063	18,634	Hydro									
114	JEBBA 2G2	1984	2	15		96.40	367,709	506,442	467,642	436,355	476,532	Hydro									
115	JEBBA 2G3	1983	3	22		96.40	367,709	506,442	467,642	436,355	476,532	Hydro									
116	JEBBA 2G4	1984	3	17		96.40	367,709	506,442	467,642	436,355	476,532	Hydro									
117	JEBBA 2G5	1984	7	25		96.40	367,709	506,442	467,642	436,355	476,532	Hydro									

118	JEBBA 2G6	1988	5	19		96.40	367,709	506,442	467,642	436,355	476,532	Hydro									
119	SHIRORO 411G1	1990	6	20		150.00	464,900	671,004	557,332	620,156	661,589	Hydro									
120	SHIRORO 411G2	1990	6	20		150.00	464,900	671,004	557,332	620,156	661,589	Hydro									
121	SHIRORO 411G3	1990	6	20		150.00	464,900	671,004	557,332	620,156	661,589	Hydro									
122	SHIRORO 411G4	1990	6	20		150.00	464,900	671,004	557,332	620,156	661,589	Hydro									
123	EGBIN ST1	1985	5			220.0	916,943	692,798	570,861	718,549	631,052	Natural Gas	105,228	147,580	124,731						
124	EGBIN ST2	1985	11			220.0	916,943	692,798	570,861	718,549	631,052	Natural Gas	105,228	147,580	124,731						
125	EGBIN ST3	1985	5			220.0	916,943	692,798	570,861	718,549	631,052	Natural Gas	105,228	147,580	124,731						
126	EGBIN ST4	1986	11			220.0	916,943	692,798	570,861	718,549	631,052	Natural Gas	105,228	147,580	124,731						
127	EGBIN ST5	1987	5			220.0	916,943	692,798	570,861	718,549	631,052	Natural Gas	105,228	147,580	124,731						
128	EGBIN ST6	1987	11			220.0	916,943	692,798	570,861	718,549	631,052	Natural Gas	105,228	147,580	124,731						
129	SAPELE ST1	1978	9	12		120.0	67,528	42,341	35,681	28,783	36,874	Natural Gas	11,886	8,869	9,143						
130	SAPELE ST2	1979	2	1		120.0	67,528	42,341	35,681	28,783	36,874	Natural Gas	11,886	8,869	9,143						
131	SAPELE ST3	1979	3	22		120.0	67,528	42,341	35,681	28,783	36,874	Natural Gas	11,886	8,869	9,143						
132	SAPELE ST4	1979	11	2		120.0	67,528	42,341	35,681	28,783	36,874	Natural Gas	11,886	8,869	9,143						
133	SAPELE ST5	1980	4	24		120.0	67,528	42,341	35,681	28,783	36,874	Natural Gas	11,886	8,869	9,143						
134	SAPELE ST6	1981	8	19		120.0	67,528	42,341	35,681	28,783	36,874	Natural Gas	11,886	8,869	9,143						
135	SAPELE GT01	1981	6	26		75.0	42,205	26,463	22,301	17,989	23,046	Natural Gas	7,429	5,543	5,714						
136	SAPELE GT02	1981	7	15		75.0	42,205	26,463	22,301	17,989	23,046	Natural Gas	7,429	5,543	5,714						
137	SAPELE GT03	1981	7	30		75.0	42,205	26,463	22,301	17,989	23,046	Natural Gas	7,429	5,543	5,714						
138	SAPELE GT04	1981	8	22		75.0	42,205	26,463	22,301	17,989	23,046	Natural Gas	7,429	5,543	5,714						
139	SAPELE GT1-14	2018	12	18		25.0	14,068	8,821	7,434	5,996	7,682	Natural Gas	2,476	1,848	1,905						
140	DELTA GT3	2002	3			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
141	DELTA GT4	2002	2			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						

142	DELTA GT5	2002	3			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
143	DELTA GT6	2002	3			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
144	DELTA GT7	2002	2			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
145	DELTA GT8	2002	1			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
146	DELTA GT9	2005	10			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
147	DELTA GT10	2005	10			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
148	DELTA GT11	2005	10			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
149	DELTA GT12	2005	11			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
150	DELTA GT13	2005	11			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
151	DELTA GT14	2005	11			26.9	74,471	63,424	81,564	104,161	72,815	Natural Gas	20,001	24,704	17,199						
152	DELTA GT15	1990	1			126.0	348,821	297,081	382,045	487,892	341,065	Natural Gas	93,686	115,713	80,559						
153	DELTA GT16	1990	3			110.9	307,018	261,478	336,260	429,422	300,192	Natural Gas	82,459	101,846	70,904						
154	DELTA GT17	1990	5			110.9	307,018	261,478	336,260	429,422	300,192	Natural Gas	82,459	101,846	70,904						
155	DELTA GT18	1990	7			110.9	307,018	261,478	336,260	429,422	300,192	Natural Gas	82,459	101,846	70,904						
156	DELTA GT19	1990	8			110.9	307,018	261,478	336,260	429,422	300,192	Natural Gas	82,459	101,846	70,904						
157	DELTA GT20	1990	9			110.9	307,018	261,478	336,260	429,422	300,192	Natural Gas	82,459	101,846	70,904						
158	AFAM IV GT17	1982	7	5		75.0	4,278	0	45,272	156,683	152,351	Natural Gas	149,661	39,727	41,365						
159	AFAM IV GT18	1985	8	2		75.0	4,278	0	45,272	156,683	152,351	Natural Gas	149,661	39,727	41,365						
160	GEREGU GAS GT11	2007	5	12		145.0	364,153	229,252	542,194	528,172	600,198	Natural Gas	123,962	102,904	119,976						
161	GEREGU GAS GT12	2007	4	17		145.0	364,153	229,252	542,194	528,172	600,198	Natural Gas	123,962	102,904	119,976						
162	GEREGU GAS GT13	2007	3	14		145.0	364,153	229,252	542,194	528,172	600,198	Natural Gas	123,962	102,904	119,976						
163	OMOTOSHO GAS GT1	2007	6	14		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						

164	OMOTOSHO GAS GT2	2007	7	18		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
165	OMOTOSHO GAS GT3	2007	12	4		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
166	OMOTOSHO GAS GT4	2008	4	19		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
167	OMOTOSHO GAS GT5	2007	11	22		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
168	OMOTOSHO GAS GT6	2007	10	11		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
169	OMOTOSHO GAS GT7	2007	9	6		42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
170	OMOTOSHO GAS GT8	2007	7			42.0	183,148	114,959	143,910	135,910	129,352	Natural Gas	26,104	31,035	29,769						
171	OLORUNSOGO GAS GT1	2005	11			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
172	OLORUNSOGO GAS GT2	2006	3			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
173	OLORUNSOGO GAS GT3	2006	8			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
174	OLORUNSOGO GAS GT4	2006	9			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
175	OLORUNSOGO GAS GT5	2006	9			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
176	OLORUNSOGO GAS GT6	2006	11			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
177	OLORUNSOGO GAS GT7	2006	12			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
178	OLORUNSOGO GAS GT8	2007	1			42.0	191,797	107,605	147,587	144,597	173,150	Natural Gas	31,895	30,480	38,186						
179	GEREGU NIPP GT21	2013	3	4		145.0	388,804	231,422	303,727	238,684	602,076	Natural Gas	63,172	51,491	85,406						
180	GEREGU NIPP GT22	2013	5	14		145.0	388,804	231,422	303,727	238,684	602,076	Natural Gas	63,172	51,491	85,406						
181	GEREGU NIPP GT23	2013	5	14		145.0	388,804	231,422	303,727	238,684	602,076	Natural Gas	63,172	51,491	85,406						
182	SAPELE NIPP GT1	2011	8	21		126.1	229,919	199,598	233,655	290,365	152,419	Natural Gas	23,121	59,653	28,665						
183	SAPELE NIPP GT2	2011	2	10		126.1	229,919	199,598	233,655	290,365	152,419	Natural Gas	23,121	59,653	28,665						
184	SAPELE NIPP GT3	2013	2	24		126.1	229,919	199,598	233,655	290,365	152,419	Natural Gas	23,121	59,653	28,665						
185	SAPELE NIPP GT4	2012	8	13		126.1	229,919	199,598	233,655	290,365	152,419	Natural Gas	23,121	59,653	28,665						

186	ALAOJI NIPP GT1	2015	4	25		118.0	173,137	219,378	120,119	60,269	52,363	Natural Gas	23,344	13,798	12,170						
187	ALAOJI NIPP GT2	2015	4	25		118.0	173,137	219,378	120,119	60,269	52,363	Natural Gas	23,344	13,798	12,170						
188	ALAOJI NIPP GT3	2015	4	25		118.0	173,137	219,378	120,119	60,269	52,363	Natural Gas	23,344	13,798	12,170						
189	ALAOJI NIPP GT4	2015	4	25		118.0	173,137	219,378	120,119	60,269	52,363	Natural Gas	23,344	13,798	12,170						
190	OLORUNSOGO NIPP GT11	2011	1	10		125.0	191,359	27,059	112,666	85,169	35,213	Natural Gas	24,687	21,429	7,854						
191	OLORUNSOGO NIPP GT12	2011	1	13		125.0	191,359	27,059	112,666	85,169	35,213	Natural Gas	24,687	21,429	7,854						
192	OLORUNSOGO NIPP GT21	2011	5	16		125.0	191,359	27,059	112,666	85,169	35,213	Natural Gas	24,687	21,429	7,854						
193	OLORUNSOGO NIPP GT22	2011	12	14		125.0	191,359	27,059	112,666	85,169	35,213	Natural Gas	24,687	21,429	7,854						
194	OLORUNSOGO NIPP ST13	2012	3	18		125.0	191,359	27,059	112,666	85,169	35,213	Natural Gas	24,687	21,429	7,854						
195	OLORUNSOGO NIPP ST23	2012	11	14		125.0	191,359	27,059	112,666	85,169	35,213	Natural Gas	24,687	21,429	7,854						
196	OMOTOSHO NIPP GT1	2012	10	10		125.0	327,901	219,495	241,823	246,114	205,366	Natural Gas	54,126	53,842	44,575						
197	OMOTOSHO NIPP GT2	2012	8	2		125.0	327,901	219,495	241,823	246,114	205,366	Natural Gas	54,126	53,842	44,575						
198	OMOTOSHO NIPP GT3	2012	11	26		125.0	327,901	219,495	241,823	246,114	205,366	Natural Gas	54,126	53,842	44,575						
199	OMOTOSHO NIPP GT4	2012	12	21		125.0	327,901	219,495	241,823	246,114	205,366	Natural Gas	54,126	53,842	44,575						
200	IHOVBOR GT1	2013	5	15		126.0	277,708	181,766	205,130	203,081	174,120	Natural Gas	48,124	89,217	41,074						
201	IHOVBOR GT2	2013	7	13		126.0	277,708	181,766	205,130	203,081	174,120	Natural Gas	48,124	89,217	41,074						
202	IHOVBOR GT3	2013	11	11		126.0	277,708	181,766	205,130	203,081	174,120	Natural Gas	48,124	89,217	41,074						
203	IHOVBOR GT4	2013	2	3		126.0	277,708	181,766	205,130	203,081	174,120	Natural Gas	48,124	89,217	41,074						
204	OKPAI GT11	2005	4	1		165.0	916,428	881,953	805,750	668,555	488,030	Natural Gas	114,968	105,306	85,563						
205	OKPAI GT12	2005	4	1		165.0	916,428	881,953	805,750	668,555	488,030	Natural Gas	114,968	105,306	85,563						
206	OKPAI ST18	2005	4	1		150.0	833,117	801,775	732,500	607,777	443,664	Natural Gas	104,516	95,732	77,785						
207	AFAM VI GT11	2010	5	15		150.0	681,902	491,482	505,780	410,313	330,217	Natural Gas	67,013	53,541	52,968						

208	AFAM VI GT12	2010	5	15		150.0	681,902	491,482	505,780	410,313	330,217	Natural Gas	67,013	53,541	52,968						
209	AFAM VI GT13	2010	5	15		150.0	681,902	491,482	505,780	410,313	330,217	Natural Gas	67,013	53,541	52,968						
210	AFAM VI ST18	2010	5	15		220.0	1,000,123	720,841	741,810	601,792	484,318	Natural Gas	98,285	78,526	77,686						
211	IBOM GT1	2009	12	15		36.0	96,720	89,940	92,282	98,363	93,619	Natural Gas	22,446	24,355	22,176						
212	IBOM GT2	2017	6	14		36.0	96,720	89,940	92,282	98,363	93,619	Natural Gas	22,446	24,355	22,176						
213	IBOM GT3	2010	6	16		119.0	319,714	297,301	305,044	325,143	309,464	Natural Gas	74,197	80,506	73,305						
214	RIVERS GT1	2012	2	14		180.0	0	12,573	30,789	627,372	833,490	Natural Gas	4,927	99,789	123,764						
215	AZURA GT 11	2018	5	24		154.0	0	0	0	538,959	562,870	Natural Gas									
216	AZURA GT 12	2018	5	24		154.0				538,959	562,870	Natural Gas									
217	AZURA GT 13	2018	5	24		154.0				538,959	562,870	Natural Gas									
218	OMOKU GT1	2006	12	5		25.0	0	36,053	91,564	82,326	84,499	Natural Gas	18,586	153,210	25,224						
219	OMOKU GT2	2006	12	5		25.0		36,053	91,564	82,326	84,499	Natural Gas	18,586	153,210	25,224						
220	OMOKU GT3	2006	12	5		25.0		36,053	91,564	82,326	84,499	Natural Gas	18,586	153,210	25,224						
221	OMOKU GT4	2007	3	4		25.0		36,053	91,564	82,326	84,499	Natural Gas	18,586	153,210	25,224						
222	OMOKU GT5	2007	12	30		25.0		36,053	91,564	82,326	84,499	Natural Gas	18,586	153,210	25,224						
223	OMOKU GT6	2008	4	12		25.0		36,053	91,564	82,326	84,499	Natural Gas	18,586	153,210	25,224						
224	ODUKPANI NIPP GT1	2015	6	5		125.0	45,947	94,062	288,929	150,064	389,551	Natural Gas	66,753	36,607	81,764						
225	ODUKPANI NIPP GT2	2015	4	30		125.0	45,947	94,062	288,929	150,064	389,551	Natural Gas	66,753	36,607	81,764						
226	ODUKPANI NIPP GT3	2015	4	11		125.0	45,947	94,062	288,929	150,064	389,551	Natural Gas	66,753	36,607	81,764						
227	ODUKPANI NIPP GT4	2015	6	29		125.0	45,947	94,062	288,929	150,064	389,551	Natural Gas	66,753	36,607	81,764						
228	ODUKPANI NIPP GT5	2015	8			125.0	45,947	94,062	288,929	150,064	389,551	Natural Gas	66,753	36,607	81,764						
229	GBARAIN GT-2	2016	4	31		112.5		176,831	344,562	360,077	257,442	Natural Gas	73,607	80,400	58,462						

230	TRANS-AMADI GT1	2010	5	14		25.0	0	15,390	36,155	60,058	80,828	Natural Gas	9,076	15,403	20,434		2.35				
231	TRANS-AMADI GT2	2010	5	14		25.0		15,390	36,155	60,058	80,828	Natural Gas	9,076	15,403	20,434						
232	TRANS-AMADI GT3	2019	7	11		25.0		15,390	36,155	60,058	80,828	Natural Gas	9,076	15,403	20,434						
233	TRANS-AMADI GT4	2010	5	14		25.0		15,390	36,155	60,058	80,828	Natural Gas	9,076	15,403	20,434						
234	PARAS ENERGY GT1	2012	11	29		87.30	0	0	40,617	46,341	45,387	Natural Gas				18.87	18.87	18.86			
235	PARAS ENERGY GT2	2012	3	19		96.00			44,664	50,959	49,910	Natural Gas				18.87	18.87	18.86			
236	PARAS ENERGY GT3	2012	3	19		96.00			44,664	50,959	49,910	Natural Gas				18.87	18.87	18.86			
237	PARAS ENERGY GT4	2012	5	4		96.00			44,664	50,959	49,910	Natural Gas				18.87	18.87	18.86			
238	PARAS ENERGY GT5	2014	9	25		97.30			45,269	51,649	50,585	Natural Gas				18.87	18.87	18.86			
239	PARAS ENERGY GT6	2014	9	25		97.30			45,269	51,649	50,585	Natural Gas				18.87	18.87	18.86			
240	PARAS ENERGY GT7	2014	9	25		97.30			45,269	51,649	50,585	Natural Gas				18.87	18.87	18.86			
241	PARAS ENERGY GT8	2014	9	25		97.30			45,269	51,649	50,585	Natural Gas				18.87	18.87	18.86			
242	PARAS ENERGY GT9	2018	9	20		97.80			45,502	51,914	50,845	Natural Gas				18.87	18.87	18.86			
243	PARAS ENERGY GT10	2018	9	18		97.80			45,502	51,914	50,845	Natural Gas				18.87	18.87	18.86			
244	PARAS ENERGY GT11	2019	1	30		97.90			45,548	51,967	50,897	Natural Gas				18.87	18.87	18.86			
245	CALABAR NIPP GT4	2015	2	7		113.0	52,898	61,554	78,891	248,336	520,237	Natural Gas	905	2,820	5,976						
246	CALABAR NIPPGT5	2015	2	11		113.0	47,508	158,354	375,275	167,287	379,519	Natural Gas	3,454	1,938	4,787						
247	CALABAR NIPP GT3	2015	3	15		113.0	40,858	140,700	421,554	163,151	267,997	Natural Gas	4,718	1,750	690						
248	CALABAR NIPP GT2	2015	4	5		113.0	71,782	95,966	260,565	87,774	323,641	Natural Gas	3,841	1,272	4,247						
249	CALABAR NIPP GT1	2015	8	6		113.0	15,497	32,103	268,656	81,659	446,993	Natural Gas	12,415	954	5,116						
250	Cap des Biches - C.III Vapeur	1966				57.50	226,816	220,752	242,116	253,988	281,964	Residual Fuel Oil	85,833	91,308	103,029	40.17	40.17	40.17			
251	Bel air - TAG 4	2011				35.00	39,429	5,305	11,516	16,787	31,512	Gas/Diesel Oil	4,470	5,976	11,446						

252	Cap des Biches - TAG 2	2000				20.00	12,500	614	2,783	2,618	9,398	Gas/Diesel Oil	1,084	1,264	4,475						
253	Cap des Biches - TAG 3	2000				22.00	0	0	0	0	0	Gas/Diesel Oil									
254	CIV	2000				98.70	628,840	596,887	628,925	648,923	661,439	Residual Fuel Oil	130,309	133,684	136,473	40.17	40.17	40.17	Gas/Diesel Oil	8	47
255	Cap des Biches - CIV	2000				95.00	502,266	481,568	421,569	327,452	276,679	Residual Fuel Oil	91,222	68,653	58,795	40.17	40.17	40.17	Gas/Diesel Oil	405	103
256	Kaolack - Kahone 1	2000				14.40	21,393	50,223	14,672	5,967	14,895	Residual Fuel Oil	3,798	1,136	3,704	40.17	40.17	40.17	Gas/Diesel Oil	88	427
257	Kaolack - Kahone 2 CVII	2000				101.40	597,448	569,914	594,445	633,841	601,728	Residual Fuel Oil	118,681	127,405	121,139	40.17	40.17	40.17	Gas/Diesel Oil	50	160
258	Solaire CICAD	2015	1	16		2.00		2,638	3,324	2,789	2,935	Solar									
259	Solaire DIASS	2018				23.00					13,638	Solar									
260	Gorée	2016						628	734	0	0	Gas/Diesel Oil	181	3	0						
261	Kounoune Power	2008	1	22		67.50	412,871	302,806	234,947	150,772	171,164	Residual Fuel Oil	52,778	33,806	38,283	41.00	41.00	41.00	Gas/Diesel Oil	384	167
262	Tobene Power	2016	3			115.00		343,259	429,653	405,106	257,275	Residual Fuel Oil	84,091	79,101	51,385	41.00	41.00	41.00			
263	Contour Global-Ex GTI	2016	4			85.90		290,091	574,751	541,910	495,262	Residual Fuel Oil	112,947	110,478	92,107	41.00	41.00	41.00			
264	Location - Aggreko	2016				0.00	221,062	32,482	0	26,772	92,133	Gas/Diesel Oil	0	6,256	20,873						
265	Location - APR	2011				88.50	128,442	35,606	40,486	45,486	68,635	Gas/Diesel Oil	9,018	9,887	14,872						
266	Sendou	2018				125.00				135,406	302,868	Anthracite		54,135	115,722						
267	Autoproduction (ICS/Dangoté/SOCOCIM)	2016	3	1		6.00	42	31,937	49,377	49,030	52,467	Anthracite									
268	Solaire Malicounda	2016				22.00		1,160	27,146	35,199	35,790	Solar									
269	Solaire Bokhol	2016				20.00		3,059	33,414	33,387	33,855	Solar									
270	Solaire TenMérina	2017				29.50			16,847	50,025	50,561	Solar									
271	Solaire Mékhé	2017				29.50			5,098	49,406	50,777	Solar									
272	Solaire Kahone	2018				20.00				25,708	31,512	Solar									
273	Solaire Sakal	2018				20.00				18,724	44,205	Solar									
274	Parc éolien de Taïba Ndiaye	2019				55.20					23,132	Wind									
273	KARPOWERSHIP	2019				120.00					236,051	Residual Fuel Oil			47,999						

274	Lomé-Siège (SULZER)	1979				16.00	4,083	5,452	9,405	2,535	1,475	Gas/Diesel Oil	2,256	612	354						
275	Lomé-B	2008				10.84	1,982	11,605	5,970	3,437	4,556	Gas/Diesel Oil	1,371	791	1,055						
276	Kpimé	1963				1.60	4,320	3,856	4,295	4,083	4,424	Hydro									
277	Sokodé	2001				0.75	20	17	0	9	5	Gas/Diesel Oil	0	3	1						
278	Kara	1971				9.64	508	1,102	254	220	174	Gas/Diesel Oil	61	53	42						
279	Dapaong	2014	1			1.97	4,392	2,944	280	469	262	Gas/Diesel Oil	70	122	73						
280	ContourGlobal Togo (CGT)	2010	10	14		99.73	340,427	660,496	431,860	358,730	449,122	Natural Gas	0	30,785	67,549	0.00	24.54	24.68	Residual Fuel Oil	89,644	32,569
281	NANGBETO	1987	9	1		65.00	56,437	204,094	206,795	196,217	236,426	Hydro									
282	TAG LPO	1998	9	10		25.00	0	18,611	126,044	10,027	0	Natural Gas	24,213	2,164	0	21.82	21.87				

ANNEX II: DETERMINATION OF THE OPERATING MARGIN

Table 6: Calculation of the Simple Operating Margin							
No.	Name of Power Unit	2017		2018		2019	
		Net Electricity Generation	CO2 Emission Factor	Net Electricity Generation	CO2 Emission Factor	Net Electricity Generation	CO2 Emission Factor
		MWh	t-CO_2/MWh	MWh	t-CO_2/MWh	MWh	t-CO_2/MWh
1		-	-	-	-	-	-
2	MARIA-GLETA CAI Decomissione	-	-	-	-	-	-
3	Porto Novo	295	0.7090	240	0.6769	601	0.6568
4	Parakou	151	0.7588	461	0.7367	629	0.6552
5	Natitingou	32	1.0184	207	0.7108	426	0.6618
6	Maria-Gleta 1	-	-	-	-	252,306	1.2405
7	Yeripao	-	-	-	-	-	-
8	TAG MGL	139,922	0.4613	62,692	0.5186	7,582	0.5161
9	OUAGA I	8,500	0.6954	10,417	0.6996	6,255	0.7011
10	OUAGA II	30,200	0.7372	35,874	0.7359	23,284	0.7447
11	KOSSODO	193,325	0.6513	174,633	0.6602	124,899	0.6696
12	KOMSILGA	426,991	0.5945	401,621	0.6003	241,905	0.5700
13	BOBO I	0	-	0	-	0	-
14	BOBO II	278,133	0.6314	234,417	0.6371	177,239	0.6326
15	GAOUA	1,274	0.7884	1,574	0.7455	4,123	0.7084
16	OUAHIGOUYA	6,179	0.6872	4,773	0.6745	2,427	0.6768
17	DEDOUGOU	3,928	0.7044	5,917	0.7139	2,543	0.7192
18	DJIBO	430	0.7776	0	-	0	-
19	FADA	560	0.7885	255	0.7988	107	0.7946
20	DORI	4,057	0.7696	925	0.7267	978	0.7590
21	KOMPIENGA	-	-	-	-	-	-
22	BAGRE	-	-	-	-	-	-
23	TOURNI	-	-	-	-	-	-
24	NIOFILA	-	-	-	-	-	-
25	KOMPIENGA THERMIQUE	51	1.0219	20	1.2767	30	1.2580
26	ZIGA	-	-	-	-	-	-
27	ZAGTOULI	-	-	-	-	-	-
28	AGGREKO THERMIQUE (location)	-	-	-	-	149,549	0.6951
29	Vridi TAG	184,998	0.4969	111,596	0.5097	80,234	0.4843
30	Ciprel 1	429,346	0.2825	424,585	0.2887	445,719	0.2865
31	Ciprel 2	473,642	0.2825	392,324	0.2887	430,134	0.2865
32	Ciprel 3	778,213	0.2825	744,997	0.2887	867,363	0.2865
33	Ciprel 4	863,041	0.2823	806,817	0.2875	749,159	0.2827
34	Ciprel TAV	723,153	0.2823	649,488	0.2875	789,246	0.2827
35	Azito 1	1,046,010	0.2337	979,813	0.2378	1,004,454	0.2269
36	Azito 2	1,014,965	0.2337	941,220	0.2378	888,109	0.2269

37	Azito TAV	1,067,047	0.2337	968,046	0.2378	911,321	0.2269
38	Aggreko 1	425,161	0.2970	335,677	0.2970	362,275	0.2981
39	Aggreko 2	251,423	0.2970	199,712	0.2970	206,746	0.2981
40	Aggreko 3	636,645	0.2970	473,556	0.2970	389,822	0.2981
41	Ayamé 1	-	-	-	-	-	-
42	Ayamé 2	-	-	-	-	-	-
43	Kossou	-	-	-	-	-	-
44	Taabo	-	-	-	-	-	-
45	Buyo	-	-	-	-	-	-
46	Fayé	-	-	-	-	-	-
47	Soubre	-	-	-	-	-	-
48	TAPCO - Takoradi 1 Thermal Power Plant (T1)	685,515	0.3026	730,046	0.5760	1,067,430	0.4947
49	TICO - Takoradi 2 Thermal Power Plant (T2)	1,880,155	0.2892	2,210,950	0.3441	1,616,298	0.3981
50	Takoradi 3 Thermal Power Plant (T3)	0	-	0	-	0	-
51	Tema Thermal 1 Plant TT1PP	365,348	0.3901	314,341	0.5296	377,283	0.5537
52	Tema Thermal 2 Plant TT2PP	492	0.4450	2,680	0.4450	138,430	0.4450
53	Kpone Thermal Power Plant KTPP	124,330	0.7926	317,441	3.9159	392,966	4.1802
54	Ameri	1,228,725	0.4498	872,607	0.4802	1,483,400	0.5079
55	VRA Solar	-	-	-	-	-	-
56	Akosombo	-	-	-	-	-	-
57	Kpong	-	-	-	-	-	-
58	Tema CENIT Thermal Power Plant	59,183	6.5909	2,221	6.5909	179,060	28.1750
59	Akosombo	-	-	-	-	-	-
60	Kpong	-	-	-	-	-	-
61	Bui	-	-	-	-	-	-
62	Sunon Asogli	1,417,000	0.3777	1,970,000	0.3903	2,622,000	0.3634
63	Karpowership	1,814,000	1.3338	2,556,000	1.0415	1,510,000	0.9279
64	Trojan	51	0.5213	0	-	0	-
65	AKSA	799,000	1.1651	748,000	1.0786	608,000	0.9911
66	Cenpower GT1	-	-	-	-	58,763	0.8461
67	Cenpower GT2	-	-	-	-	59,675	0.7955
68	Cenpower ST1	-	-	-	-	63,878	0.0000
69	Genser	0	-	392	0.5914	377	0.5914
70	Amandi	-	-	-	-	149,000	0.8253
71	Safisana	-	-	-	-	-	-
72	BXC Solar	-	-	-	-	-	-
73	Mienergy Solar Plant	-	-	-	-	-	-
74	Darsalam	61,642	0.6789	30,160	0.7525	34,863	0.7687
75	Balingué Diesel	18,734	0.6864	16,690	0.6921	39,193	0.7108
76	Balingué BID	380,701	0.6489	308,291	0.6519	297,858	0.6556
77	SOPAM (IPP)	21,317	0.6125	0	-	0	-

78	Selingué	-	-	-	-	-	-
79	Sotuba	-	-	-	-	-	-
80	Aksa enerji (Location)	71,407	0.6481	146,559	0.6956	142,149	0.7165
81	Albatros Energy Mali (IPP)	-	-	49,109	0.6190	118,814	0.5809
82	Aggreko (Location)	80,090	0.6766	110,316	0.6776	119,121	0.6579
83	SES (Location)	52,979	0.6668	35,383	0.6752	70,467	0.6735
84	Manantali	-	-	-	-	-	-
85	Félou	-	-	-	-	-	-
86	DIFFA	17,756	0.6406	18,640	0.6449	19,171	0.6421
87	DOSSO	132	0.7956	119	0.7631	60	0.7771
88	GAYA	363	0.6849	416	0.7170	605	0.7320
89	GOUDEL	17,728	0.6884	8,713	0.7043	7,978	0.6269
90	MAINE	0	-	0	-	0	-
91	MALBAZA	752	0.6421	686	0.6054	11,550	0.6361
92	MARADI	328	0.7237	318	0.7563	233	0.7550
93	N'GUIGMI	3,126	0.7316	2,446	0.7198	3,021	0.7001
94	NIAMEYII	2,077	1.0153	0	-	0	-
95	TAHOUA	166	0.7590	347	0.7141	1,651	0.6699
96	TILLABERY	0	-	0	-	0	-
97	ZINDER	326	0.7229	367	0.7142	528	0.6941
98	GOROU BANDA	172,378	0.6281	134,403	0.5922	164,437	0.5996
99	SONICHAR	103,259	2.3684	117,346	2.4162	105,635	1.9304
100	SONICHAR	103,644	2.1379	70,377	2.2582	98,194	2.1038
101	SONICHAR	73	3.4175	76	3.9267	42	0.9376
102	SONICHAR	90	273.0802	89	140.7746	36	2.7815
103	KAINJI 1G2	-	-	-	-	-	-
104	KAINJI 1G6	-	-	-	-	-	-
105	KAINJI 1G7	-	-	-	-	-	-
106	KAINJI 1G8	-	-	-	-	-	-
107	KAINJI 1G9	-	-	-	-	-	-
108	KAINJI 1G10	-	-	-	-	-	-
109	KAINJI 1G11	-	-	-	-	-	-
110	KAINJI 1G12	-	-	-	-	-	-
111	JEBBA 2G1	-	-	-	-	-	-
112	JEBBA 2G2	-	-	-	-	-	-
113	JEBBA 2G3	-	-	-	-	-	-
114	JEBBA 2G4	-	-	-	-	-	-
115	JEBBA 2G5	-	-	-	-	-	-
116	JEBBA 2G6	-	-	-	-	-	-
117	SHIRORO 411G1	-	-	-	-	-	-
118	SHIRORO 411G2	-	-	-	-	-	-
119	SHIRORO 411G3	-	-	-	-	-	-
120	SHIRORO 411G4	-	-	-	-	-	-
121	EGBIN ST1	570,861	0.4654	718,549	0.5186	631,052	0.4991
122	EGBIN ST2	570,861	0.4654	718,549	0.5186	631,052	0.4991
123	EGBIN ST3	570,861	0.4654	718,549	0.5186	631,052	0.4991
124	EGBIN ST4	570,861	0.4654	718,549	0.5186	631,052	0.4991

125	EGBIN ST5	570,861	0.4654	718,549	0.5186	631,052	0.4991
126	EGBIN ST6	570,861	0.4654	718,549	0.5186	631,052	0.4991
127	SAPELE ST1	35,681	0.8411	28,783	0.7780	36,874	0.6260
128	SAPELE ST2	35,681	0.8411	28,783	0.7780	36,874	0.6260
129	SAPELE ST3	35,681	0.8411	28,783	0.7780	36,874	0.6260
130	SAPELE ST4	35,681	0.8411	28,783	0.7780	36,874	0.6260
131	SAPELE ST5	35,681	0.8411	28,783	0.7780	36,874	0.6260
132	SAPELE ST6	35,681	0.8411	28,783	0.7780	36,874	0.6260
133	SAPELE GT01	22,301	0.8411	17,989	0.7780	23,046	0.6260
134	SAPELE GT02	22,301	0.8411	17,989	0.7780	23,046	0.6260
135	SAPELE GT03	22,301	0.8411	17,989	0.7780	23,046	0.6260
136	SAPELE GT04	22,301	0.8411	17,989	0.7780	23,046	0.6260
137	SAPELE GT1-14	7,434	0.8411	5,996	0.7780	7,682	0.6260
138	DELTA GT3	81,564	0.6192	104,161	0.5988	72,815	0.5964
139	DELTA GT4	81,564	0.6192	104,161	0.5988	72,815	0.5964
140	DELTA GT5	81,564	0.6192	104,161	0.5988	72,815	0.5964
141	DELTA GT6	81,564	0.6192	104,161	0.5988	72,815	0.5964
142	DELTA GT7	81,564	0.6192	104,161	0.5988	72,815	0.5964
143	DELTA GT8	81,564	0.6192	104,161	0.5988	72,815	0.5964
144	DELTA GT9	81,564	0.6192	104,161	0.5988	72,815	0.5964
145	DELTA GT10	81,564	0.6192	104,161	0.5988	72,815	0.5964
146	DELTA GT11	81,564	0.6192	104,161	0.5988	72,815	0.5964
147	DELTA GT12	81,564	0.6192	104,161	0.5988	72,815	0.5964
148	DELTA GT13	81,564	0.6192	104,161	0.5988	72,815	0.5964
149	DELTA GT14	81,564	0.6192	104,161	0.5988	72,815	0.5964
150	DELTA GT15	382,045	0.6192	487,892	0.5988	341,065	0.5964
151	DELTA GT16	336,260	0.6192	429,422	0.5988	300,192	0.5964
152	DELTA GT17	336,260	0.6192	429,422	0.5988	300,192	0.5964
153	DELTA GT18	336,260	0.6192	429,422	0.5988	300,192	0.5964
154	DELTA GT19	336,260	0.6192	429,422	0.5988	300,192	0.5964
155	DELTA GT20	336,260	0.6192	429,422	0.5988	300,192	0.5964
156	AFAM IV GT17	45,272	8.3471	156,683	0.6402	152,351	0.6856
157	AFAM IV GT18	45,272	8.3471	156,683	0.6402	152,351	0.6856
158	GEREGU GAS GT11	542,194	0.5773	528,172	0.4919	600,198	0.5047
159	GEREGU GAS GT12	542,194	0.5773	528,172	0.4919	600,198	0.5047
160	GEREGU GAS GT13	542,194	0.5773	528,172	0.4919	600,198	0.5047
161	OMOTOSHO GAS GT1	143,910	0.4580	135,910	0.5766	129,352	0.5811
162	OMOTOSHO GAS GT2	143,910	0.4580	135,910	0.5766	129,352	0.5811
163	OMOTOSHO GAS GT3	143,910	0.4580	135,910	0.5766	129,352	0.5811
164	OMOTOSHO GAS GT4	143,910	0.4580	135,910	0.5766	129,352	0.5811
165	OMOTOSHO GAS GT5	143,910	0.4580	135,910	0.5766	129,352	0.5811
166	OMOTOSHO GAS GT6	143,910	0.4580	135,910	0.5766	129,352	0.5811
167	OMOTOSHO GAS GT7	143,910	0.4580	135,910	0.5766	129,352	0.5811
168	OMOTOSHO GAS GT8	143,910	0.4580	135,910	0.5766	129,352	0.5811
169	OLORUNSOGO GAS GT1	147,587	0.5457	144,597	0.5322	173,150	0.5568
170	OLORUNSOGO GAS GT2	147,587	0.5457	144,597	0.5322	173,150	0.5568
171	OLORUNSOGO GAS GT3	147,587	0.5457	144,597	0.5322	173,150	0.5568

172	OLORUNSOGO GAS GT4	147,587	0.5457	144,597	0.5322	173,150	0.5568
173	OLORUNSOGO GAS GT5	147,587	0.5457	144,597	0.5322	173,150	0.5568
174	OLORUNSOGO GAS GT6	147,587	0.5457	144,597	0.5322	173,150	0.5568
175	OLORUNSOGO GAS GT7	147,587	0.5457	144,597	0.5322	173,150	0.5568
176	OLORUNSOGO GAS GT8	147,587	0.5457	144,597	0.5322	173,150	0.5568
177	GEREGU NIPP GT21	303,727	0.5252	238,684	0.5447	602,076	0.3582
178	GEREGU NIPP GT22	303,727	0.5252	238,684	0.5447	602,076	0.3582
179	GEREGU NIPP GT23	303,727	0.5252	238,684	0.5447	602,076	0.3582
180	SAPELE NIPP GT1	233,655	0.2499	290,365	0.5187	152,419	0.4749
181	SAPELE NIPP GT2	233,655	0.2499	290,365	0.5187	152,419	0.4749
182	SAPELE NIPP GT3	233,655	0.2499	290,365	0.5187	152,419	0.4749
183	SAPELE NIPP GT4	233,655	0.2499	290,365	0.5187	152,419	0.4749
184	ALAOJI NIPP GT1	120,119	0.4907	60,269	0.5780	52,363	0.5868
185	ALAOJI NIPP GT2	120,119	0.4907	60,269	0.5780	52,363	0.5868
186	ALAOJI NIPP GT3	120,119	0.4907	60,269	0.5780	52,363	0.5868
187	ALAOJI NIPP GT4	120,119	0.4907	60,269	0.5780	52,363	0.5868
188	OLORUNSOGO NIPP GT11	112,666	0.5533	85,169	0.6353	35,213	0.5632
189	OLORUNSOGO NIPP GT12	112,666	0.5533	85,169	0.6353	35,213	0.5632
190	OLORUNSOGO NIPP GT21	112,666	0.5533	85,169	0.6353	35,213	0.5632
191	OLORUNSOGO NIPP GT22	112,666	0.5533	85,169	0.6353	35,213	0.5632
192	OLORUNSOGO NIPP ST13	112,666	0.5533	85,169	0.6353	35,213	0.5632
193	OLORUNSOGO NIPP ST23	112,666	0.5533	85,169	0.6353	35,213	0.5632
194	OMOTOSHO NIPP GT1	241,823	0.5651	246,114	0.5524	205,366	0.5480
195	OMOTOSHO NIPP GT2	241,823	0.5651	246,114	0.5524	205,366	0.5480
196	OMOTOSHO NIPP GT3	241,823	0.5651	246,114	0.5524	205,366	0.5480
197	OMOTOSHO NIPP GT4	241,823	0.5651	246,114	0.5524	205,366	0.5480
198	IHOVBOR GT1	205,130	0.5924	203,081	1.1092	174,120	0.5956
199	IHOVBOR GT2	205,130	0.5924	203,081	1.1092	174,120	0.5956
200	IHOVBOR GT3	205,130	0.5924	203,081	1.1092	174,120	0.5956
201	IHOVBOR GT4	205,130	0.5924	203,081	1.1092	174,120	0.5956
202	OKPAI GT11	805,750	0.3603	668,555	0.3977	488,030	0.4427
203	OKPAI GT12	805,750	0.3603	668,555	0.3977	488,030	0.4427
204	OKPAI ST18	732,500	0.3603	607,777	0.3977	443,664	0.4427
205	AFAM VI GT11	505,780	0.3345	410,313	0.3295	330,217	0.4050
206	AFAM VI GT12	505,780	0.3345	410,313	0.3295	330,217	0.4050
207	AFAM VI GT13	505,780	0.3345	410,313	0.3295	330,217	0.4050
208	AFAM VI ST18	741,810	0.3345	601,792	0.3295	484,318	0.4050
209	IBOM GT1	92,282	0.6141	98,363	0.6252	93,619	0.5981
210	IBOM GT2	92,282	0.6141	98,363	0.6252	93,619	0.5981
211	IBOM GT3	305,044	0.6141	325,143	0.6252	309,464	0.5981
212	RIVERS GT1	30,789	0.4040	627,372	0.4016	833,490	0.3749
213	AZURA GT 11	0	-	538,959	0.5213	562,870	0.5213
214	AZURA GT 12	-	-	538,959	0.5213	562,870	0.5213

215	AZURA GT 13	-	-	538,959	0.5213	562,870	0.5213
216	OMOKU GT1	91,564	0.5125	82,326	4.6989	84,499	0.7537
217	OMOKU GT2	91,564	0.5125	82,326	4.6989	84,499	0.7537
218	OMOKU GT3	91,564	0.5125	82,326	4.6989	84,499	0.7537
219	OMOKU GT4	91,564	0.5125	82,326	4.6989	84,499	0.7537
220	OMOKU GT5	91,564	0.5125	82,326	4.6989	84,499	0.7537
221	OMOKU GT6	91,564	0.5125	82,326	4.6989	84,499	0.7537
222	ODUKPANI NIPP GT1	288,929	0.5834	150,064	0.6159	389,551	0.5300
223	ODUKPANI NIPP GT2	288,929	0.5834	150,064	0.6159	389,551	0.5300
224	ODUKPANI NIPP GT3	288,929	0.5834	150,064	0.6159	389,551	0.5300
225	ODUKPANI NIPP GT4	288,929	0.5834	150,064	0.6159	389,551	0.5300
226	ODUKPANI NIPP GT5	288,929	0.5834	150,064	0.6159	389,551	0.5300
227	GBARAIN GT-2	344,562	0.5394	360,077	0.5638	257,442	0.5734
228	TRANS-AMADI GT1	36,155	0.6339	60,058	0.0327	80,828	0.6383
229	TRANS-AMADI GT2	36,155	0.6339	60,058	0.6476	80,828	0.6383
230	TRANS-AMADI GT3	36,155	0.6339	60,058	0.6476	80,828	0.6383
231	TRANS-AMADI GT4	36,155	0.6339	60,058	0.6476	80,828	0.6383
232	PARAS ENERGY GT1	40,617	0.4949	46,341	0.4949	45,387	0.4949
233	PARAS ENERGY GT2	44,664	0.4949	50,959	0.4949	49,910	0.4949
234	PARAS ENERGY GT3	44,664	0.4949	50,959	0.4949	49,910	0.4949
235	PARAS ENERGY GT4	44,664	0.4949	50,959	0.4949	49,910	0.4949
236	PARAS ENERGY GT5	45,269	0.4949	51,649	0.4949	50,585	0.4949
237	PARAS ENERGY GT6	45,269	0.4949	51,649	0.4949	50,585	0.4949
238	PARAS ENERGY GT7	45,269	0.4949	51,649	0.4949	50,585	0.4949
239	PARAS ENERGY GT8	45,269	0.4949	51,649	0.4949	50,585	0.4949
240	PARAS ENERGY GT9	45,502	0.4949	51,914	0.4949	50,845	0.4949
241	PARAS ENERGY GT10	45,502	0.4949	51,914	0.4949	50,845	0.4949
242	PARAS ENERGY GT11	45,548	0.4949	51,967	0.4949	50,897	0.4949
243	CALABAR NIPP GT4	78,891	0.6339	248,336	0.6275	520,237	0.6348
244	CALABAR NIPPGT5	375,275	0.5086	167,287	0.6402	379,519	0.6970
245	CALABAR NIPP GT3	421,554	0.6185	163,151	0.5926	267,997	0.1423
246	CALABAR NIPP GT2	260,565	0.8146	87,774	0.8006	323,641	0.7251
247	CALABAR NIPP GT1	268,656	2.5536	81,659	0.6455	446,993	0.6325
248	Cap des Biches - C.III Vapeur	242,116	1.0751	253,988	1.0902	281,964	1.1081
249	Bel air - TAG 4	11,516	1.1666	16,787	1.0699	31,512	1.0917
250	Cap des Biches - TAG 2	2,783	1.1705	2,618	1.4511	9,398	1.4311
251	Cap des Biches - TAG 3	0	-	0	-	0	-
252	CIV	628,925	0.6284	648,923	0.6249	661,439	0.6257
253	Cap des Biches - CIV	421,569	0.6591	327,452	0.6367	276,679	0.6501
254	Kaolack - Kahone 1	14,672	0.8031	5,967	0.7924	14,895	0.8345
255	Kaolack - Kahone 2 CVII	594,445	0.6057	633,841	0.6103	601,728	0.6107
256	Solaire CICAD	-	-	-	-	-	-
257	Solaire DIASS	-	-	-	-	-	-
258	Gorée	734	0.7405	0	-	0	-
259	Kounoune Power	234,947	0.7003	150,772	0.6975	171,164	0.6998
260	Tobene Power	429,653	0.6059	405,106	0.6045	257,275	0.6183
261	Contour Global-Ex GTI	574,751	0.6084	541,910	0.6311	495,262	0.5757

262	Location - Aggreko	0	-	26,772	0.7023	92,133	0.6809
263	Location - APR	40,486	0.6695	45,486	0.6533	68,635	0.6513
264	Sendou	-	-	135,406	0.8169	302,868	0.7807
265	Autoproduction (ICS/Dangoté/SOCOCIM)	49,377	0.8514	49,030	0.8514	52,467	0.8514
266	Solaire Malicounda	-	-	-	-	-	-
267	Solaire Bokhol	-	-	-	-	-	-
268	Solaire TenMérina	-	-	-	-	-	-
269	Solaire Mékhé	-	-	-	-	-	-
270	Solaire Kahone	-	-	-	-	-	-
271	Solaire Sakal	-	-	-	-	-	-
272	Parc éolien de Taïba Ndiaye	-	-	-	-	-	-
273	KARPOWERSHIP	-	-	-	-	236,051	0.6110
274	Lomé-Siège (SULZER)	9,405	0.7209	2,535	0.7261	1,475	0.7217
275	Lomé-B	5,970	0.6901	3,437	0.6921	4,556	0.6957
276	Kpimé	-	-	-	-	-	-
277	Sokodé	0	0.9224	9	0.9711	5	0.8218
278	Kara	254	0.7277	220	0.7281	174	0.7283
279	Dapaong	280	0.7552	469	0.7805	262	0.8376
280	ContourGlobal Togo (CGT)	431,860	0.6432	358,730	0.3957	449,122	0.2040
281	NANGBETO	-	-	-	-	-	-
282	TAG LPO	126,044	0.2276	10,027	0.2563	0	-
Annual Electricity Generation		**23,567,235**		**25,037,148**		**25,003,894**	

Annex III: Determination of the Built Margin

Table 7: Calculation of the Build Margin for 2019						
No.	Name of Power Unit	Date Commissioned		Generation (in MWj)	Emissions (in tCO2)	Share of Generation
		Year	Month			
6	Maria-Gleta 1	2019	8	252,306	312,975	0.3%
28	AGGREKO THERMIQUE (location)	2019	6	149,549	103,944	0.5%
66	Cenpower GT1	2019	6	58,763	49,718	0.6%
67	Cenpower GT2	2019	6	59,675	47,471	0.7%
68	Cenpower ST1	2019	6	63,878	0	0.7%
70	Amandi	2019	10	149,000	122,967	0.9%
230	TRANS-AMADI GT3	2019	7	80,828	51,595	1.0%
242	PARAS ENERGY GT11	2019	1	50,897	25,188	1.1%
73	Mienergy Solar Plant	2018	9	21,000	-	1.1%
81	Albatros Energy Mali (IPP)	2018	10	118,814	69,017	1.3%
137	SAPELE GT1-14	2018	12	7,682	4,809	1.3%
213	AZURA GT 11	2018	5	562,870	293,413	2.0%
214	AZURA GT 12	2018	5	562,870	293,413	2.7%
215	AZURA GT 13	2018	5	562,870	293,413	3.5%
240	PARAS ENERGY GT9	2018	9	50,845	25,163	3.5%
241	PARAS ENERGY GT10	2018	9	50,845	25,163	3.6%
257	Solaire DIASS	2018		13,638	-	3.6%
264	Sendou	2018		302,868	236,462	4.0%
26	ZIGA	2017	4	1,558	-	4.0%
27	ZAGTOULI	2017	9	57,283	-	4.1%
47	Soubre	2017		1,604,715	-	6.1%
65	AKSA	2017	11	608,000	602,608	6.9%
80	Aksa enerji (Location)	2017	8	142,149	101,852	7.1%
210	IBOM GT2	2017	6	93,619	55,994	7.2%
53	Kpone Thermal Power Plant KTPP	2016		392,966	1,642,683	7.7%
54	Ameri	2016		1,483,400	753,442	9.6%
64	Trojan	2016		0	-	9.6%
69	Genser	2016	12	377	223	9.6%
71	Safisana	2016	9	317	0	9.6%
72	BXC Solar	2016	1	27,000	-	9.7%
83	SES (Location)	2016	5	70,467	47,461	9.8%
98	GOROU BANDA	2016		164,437	98,599	10.0%
227	GBARAIN GT-2	2016	4	257,442	147,614	10.3%
258	Gorée	2016		0	-	10.3%
260	Tobene Power	2016	3	257,275	159,074	10.6%

261	Contour Global-Ex GTI	2016	4	495,262	285,139	11.3%
262	Location - Aggreko	2016		92,133	62,736	11.4%
265	Autoproduction (ICS/Dangoté/SOCOCIM)	2016	3	52,467	44,670	11.5%
34	Ciprel TAV	2015	12	789,246	223,119	12.5%
37	Azito TAV	2015	6	911,321	206,745	13.6%
63	Karpowership	2015	12	1,510,000	1,401,142	15.6%
184	ALAOJI NIPP GT1	2015	4	52,363	30,729	15.6%
185	ALAOJI NIPP GT2	2015	4	52,363	30,729	15.7%
186	ALAOJI NIPP GT3	2015	4	52,363	30,729	15.8%
187	ALAOJI NIPP GT4	2015	4	52,363	30,729	15.8%
222	ODUKPANI NIPP GT1	2015	6	389,551	206,449	16.3%
223	ODUKPANI NIPP GT2	2015	4	389,551	206,449	16.8%
224	ODUKPANI NIPP GT3	2015	4	389,551	206,449	17.3%
225	ODUKPANI NIPP GT4	2015	6	389,551	206,449	17.8%
226	ODUKPANI NIPP GT5	2015	8	389,551	206,449	18.3%
243	CALABAR NIPP GT4	2015	2	520,237	330,242	19.0%
244	CALABAR NIPPGT5	2015	2	379,519	264,537	19.5%
245	CALABAR NIPP GT3	2015	3	267,997	38,136	19.8%
246	CALABAR NIPP GT2	2015	4	323,641	234,676	20.3%
247	CALABAR NIPP GT1	2015	8	446,993	282,714	20.8%
256	Solaire CICAD	2015	1	2,935	-	20.8%
82	Aggreko (Location)	2014	5	119,121	78,368	21.0%
236	PARAS ENERGY GT5	2014	9	50,585	25,034	21.1%
237	PARAS ENERGY GT6	2014	9	50,585	25,034	21.1%
238	PARAS ENERGY GT7	2014	9	50,585	25,034	21.2%
239	PARAS ENERGY GT8	2014	9	50,585	25,034	21.2%

Annex IV: Default NCVs, Upper and Lower Limits

Table 8: Default NCVs, Lower and Upper Limits

Fuel type Description		Net calorific value (TJ/Gg)	Lower	Upper
	Crude Oil	42.3	40.1	44.8
	Orimulsion	27.5	27.5	28.3
	Natural Gas Liquids	44.2	40.9	46.9
Gasoline	Motor Gasoline	44.3	42.5	44.8
	Aviation Gasoline	44.3	42.5	44.8
	Jet Gasoline	44.3	42.5	44.8
	Jet Kerosene	44.1	42	45
	Other Kerosene	43.8	42.4	45.2
	Shale Oil	38.1	32.1	45.2
	Gas/Diesel Oil	43	41.4	43.3
	Residual Fuel Oil	40.4	39.8	41.7
	Liquefied Petroleum Gases	47.3	44.8	52.2
	Ethane	46.4	44.9	48.8
	Naphtha	44.5	41.8	46.5
	Bitumen	40.2	33.5	41.2
	Lubricants	40.2	33.5	42.3
	Petroleum Coke	32.5	29.7	41.9
	Refinery Feedstocks	43	36.3	46.4
Other Oil	Refinery Gas	49.5	47.5	50.6
	Paraffin Waxes	40.2	33.7	48.2
	White Spirit and SBP	40.2	33.7	48.2
	Other Petroleum Products	40.2	33.7	48.2
	Anthracite	26.7	21.6	32.2
	Coking Coal	28.2	24	31
	Other Bituminous Coal	25.8	19.9	30.5
	Sub-Bituminous Coal	18.9	11.5	26
	Lignite	11.9	5.5	21.6
	Oil Shale and Tar Sands	8.9	7.1	11.1
	Brown Coal Briquettes	20.7	15.1	32
	Patent Fuel	20.7	15.1	32
Coke	Coke Oven Coke and Lignite Coke	28.2	25.1	30.2
	Gas Coke	28.2	25.1	30.2
	Coal Tar	28	14.1	55
Derived Gases	Gas Works Gas	38.7	19.6	77

	Coke Oven Gas	38.7	19.6	77
	Blast Furnace Gas	2.47	1.2	5
	Oxygen Steel Furnace Gas	7.06	3.8	15
	Natural Gas	48	46.5	50.4
	Municipal Wastes (non-biomass fraction)	10	7	18
	Industrial Wastes	NA	NA	NA
	Waste Oil	40.2	20.3	80
	Peat	9.76	7.8	12.5
Solid Biofuels	Wood/Wood Waste	15.6	7.9	31
	Sulphite lyes (black liquor)	11.8	5.9	23
	Other Primary Solid Biomass	11.6	5.9	23
	Charcoal	29.5	14.9	58
Liquid Biofuels	Biogasoline	27	13.6	54
	Biodiesels	27	13.6	54
	Other Liquid Biofuels	27.4	13.8	54
GasBiomass	Landfill Gas	50.4	25.4	100
	Sludge Gas	50.4	25.4	100
	Other Biogas	50.4	25.4	100
Other non-fossil fuels	Municipal Wastes (biomass fraction)	11.6	6.8	18

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, page 1.18
Notes: 1 The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5.
2 Japanese data; uncertainty range: expert judgement
3 EFDB; uncertainty range: expert judgement
4 Coke Oven Gas; uncertainty range: expert judgement
5-7Japan and UK small number data; uncertainty range: expert judgement
8 For waste oils the values of Lubricants" are taken
9 EFDB; uncertainty range: expert judgement
10 Japanese data ; uncertainty range: expert judgement
11 Solid Biomass; uncertainty range: expert judgement
12 EFDB; uncertainty range: expert judgement
13-14Ethanol theoretical number; uncertainty range: expert judgement;
15 Liquid Biomass; uncertainty range: expert judgement
16 -18Methane theoretical number uncertainty range: expert judgement; "

ANNEX V: DEFAULT CO2 EMISSION FACTORS FOR COMBUSTION

Table 9: Default CO2 Emission Factors for Combustion						
Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO2 emission factor (kg/TJ) 2		
				Default value 3	95% confidence interval	
		A	B	C=A*B*44/ 12*1000	Lower	Upper
	Crude Oil	20	1	73,300	71,100	75,500
	Orimulsion	21	1	77,000	69,300	85,400
	Natural Gas Liquids	17.5	1	64,200	58,300	70,400
Gasoline	Motor Gasoline	18.9	1	69,300	67,500	73,000
	Aviation Gasoline	19.1	1	70,000	67,500	73,000
	Jet Gasoline	19.1	1	70,000	67,500	73,000
	Jet Kerosene	19.5	1	71,500	69,700	74,400
	Other Kerosene	19.6	1	71,900	70,800	73,700
	Shale Oil	20	1	73,300	67,800	79,200
	Gas/Diesel Oil	20.2	1	74,100	72,600	74,800
	Residual Fuel Oil	21.1	1	77,400	75,500	78,800
	Liquefied Petroleum Gases	17.2	1	63,100	61,600	65,600
	Ethane	16.8	1	61,600	56,500	68,600
	Naphtha	20	1	73,300	69,300	76,300
	Bitumen	22	1	80,700	73,000	89,900
	Lubricants	20	1	73,300	71,900	75,200
	Petroleum Coke	26.6	1	97,500	82,900	115,000
	Refinery Feedstocks	20	1	73,300	68,900	76,600
Other Oil	Refinery Gas	15.7	1	57,600	48,200	69,000
	Paraffin Waxes	20	1	73,300	72,200	74,400
	White Spirit & SBP	20	1	73,300	72,200	74,400
	Other Petroleum Products	20	1	73,300	72,200	74,400
	Anthracite	26.8	1	98,300	94,600	101,000
	Coking Coal	25.8	1	94,600	87,300	101,000
	Other Bituminous Coal	25.8	1	94,600	89,500	99,700
	Sub-Bituminous Coal	26.2	1	96,100	92,800	100,000
	Lignite	27.6	1	101,000	90,900	115,000
	Oil Shale and Tar Sands	29.1	1	107,000	90,200	125,000
	Brown Coal Briquettes	26.6	1	97,500	87,300	109,000
	Patent Fuel	26.6	1	97,500	87,300	109,000
Coke	Coke oven coke and lignite Coke	29.2	1	107,000	95,700	119,000
	Gas Coke	29.2	1	107,000	95,700	119,000

	Coal Tar	22	1	80,700	68,200	95,300
Derived Gases	Gas Works Gas	12.1	1	44,400	37,300	54,100
	Coke Oven Gas	12.1	1	44,400	37,300	54,100
	Blast Furnace Gas	70.8	1	260,000	219,000	308,000
	Oxygen Steel Furnace Gas	49.6	1	182,000	145,000	202,000
	Natural Gas	15.3	1	56,100	54,300	58,300
	Municipal Wastes (non-biomass fraction)	25	1	91,700	73,300	121,000
	Industrial Wastes	39	1	143,000	110,000	183,000
	Waste Oil	20	1	73,300	72,200	74,400
	Peat	28.9	1	106,000	100,000	108,000
Solid Biofuels	Wood/Wood Waste	30.5	1	112,000	95,000	132,000
	Sulphite lyes (black liquor)	26	1	95,300	80,700	110,000
	Other Primary Solid Biomass	27.3	1	100,000	84,700	117,000
	Charcoal	30.5	1	112,000	95,000	132,000
Liquid Biofuels	Biogasoline	19.3	1	70,800	59,800	84,300
	Biodiesels	19.3	1	70,800	59,800	84,300
	Other Liquid Biofuels	21.7	1	79,600	67,100	95,300
Gas biomass	Landfill Gas	14.9	1	54,600	46,200	66,000
	Sludge Gas	14.9	1	54,600	46,200	66,000
	Other Biogas	14.9	1	54,600	46,200	66,000
Other non-fossil fuels	Municipal Wastes (biomass fraction)	27.3	1	100,000	84,700	117,000

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, page 1.23

Notes: 1 The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5, 2 TJ = 1000GJ

3 The emission factor values for BFG includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas.

4 The emission factor values for OSF includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas

5 Includes the biomass-derived CO2 emitted from the black liquor combustion unit and the biomass-derived CO2 emitted from the kraft mill lime kiln.