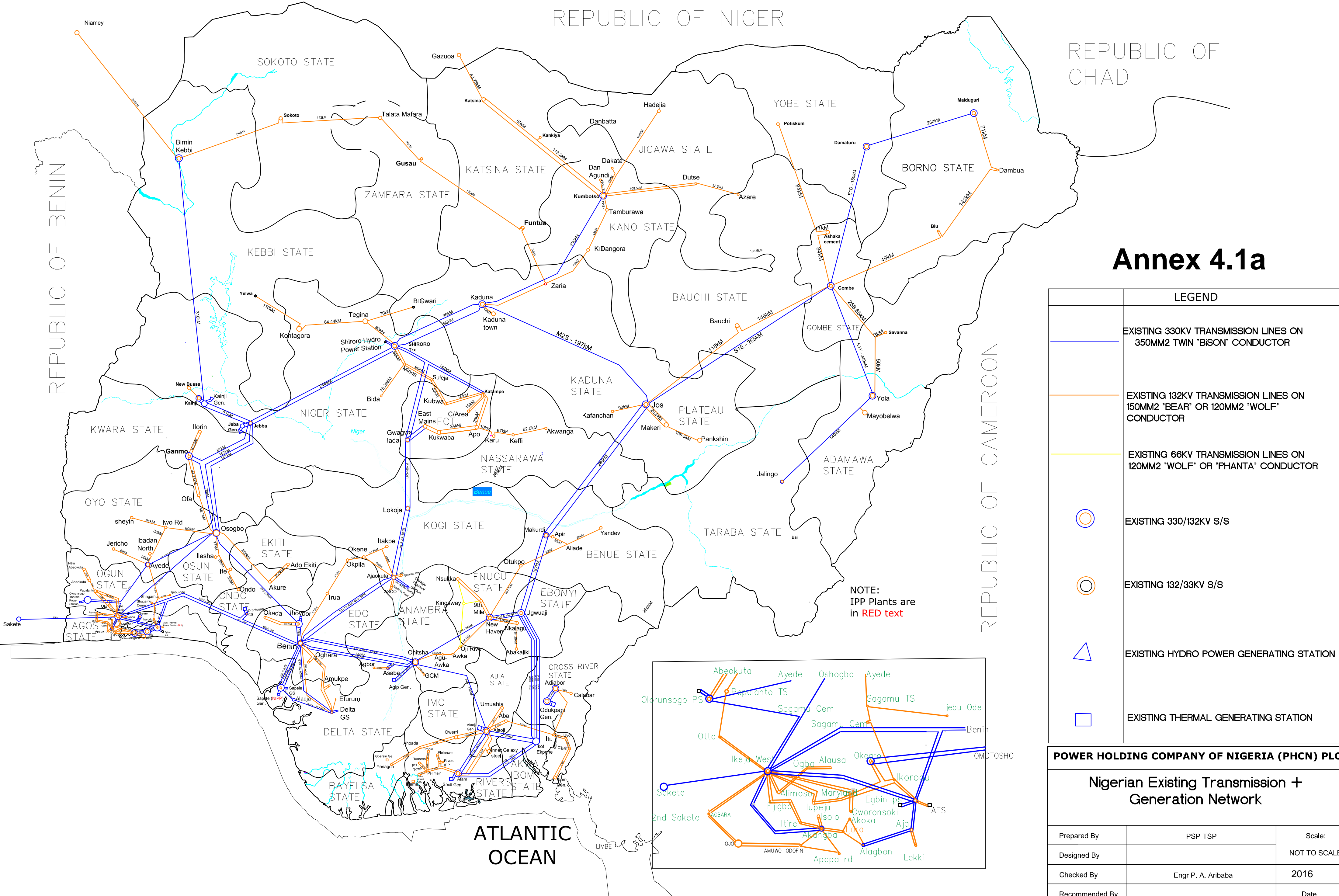
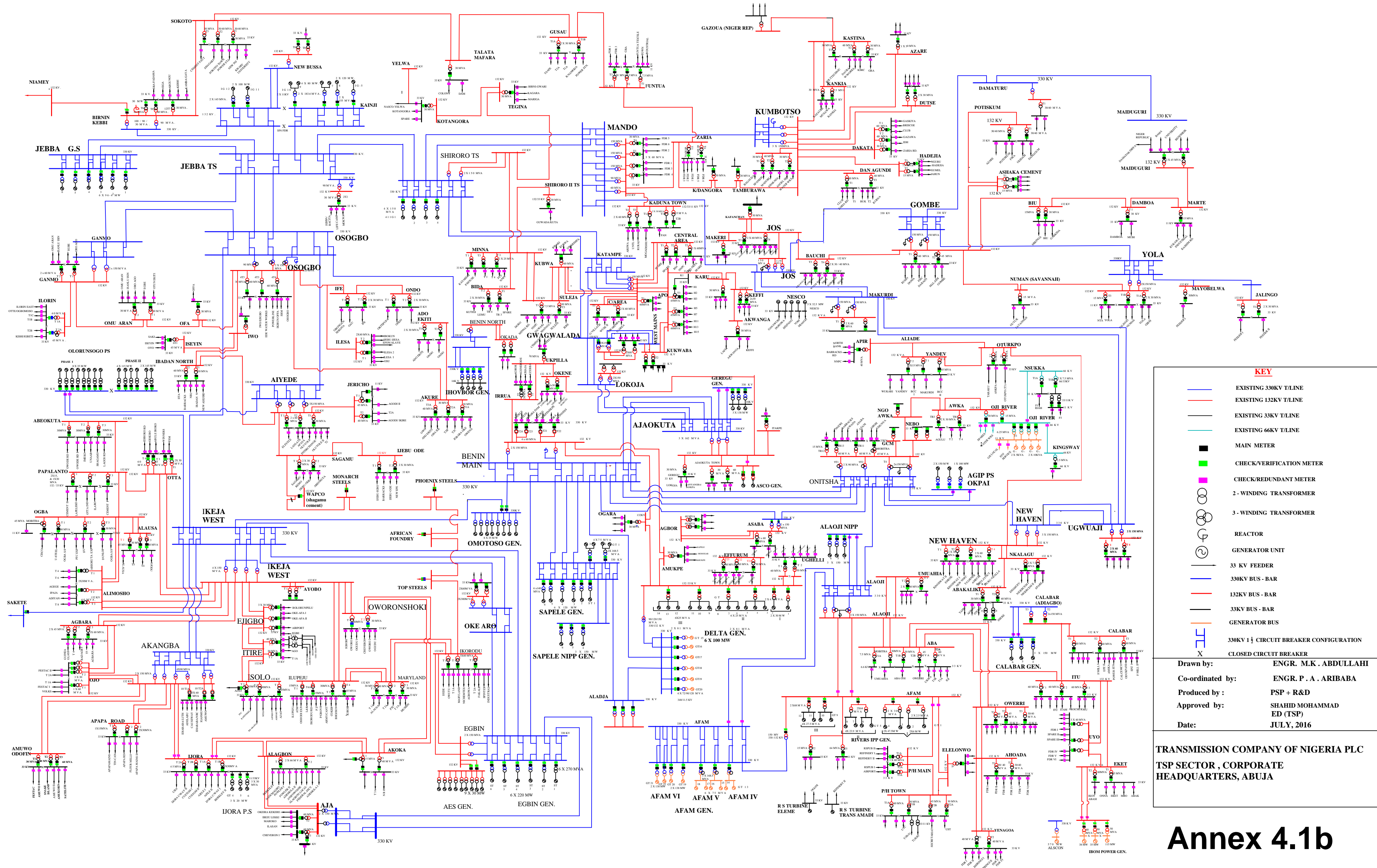


GRID MAP FOR EXISTING TRANSMISSION AND GENERATION NETWORK



SINGLE LINE DIAGRAM OF THE EXISTING NIGERIA GRID NETWORK



Annex 4.2a
CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
	Projects In South-East Zone							
1	Owerri-Ahoada-Yenegoa 132kv DC lines and substations Imo-Rivers-Bayelsa States	Imo/Rivers/Bayelsa	Oct, 2000	2010	11,509,951,810.57	Pivot Engineering Co. Ltd	Completed	Delivery of bulk power to Yenagoa in Bayelsa State & Ahaoada in Rivers State.Enhancement of industrial and socio-economic activities in the states.
2	Construction of Alaoji-Umuahia 132kV DC line	Abia	Sept., 2001	June, 2012	1,347,505,044.12	Pivot Engineering Co. Ltd	Completed	Increase in power supply to Umuahia and environs. Boosting of socio-economic activities in the areas.
3	Umuahia 2x30/40MVA, 132/33kV Substation	Abia	May, 2001	June, 2013	1,602,261,641.87	Valenz Holdings (Nig) Ltd.	Completed	Increase in power supply to Umuahia and environs. Boosting of socio-economic activities in the areas.
4	Mbalano-Okigwe 132kv SC line	Abia	Sept,2001	Apr, 2012	329,754,483.86	Atlantic Engineering & Construction	Completed	Provision of bulk energy delivery to Okigwe and environs; increase in socio-economic activity in the areas.
5	Construction of 150MVA 330/132/33kV T/F and 330kV bays at Onitsha and Benin.	Anambra/Edo	18th May, 2001; reawarded Sept. 2008	June, 2013	639,623,673.85	Siemens Ltd. MBH Power Ltd	Completed	150MVA increase in transformer capacity at 330kV Voltage level at Onitsha. Boost in economic activity in the South East Zone.
6	2nd Benin-Onitsha 330kv SC line.	Anambra/Edo	17th,Sept.2008	June, 2015	4,205,289,346.35	ABB; Dextron Engineering Ltd	Completed	Increase in wheeling capacity to the South-East Zone and Benue State. Boost in socio-economic activity in the South East zone and Benue State.
7	3rd Benin - Onitsha 330KV DC Line	Anambra/Edo	Dec, 2007	Feb., 2013	6,539,926,332.00	KEC International	Completed	Increase in wheeling capacity to the South-East Zone and Benue State. Boost in socio-economic activity in the South East zone and Benue State.
8	2 x 330KV Line bay extension at Kaduna, Jos and Onitsha	Kaduna/Plateau/Anambra	Nov, 2009	Sept, 2015	1,240,589,916.19	Valenz Holding Ltd	30%	Increase in wheeling capacity to the South-East and North-East Zones . Boost in socio-economic activity in the affected areas.
9	2x60MVA, 132/33kv at Aboh -Mbaise S/S	Imo	Nov, 2009	July, 2014	1,480,777,014.45	Ashtavinayaka/Bran Engineering Ltd	75%	Improvement in power supply to Aboh Mbaise (Imo State)and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
10	2x60 MVA, 132/33 kV substation at Ideato and 2 x132KV Line Bays at Okigwe	Imo	Nov, 2009	December, 2014	1,852,143,857.48	Ashtavinayaka/Bran Engineering Ltd	70%	Improvement in power supply to Ideato (Imo State)and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
11	Onitsha - Oba - Nnewi - Ideato- Okigwe 132kv DC Line	Anambra/Imo	January, 2014	June, 2015	1,649,992,957.64	Ashtavinayaka/Bran Engineering Ltd	10%	Bulk power supply to parts of Anambra and Imo States. Improvement in socio-economic life of the people of the states.
12	Arochukwu 2x30/40MVA, 132/33kV substation	Abia	Sept,2001	June, 2015	921,727,696.35	Omen International Ltd.	86	Improvement in power supply to Arochukwuand environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
13	Okigwe 2x30/40MVA 132/33kV Substation	Imo	Sept,2001	March, 2015	1,839,789,715.03	Union Allied Engineering Ltd.	65	Improvement in power supply to Okigwe and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
14	Ohafia 2x30/40MVA 132/33kV substation.	Abia	Sept,2001	March, 2015	1,972,613,202.90	Union Allied Engineering Ltd.	60	Improvement in power supply to Ohafia and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
15	Mbalano 2x30/40MVA 132/33kV substation.	Abia	Nov, 2001	March, 2015	1,409,011,316.42	Union Allied Engineering Ltd.	60	80MVA transformer capacity at 132kV Voltage level at Mbalano to meet the power requirement of the town and environs, increase socio-economic activity and generate employment.
16	Nnewi 2x60 MVA 132kV substation	Anambra	April, 2006	March, 2015	1,233,491,817.28	Valenz Holdings (Nig) Ltd.	70	Improvement in power supply to Nnewi and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
17	Nsukka - Ayangba 132KV DC Line	Enugu/Kogi	Aug. 2009	Dec., 2015	1,480,777,014.45	West Com Ltd/PPCL	35	Improvement in power supply to Nsukka and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
18	2x60 MVA, 132/33 kV substation at Oba and 2 x132KV Line Bays at Nnewi	Anambra	Dec., 2009	December, 2015	1,863,432,339.26	Xian/GIT Engineering	42	Improvement in power supply to Oba and adjoining parts of Anambra State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.

Annex 4.2a
CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
19	Owerri - Abo Mbaise 132KV DC Line	Imo	January, 2011	March, 2016	781,193,181.81	Bateman	12	Improvement in power supply to parts of Imo State to meet the power demand of the people, increase socio-economic activity and generate employment in the areas.
20	Onitsha-Ikitedunu 132kv DC Transmission line	Anambra	Yet to commence	Yet to commence	2,265,940,601.10	Sinotec-CCC JV	0	Improvement in power supply to Ikitedunu and adjoining parts of Anambra State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
21	Construction of 2 x 60MVA 132/33kV Sunstation at Ikitedinu and 2 x 132kv line bays extension at Onitsha	Anambra	Yet to commence	Yet to commence	2,582,869,065.18	MBH Power Ltd	0	Improvement in power supply to Ikitedunu and adjoining parts of Anambra State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
22	2x60MVA,132/33kV substation at Amasiri, Afikpo and 2x132kv line bay extension at Abakaliki	Ebonyi	Yet to commence	Yet to commence	1,453,991,357.66	NCPE	0	Contract was terminated and re-procured.
23	2x60MVA,132/33kV substation at Mpu, with 2x132kv line bay extension at Nnenwe	Enugu	Dec. 2010	December, 2015	1,478,201,187.82	Ashtavinayaka/Bran Engineering	15	Improvement in power supply to Mpu and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
24	Umuahia-Ohafia 132kv SC line	Abia	Sept,2001	June, 2015	886,549,064.79	Harlesden Engineering Ltd	60	Improvement in power supply to Ohafia and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
25	Umuahia - Mbalano 132KV Line	Abia	April, 2001	March, 2015	557,323,066.60	Santon Energy L:td	67	Improvement in power supply to Mbalano and adjoining parts of Imo State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
26	Ohafia - Arochukwu 132KV Line	Abia	Sept. 2008	March, 2015	765,778,020.25	Mogabs Nig. Ltd	65	Improvement in power supply to Ohafia and Arochukwu areas of Abia State to meet the power people and of the areas, increase socio-economic activity and generate employment in the areas.
27	Abakaliki - Amasiri 132kv DC line	Ebonyi	2011	December, 2015	1,448,780,446.73	Fluor Eng/Eurafric	20	Improvement in power supply to the entire Ebonyi South Senatorial Zone to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
28	Ugwuaji-Nnenwe 132kv DC line	Enugu	2011	December, 2015	860,431,361.12	Ashtavinayaka/Bran Eng Ltd	10	Improvement in power supply to Nnenwe and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
29	2x60MVA, 132/33kV substation at Nnenwe	Enugu	2011	December, 2015	1,754,876,530.28	Metro Elektrik	2	Improvement in power supply to Nnenwe and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
30	Nnenwe-Mpu 132kv DC line	Enugu	2011	December, 2015	860,403,171.63	Power Projects Ltd/Dorman Long	8	Improvement in power supply to Mpu and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.
Projects In South-West Zone								
31	Akure-Ado Ekiti 132kv SC line	Ondo/Ekiti	May ,2003	June, 2012	849,000,374.22	Siemens Ag + Dextron Engineering Ltd	Completed	Improved power wheeling capacity to Ekiti State. Enhancement of socio-economic activity and generation of employment.
32	2 x 60MVA, 132/33kV substations at Odogunyan and Ayobo with 132kv DC Tline Ikeja West - Ayobo.		2010	Ayobo - March, 2014. Odogunyan - June,	3,657,155,630.00	Laga CePower Ltd	Completed	Improved power supply Odogunyan and Ayobo areas of Ogun and Lagos States (respectively). Enhancement of socio-economic activity and generation of employment.
33	Benin North-Oshogbo 330KV DC line with one SC turning in and out to New Akure substation	Edo/Osun	Dec. 2010	December, 2015	7,460,190,274.90	Gammon India Ltd	28	Improvement in power wheeling to Osgbo and Akure (Ondo State). Enhancement of the socio-economic live of the people of the states.
34	New Akure 2X150MVA,330/132KV + 2x60MVA, 132/33kV Substation and 2x330kV line bays extensions in Benin North and Osogbo substations	Osun/Ondo	October, 2011	June, 2015	4,541,953,527.00	Matelec	60	Increase in power supply to Akure and entire Ondo State t bBoost economic activity and employment generation
35	New Abeokuta - Igboora - Lanlate 132kv DC Line and Tee- Off at Igboora- Igangan	Ogun	January, 2014	December, 2015	1,389,786,019.95	LAGA CE Power	10	Bulk power supply to Lanlate town and improved power supply to the town and environs. Stimulation of growth in socio-economic activity and generation of employment.
36	Ganmo -Ogbomosho 132kv DC line	Kwara/Oyo	Feb. 2011	December, 2015	1,223,259,627.73	Trennco Power/Eco Energo Group	15	Bulk power supply to Ogbomosho and environs. Stimulation of growth in socio-economic activity and generation of employment.

Annex 4.2a
CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
37	2 x60MVA 132/33kV S/S at Ogbomosho 1no. 132kV Bay Extension at Ganmo	Oyo/Kwara	Dec, 2007	March, 2015	1,381,986,399.86	Payma Bargh/ Cartlark	70	Bulk power supply to Ogbomosho and environs. Stimulation of growth in socio-economic activity and generation of employment.
38	2x30/40 MVA, 132/33 kV substation at Lanlate plus 2 x132KV Line Bays at New Abeokuta 132/33 kV substation	Ogun	August, 2010	March, 2015	1,577,304,387.87	Skipper Electricals Ltd	70	Bulk power supply to Lanlate town and improved power supply to the town and environs. Stimulation of growth in socio-economic activity and generation of employment.
39	Ikorodu - Odogunyan - Shagamu 132kV DC Transmission Line	Lagos/Ogun	2010	June, 2015	3,192,097,185.53	PPCL/ Westcom JV	55	Bulk power supply to Odogunyan and Shagamu and environs. Stimulation of growth in socio-economic activity and generation of employment.
40	Transmission - 2x60MVA 132/33KV Substation at Igangan & 132kV Switching Station at Igboora	Ogun	Aug, 2010	December, 2015	2,420,443,752.74	Rhuoga Energy	45	Boost in power supply to Igangan and environs, enhancement of socio-economic activity and creation of employment in the areas.
41	Omotosho-Epe-Aja 330KV DC Line.	Lagos	Jan. 2011	June, 2015	6,620,497,079.07	KEC International Limited	50	Increase in power wheeling capacity to Aja and Epe in Lagos State. Boost in socio-economic activity.
42	Oshogbo- Ede 132KV DC Line	Osun/Ondo	Jan. 2011	June, 2015	530,226,664.19	Aster Infrac/Aster Teleservices	72	Bulk power supply to Ede town and environs. Stimulation of growth in socio-economic activity and generation of employment in the areas.
43	2X60MVA Substation at Ede	Osun	Marc 3, 2011	December, 2015	1,747,600,713.91	Cobra-Sibga JV	20	Bulk power supply to Ede town and environs. Stimulation of growth in socio-economic activity and generation of employment in the areas.
44	Erukan - Omotosho 330KV DC Trx. Line	Ogun	Dec.2010	December, 2015	6,222,079,519.42	Energio Nig Limited	20	Increase in wheeling capacity from Omotosho Power Plant. Boost in socio-economic activity in the South West zone
45	2x 150MVA, 330/132KV + 2x60MVA, 132/33kV substation at Omotosho	Ogun	Dec. 2010	December, 2015	3,614,033,428.98	AK-AY Elektrik	15	Increase in transmission capacity and power supply to Omotosho and adjoining areas to Boost economic activity, employment generation
46	Obajana-Okeagbe 132kV DC line	Kogi/Ondo	2011	December, 2015	1,969,973,210.18	Everest Infra energy Ltd	5	Improvement of power supply to Okeagbe and entire Ondo State. Boosting of socio-economic life of the people of the state
47	2x60MVA 132/33kV substation at Okeagbe, Ondo State and line bays extension at Obajana	Ondo/Kogi	March, 2012	Sept, 2015	1,541,961,682.82	Power Control & Appliances	40	Improvement of power supply to Okeagbe and entire Ondo State. Boosting of socio-economic life of the people of the state
48	2x60MVA, 132/33kV Substation at Ose LGA Headquarters, Ondo State	Ondo	March, 2012	April, 2016	1,607,059,828.55	Junot Eng. Services Ltd	5	Improvement of power supply to Ose and adjoining parts of Ondo State. Boosting of socio-economic life of the people of the state
49	Provision of additional 2x150MVA 330/132KV Transformer capacity at Olorunsogo T/S.		October, 2011	December, 2015	3,628,192,987.56	Matelec	10	Increase in transmission capacity and power supply to Olorunsogo area and environs areas to Boost economic activity, employment generation
Projects In South-South Zone								
50	Owerri-Ahoada-Yenegoa 132kv DC lines and substations Imo-Rivers-Bayelsa States	Rivers/Bayelsa	Oct, 2000	2010	11,509,951,810.57	Pivot Engineering Co. Ltd	Completed	Delivery of bulk power to Yenagoa in Bayelsa State & Ahoada in Rivers State. Enhancement of industrial and socio-economic activities in the States.
51	Afam-Port Harcourt 132kV D/C turning in and out at Port Harcourt main Ts	Rivers	2009	August, 2012	270,000,000.00	Rivers State Govt.	Completed	Increase power weeling capacity to Port Harcourt to meet the load demand in PH and increase socio-economic activity; create employment
52	Construction of 150MVA, 330/132/33kV transformer at Onitsha, 330kV bays at Onitsha and Benin.	Edo	18th May, 2001; reawarded Sept. 2008	June, 2013	639,623,673.85	Siemens Ltd. MBH Power Ltd	Completed	Boost in power supply to Onitsha and Benin areas. Boost in economic activity in the South East and South-Sout Zones.
53	3rd Benin - Onitsha 330KV DC Line	Edo	Dec, 2007	Feb., 2013	6,539,926,332.00	KEC International	Completed	Boost in power supply to Onitsha and Benin areas. Boost in economic activity in the South East and South-Sout Zones.
54	Calabar 2x150MVA, 330/132/33kV Substation and line bay at Alaoji Substation.	Cross Rivers	15th Aug. 2006	June.2013	598,094,641.88	Areva T & D SPR MBH Power Ltd.	Completed	Boost in power supply to Calabar and the entire Cross River State. Generation of employment and increase in economic activity in the state.

Annex 4.2a
CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
55	1x60MVA Substation at Ughelli Power Plant and 1x30/40MVA substation reinforcement at Amukpe	Delta	Dec, 2008	March, 2015	791,334,541.30	Continental Engr'g Nig. Ltd.	94	Improvement in power supply to Amukpe, Sapele and environs. Boost in economic activity in the areas.
56	2nd Benin-Onitsha 330kv SC line.	Edo	17th,Sept.2008	June, 2015	4,205,289,346.35	ABB; Dextron Engineering Ltd	85	Boost in power supply to Onitsha and Benin areas. Boost in economic activity in the South East and South-Sout Zones.
57	2x30/40MVA 132/33kV S/S at Ogoja	Cross Rivers	Dec, 2007	March, 2015	1,336,710,579.79	Income Electrix Ltd	75	Improvement in power supply to Ogoja and environs to meet the power demand of the areas, increase socio-economic activity and generate employment in the areas.
58	Rehabilitation of Afam TS with 1 x 150MVA 330/132/33kV transformer and construction of Afam IV to Afam II 132kV Transmission Line	Rivers	2010	June, 2015	1,472,806,633.00	Telavars Group	65	Improvement in power supply to entire Rivers State to meet the power demand, increase socio-economic activity and generate employment in parts of the state.
59	DC 132kV line from Alscot to Ibom Power and Switching Station to link the GIS at Alscot with associated bay extensions at Ibom Power - Akwa Ibom State	Akwa Ibom	2011	April, 2015	747,246,322.01	KEC International Ltd	80	Boost in power supply to Akwa Ibom State. Generation of employment and increase in economic activity in the state.
60	Benin North-Oshogbo 330KV DC line with one SC turning in and out to New Akure substation	Edo	Dec. 2010	December, 2015	7,460,190,274.90	Gammon India Ltd	28	Increase in power wheeling capacity between Osogbo and Benin and improved power availability for socio-economic development in the affected zones.
61	Obudu - Ogoja 132KV DC Line	Cross Rivers	Dec, 2007 /Dec., 2011	December, 2015	1,148,659,353.21	Jilon Elect Engr; Sinotec/KEC	7	Improvement in power supply to Ogoja, Obudu and environs to meet the power demand of the areas, increase socio-economic activity and generate employment in the areas.
62	1x60MVA, 132/33kV substation reinforcement at Ukpilla substation, Edo State	Edo	March, 2012	Sept., 2015	542,587,478.01	Power Control & Appliances	42	Improvement in power supply to Ukpilla and environs to meet the power demand of the areas, increase socio-economic activity and generate employment in the areas.
63	Yenagoa - Oporoma 132kv DC Transmission Line (50km)	Bayelsa	Yet to commence	Yet to commence	5,965,951,491.16	Fluor Eng/ Eurafric	0	Improvement of power supply to Oporoma and other parts of Bayelsa State. Increase in employment generation and socio-economic development.
64	2x 60MVA, 132/33KV Substation at Oporoma and 2x 132KV Line bays Extension at Yenagoa Substation	Bayelsa	Yet to commence	Yet to commence	2,598,473,746.01	Alfa/Cobra/Feeders JV	0	Improvement of power supply to Oporoma and other parts of Bayelsa State. Increase in employment generation and socio-economic development.
65	Delta-Port Harcourt 330KV DC line	Delta/Rivers	March, 2012	Sep, 2016	6,173,850,833.93	Icom Tele Ltd	5	Increase in power wheeling and availability to the states of the South-South Zone. Increase in employment generation and socio-economic development.
66	4x330kV line bays extensions at Delta and Port Harcourt substations	Delta/Rivers	March, 2012	December, 2015	1,237,745,143.35	MBH Power Ltd	20	Increase in power wheeling and availability to the states of the South-South Zone. Increase in employment generation and socio-economic development.
Projects In North Central Zone								
67	Katampe-National Stadium 132kv DC line	Abuja/FCT	Sept, 2001; Dec. 2010	March, 2015	2,656,115,130.98	ABB Powerlines; Energo Nigeria Ltd	95	Improvement in power wheeling capacity to National Stadium/Kukwaba areas of FCT. Enhancement of socio-economic activity and generation of employment.
68	Kukwaba 2x60MVA, 132/33kV substation	Abuja/FCT	2007	March, 2015	1,395,055,232.60	North China Power Engineering/News Engineering	80	Improvement in power supply to National Stadium/Kukwaba areas of FCT. Enhancement of socio-economic activity and generation of employment.
69	Nsukka - Ayangba 132KV DC Line	Kogi	Aug. 2009	Dec., 2015	1,480,777,014.45	West Com Ltd/PPCL	35	Increase in power availability to Ayangba and environs. Enhancement in socio-economic live of the people.
70	132/33KV Substation at Ayangba	Kogi	Dec, 2007	Dec, 2015	1,281,971,870.25	Omen International Ltd.	12	Increase in power availability to Ayangba and environs. Enhancement in socio-economic live of the people.
71	1x150MVA, 330/132kV + 1x60MVA, 132/33kV substation at Obajana	Kogi	December, 2007	June, 2015	2,568,846,118.51	Payma Bargh/ Cartlark	35	Improvement in power supply to Obajana to meet the power demand of the Industrial area and environs, to boost socio-economic activity and generate employment
72	Construction of Kwanga-Lafia 132kV Double Circuit Transmission Line	Nasarawa	January, 2011	April, 2016	1,147,170,485.67	Bateman	10	Bulk power supply to Lafia town and environs. Stimulation of growth in socio-economic activity, generation of employment

Annex 4.2a
CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
73	2x30/40MVA, 132/33kV S/S at Lafia	Nasarawa	January, 2011	Dec, 2015	1,490,085,721.56	Monotech Input/Bangladesh	37	Bulk power supply to Lafia town and environs. Stimulation of growth in socio-economic activity, generation of employment
74	Makere - Pankshin 132KV DC Line	Plateau	Dec, 2007	March, 2015	564,386,464.12	Mogabs Nig. Ltd	90	Increased power supply to Makeri, Pankshin and their environs. Boost insocio-economic live in the areas and entire Plateau State.
75	2 x 30MVA, 132/33KV S/S at Pankshin and Makeri	Plateau	Dec, 2007	Makeri - Aug., 2013. Pankshin - March,	2,058,143,958.24	North China/EESE	Completed	Increased power supply to Makeri, Pankshin and their environs. Boost insocio-economic live in the areas and entire Plateau State.
76	2x60MVA, 132/33KV S/S at Shonga.	Kwara	Jan. 2011	March, 2016	1,600,790,830.21	New World/Ruoga Energy	17	Bulk power supply to Songa and environs. Stimulation of growth in socio-economic activity, generation of employment
77	Ganmo -Ogbomosho 132kv DC line	Kwara	Feb. 2011	Dec., 2015	1,223,259,627.73	Trennco Power/Eco Energo Group	15	Bulk power supply to Ogbomosho and environs. Stimulation of growth in socio-economic activity, generation of employment
78	Lokoja - Obajana 330KV Line and Substation	Kogi	Dec, 2007 /2011	Dec., 2015	695,939,096.83	Elem & Elgo / Steers/Optic 1	30	Improvement in power supply to Obajana to meet the power demand of the Industrial area and environs,to boost socio-economic activity and generate employment
79	Ganmo-Shonga 132KV DC Line .	Kwara	Dec. 2010	Dec. 2015	2,622,191,252.87	Aster Infrast/Aster Teleservices	20	Bulk power supply to Songa and environs. Stimulation of growth in socio-economic activity, generation of employment
80	Obajana-Okeagbe 132KV DC line	Kogi	2011	March, 2016	1,969,973,210.18	Everest Infra energy Ltd	5	Bulk power supply to Okeagbe and environs. Stimulation of growth in socio-economic activity, generation of employment
81	Keffi-Kwoi-Kachia 132kv DC line	Kaduna	2011	March, 2016	3,017,531,968.16	Aster Infrast/Aster Teleservices	15	Bulk power supply to Kwoi, Kachia and adjoining parts of Kaduna State. Stimulation of growth in socio-economic activity, generation of employment
82	Omu Aran-Egbe 132kv DC line	Kwara	June, 2012	Dec. 2016	1,086,539,157.35	Aravali Infra Power Ltd	5	Improvement of power supply to Kogi State. Boosting of socio-economic life of the people of the state
83	2x60MVA 132/33kv substation at Egbe	Kwara	June, 2012	June, 2015	1,633,321,632.56	TBEA Hengyang Transformer Co. Ltd	60	Improvement of power supply to Kogi State. Boosting of socio-economic life of the people of the state
Projects In North-East Zone								
84	Construction of 2x150MVA, 330/132kv substation at Yola and 330kV Bay Extension at Gombe.	Adamawa/Gombe	May, 2001, Sept. 2008	Dec., 2010	5,991,019,162.16	Siemens Ltd. MBH Power Ltd.	Completed	Increase in power supply to Yola to meet the power demand in Adamawa State, boost in economic activity, employment generation.
85	2 x 330KV Line bay extension at Kaduna, Jos and Onitsha	Kaduna	Nov, 2009	Dec. 2015	1,240,589,916.19	Valenz Holding Ltd	30	Improvement of power wheeling to Kaduna, Plateau and Anambra States
86	Kaduna - Jos 330KV DC Line	Kaduna	July, 2010	July, 2015	8,714,447,318.27	Dextron Engr. Ltd	67	Increase in power wheeling to the North-East Zone. Boost in socio-economic activity in the North East states.
87	Jos - Kafanchan 132KV D/C Line .	Kaduna	Dec, 2007	April, 2012	1,407,774,047.57	Energo Nig Limited	Completed	Bulk power supply to Kafanchan and Southern parts of Kaduna State. Increase in economic activity, employment generation.
88	Jalingo 2x30/40MVA, 132kv Substation	Taraba	September, 2002	November, 2009	693,836,117.08	News Engineering Nig. Ltd.	Completed	Increase in power supply to Jalingo and environs. Boost in socion-economic activity and employment in the entire Taraba State.
89	Maiduguri 1x150MVA, 330/132kv Substation	Borno	May,2003	March, 2015	2,811,394,650.71	Charnel Engr. Co. Ltd. AY - KAY	80	Increase in power supply to Borno State. Boost in socion-economic activity and employment in the entire state.
90	Damaturu 330/132kv Substation	Yobe	April, 2006	March, 2015	2,502,960,280.52	Parsian High VoltageDiv./ Cartlark Int'l Ltd	88	Increase in power supply to Yobe State. Boost in socion-economic activity and employment in the entire state.

Annex 4.2a
CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
91	1x28MVA Mobile Substation at Mayo Belwa	Adamawa	14 July, 2011	March, 2015	224,918,522.80	MBH Power Ltd	80	Increase in power supply to Mayo Belwa and environs. Boost in socio-economic activity and employment in the areas.
92	Damaturu - Gashua 132kv DC Transmission Line (245km)	Yobe	Yet to commence	Yet to commence	5,440,638,606.31	Dextron Engr. Ltd	0	Bulk power supply to Gashua and environs and adjoining parts of Yobe State. Boost in socio-economic activity and employment in the areas.
93	Gashua - Hadejia 132kv DC Transmission Line (150km)	Yobe/Jigawa	Yet to commence	Yet to commence	3,392,394,044.93	Jyoti Structures Ltd	0	Increase in power supply to Gashua, Hadejia and adjoining parts of Yobe and Jigawa States. Boost in socio-economic activity and employment in the areas.
94	2x 60MVA, 132/33KV Substation at Gashua and 2x 132KV Line bays Extension at Damaturu and Hadejia	Yobe	Yet to commence	Yet to commence	2,146,875,489.00	Concept Eng./Chanref	0	Bulk power supply to Gashua nad environs. Boost in socio-economic activity and employment in the areas.
95	Yola-Song-Mubi-Gulak 132kv DC line	Adamawa	2011	July, 2016	7,457,033,255.05	Skipper Electricals Ltd	10	Bulk power supply to various parts of Adamawa State. Boost in socio-economic activity and employment in the state.
96	2x60MVA, 132/33kv substations at Song	Adamawa	2012	March, 2016	1,691,183,805.43	Qingado Wuxio/Ahmin Tech & Power System	5	Bulk power supply to Song and environs. Boost in socio-economic activity and employment in the areas.
97	2x60MVA, 132/33kv substation at Little Gombi	Adamawa	2013	March, 2016	1,468,436,221.81	Shandong Taikai	10	Bulk power supply to Little Gombi and environs. Boost in socio-economic activity and employment in the areas.
98	2x60MVA, 132/33kv substations at Mubi	Adamawa	2014	March, 2016	1,438,428,976.80	Hyundai/Richfied Energy	5	Bulk power supply to Mubi and environs. Boost in socio-economic activity and employment in the areas.
99	2x60MVA, 132/33kv substations at Gulak	Adamawa	2015	March, 2016	1,876,263,194.07	Concept Eng/Chanref	5	Bulk power supply to Gulak and environs. Boost in socio-economic activity and employment in the areas.
Projects In North-West Zone								
100	Rehabilitation of Sokoto - Talatamafara 132KV DC line	Sokoto/Zamfara	Dec, 2007	Sept, 2012	356,639,704.67	Dextron	Completed	Improved powewr supply to Talata Mafara and environs. Boost in socio-economic activity and employment in the areas.
101	1X30 MVA 132/33 KV SS at Kwanar Dangora	Kano	Oct. 2009	Jun. 2012	1,395,402,462.00	MATALEC	Completed	Improved powewr supply to Kwanar Dangora and environs. Boost in socio-economic activity and employment in the areas.
102	Transmission & Supply of Substation at Tamburawa Water Facility	Kano	Oct 2009	Sept, 2012	1,739,004,380.94	PEL/ NESPAK	Completed	Improved powewr supply to Tamburawa and environs. Boost in socio-economic activity and employment in the areas.
103	Talata Mafara 2x30/40MVA 132/33kv substation	Zamfara	Nov,2001	Feb., 2012	559,871,093.20	Continental Engr'g Nig. Ltd.	Completed	Improved powewr supply to Talata Mafara and environs. Boost in socio-economic activity and employment in the areas.
104	Kainji - New Bussa 132kv DC Transmission Line & 330KV SC River Crossing	Niger	2010	March, 2014	308,108,608.21	Dextron Engineering Ltd	Completed	Bulk power supply to New Bussa and environs. Boost in socio-econmic life and employment geration in the areas.
105	1x150MVA 330/132kv transformer at Birnin Kebbi and Reinforcement at 330/132/33 kv substation, Kumbotso	Kebbi/Kano	2010	June, 2014	3,559,832,143.76	MBH Power	Completed	Improvement in power supply to entire Kebbi and Kano States. Boost in socio-economic life and employment geration in the areas.
106	Kainji 1x150MVA 330/132kv & 2 x 30/40MVA Substation at New Bussa	Niger	2010	June, 2014	4,599,287,900.03	MBH Power	Completed	Bulk power supply to New Bussa and environs. Boost in socio-econmic life and employment geration in the areas.
107	Jos - Kafanchan 132KV D/C Line .	Kaduna	Dec, 2007	April, 2012	1,407,774,047.57	Energro Nig Limited	Completed	Bulk power supply to Kafanchan and environs. Boost in socio-econmic life and employment geration in the areas.
108	Kafanchan 132kv 2 x 60mva Substation	Kaduna	Dec, 2007	March, 2015	1,225,704,689.74	Valenz Holding Ltd	80	Bulk power supply to Kafanchan and environs. Boost in socio-econmic life and employment geration in the areas.

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TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
109	Kano- Walalanbe 132KV Line (Turn in and out of Dan agundi-Dakata 132KV single Cct Line) and 2 x 30/40MVA S/S at Walalambe	Kano	Dec, 2007	April, 2015	1,783,781,485.32	GIT	67	Bulk power supply to Walalambe and environs. Boost in socio-economic life and employment geration in the areas.
110	Yelwa - Yauri 2 x 30/40MVA S/S and 100KM of 33KV Line	Kebbi	Dec, 2007	July, 2015	1,067,910,710.00	Valenz/ Electromontaz	67	Bulk power supply to Yelwa-Yauri and environs. Boost in socio-economic life and employment geration in the areas.
111	2 x 330KV Line bay extension at Kaduna, Jos and Onitsha	Kaduna	Nov, 2009	Dec. 2015	1,240,589,916.19	Valenz Holding Ltd	30	Increased power wheeling to Kaduna, Plateau and Anambra States. Boost in socio-economic life and employment geration in the atates.
112	Grid Rehabilitation And Reinforcement, Katsina, Hadejia, Kontagora.	Katsina/Jigawa/Niger	Aug. 2010	March, 2015	1,261,482,166.72	Junot Construction	75	Improvement in power supply to entire Katsina, Hadejia, Kontagora and environs. Boost in socio-economic life and employment geration in the areas.
113	Kaduna Power Plant-Mando Road 330kV D/C line and Substation Extension	Kaduna	Dec., 2010	Dec, 2015	1,235,598,207.04	Hundai Energy & Construction Ltd/ IPDC Ltd	15	Increased power supply to entire Kaduna State. Improved socio-economic activity and employment generation.
114	Daura 2 x 30/40MVA S/S and 2x 132kv line bay ext. at Katsina	Katsina	Dec, 2007 /Dec., 2011	June, 2015	1,686,967,544.11	NCEP/Power Control & Appliances	75	Bulk power supply to Daura and environs. Boost in socio-economic life and employment geration in the areas.
115	2nd Kaduna-Kano 330kV DC line.	Kaduna/Kano	2011	December, 2017	8,514,855,688.26	National Power Construction	0	Increased power wheeling to Kano and Katsina States. Improved socio-economic activity and employment generation.
116	1X30MVA, 132/33 kV Substation at Wudil	Kano	Aug. 2010	June, 2015	1,554,231,496.95	CON Engineering	70	Bulk power supply to Wudil and environs. Boost in socio-economic life and employment geration in the areas.
117	Kaduna - Jos 330KV DC Line	Kaduna	July, 2010	July, 2015	8,714,447,318.27	Dextron Engr. Ltd	67	Increased power wheeling to Kaduna and Plateau States. Improved socio-economic activity and employment generation in the states.
118	Kano-Katsina 330KV DC Transmission Line	Kano/Katsina	Dec. 2010	December, 2015	6,123,452,721.78	Gammon India	35	Increased power wheeling to Katsina State. Improved socio-economic activity and employment generation.
119	2x150MVA Substation at Katsina.	Katsina	Dec. 2010	December, 2015	3,998,689,080.02	Barne/ESL	30	Bulk power supply to entire Katsina State. Boost in socio-economic life and employment geration in the state.
120	Katsina-Kurfi-Dutsinma-Kankara-Malumfashi 132KV Line	Katsina	Jan. 2011	Dec. , 2015	2,990,230,818.96	Skipper Electricals Ltd	15	Bulk power supply to various parts of Katsina State. Boost in socio-economic life and employment geration in the state.
121	2x60MVA, 132/33kV substation at Kurfi	Katsina	Jan. 2011	Dec, 2015	1,492,490,054.98	Gracehill Energy Nig. Ltd	5	Bulk power supply to Kurfi and environs. Boost in socio-economic life and employment geration in the areas.
122	2x60MVA, 132/33kV substation at Dutsinma	Katsina	Jan. 2011	Dec, 2015	1,278,158,301.28	Hoquado Limited	10	Bulk power supply to Dutsinma and environs. Boost in socio-economic life and employment geration in the areas.
123	2x60MVA, 132/33kV substation at Kankara	KATSINA	Jan. 2011	Dec, 2015	1,411,387,601.67	PEL-NESPAK JV	10	Bulk power supply to Kankara and environs. Boost in socio-economic life and employment geration in the areas.
124	2x60MVA, 132/33kV substation at Malumfashi	Katsina	Jan. 2011	Dec, 2015	1,250,988,584.47	Monotech Input/Bangladesh	25	Bulk power supply to Malumfashi and environs. Boost in socio-economic life and employment geration in the areas.
125	Kumbotso (Daura)-Dambatta 132KV Line	Kano	Dec. 2010	Dec, 2015	1,533,623,568.20	Icom Tele Ltd	5	Bulk power supply to Dambatta and environs. Boost in socio-economic life and employment geration in the areas.
126	2x60MVA, 132/33kV substation at Dambatta, Kano State.	Kano	Dec. 2010	June, 2015	1,533,623,568.20	PEL-NESPAK JV	50	Bulk power supply to Dambatta and environs. Boost in socio-economic life and employment geration in the areas.
127	Katsina- Daura 132kv DC line Katsina State	Katsina	Dec, 2007 December 14, 2011	June, 2015	2,465,300,298.12	Income Electrix Ltd. Reawarded to Optic 1 Nig. Ltd	60	Bulk power supply to Daura and environs. Boost in socio-economic life and employment geration in the areas.

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TCN Projects

S/N	PROJECT TITLE	STATE	DATE OF COMMENCEMENT	EXPECTED DATE OF COMPLETION	TOTAL COST (NAIRA)	NAME OF CONTRACTOR	COMPLETION STATUS	IMPACT OF PROJECT
128	2x330kV line bay extensions at each of Kaduna and Kano substations	Kaduna/Kano	March, 2012	Dec, 2015	1,157,997,292.40	Exenergia Power/Bigen Africa	20	Increased power wheeling between Kaduna and Kano.
129	Keffi-Kwoi-Kachia 132kV DC line	Kaduna	2011	March, 2016	3,017,531,968.16	Aster Infrac/Aster Teleservices	15	Bulk power supply to Kwoi, Kachia and environs. Boost in socio-economic life and employment generation in the areas.
130	2x60MVA substation at Kwoi	Kaduna	2011	Dec, 2015	1,679,728,453.64	Liaoning Efacec Elect Equipment Co.	5	Bulk power supply to Kwoi and environs. Boost in socio-economic life and employment generation in the areas.
131	2x60MVA substation at Kachia	Kaduna	March, 2012	Sept. , 2015	1,355,044,933.35	Esterbag Eng. Ltd	30	Bulk power supply to Kachia and environs. Boost in socio-economic life and employment generation in the areas.
132	Gagarawa 2x60 MVA, 132/33 kV substation, Jigawa State	Jigawa	2011	March, 2016	1,108,202,022.55	Power Control & Appliances	10	Bulk power supply to Gagarawa and environs. Boost in socio-economic life and employment generation in the areas.

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CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES
NIPP Projects

S/N	PROJECT TITLE	State	Date of Commencement	Expected Date of Completion	Total Cost (Naira)	Name of Contractor	Completion Status	IMPACTS OF PROJECT
	Projects In South-South Zone							
1	330KV DC Ikot Ekpene-Ugwuaji (Line 1 -4)		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to North West and North Central
2	330KV DC Afam -Ikot Ekpene		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to North West and North Central
3	330KV Afam SS (Line Bay Ext.)		South South	April, 2015			Yet to be completed	The project when completed will provide power evacuation at Afam S/S
4	330KV Ikot Ekpene SS		South South	April, 2015			Yet to be completed	The project when completed will provide power evacuation at Ikot Ekpene S/S
5	330/132/33KV Ikot Abasi SS (New)		South South	April, 2015			Yet to be completed	The project when completed will provide power evacuation at Ikot Ekpene S/S (New)
6	132KV DC Eket-Uyo (Reconductoring)		South South	Commissioned			Completed	The project when completed will provide alternative path for bulk power evacuation to Uyo , and the entire South - South region.
7	132KV DC Uyo-Itu (Reconductoring)		South South	Commissioned			Completed	The project when completed will provide alternative path for bulk power evacuation to Itu, and the entire South - South region.
8	132KV Uyo SS (Replacement of transformers)		South South	Commissioned			Completed	The project when completed will provide power evacuation at Uyo S/S
9	132KV Itu SS (Replacement of transformers)		South South	Delivered to site, not energized			Yet to be completed	The project when completed will provide power evacuation at Itu S/S
10	330/132/33KV Omoku SS (Supervised by DECON for Steag)		South South	April, 2015			Yet to be completed	The project when completed will provide power evacuation at Omoku S/S
11	330KV DC Omoku-Egbema		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation from Omoku-Egbema , and the entire South - east & South - South regions.
12	330KV DC Egbema-Owerri		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation from Egbema - Owerri , and the entire South - east & South - South regions.
13	132/33KV Ihovbor SS (New)		South South	April, 2015			Yet to be completed	The project when completed will provide power evacuation at Ihovbor S/S

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14	132/33V Agbor SS (New)		South South	April, 2015			Yet to be completed	The project when completed will provide power evacuation at Agbor S/S
15	132/33KV Asaba SS (New)		South South	April, 2015			Yet to be completed	Grid Reinforcement
16	132KV DC Agbor-Asaba		South South	April, 2015			Yet to be completed	Grid Reinforcement
17	330/132/33KV Onne SS (New)		South South	April, 2015			Yet to be completed	Power Evacuation
18	330KV Afam SS (Ext.)		South South	April, 2015			Yet to be completed	Power Evacuation
19	132/33KV Trans Amadi SS (Ext.)		South South	April, 2015			Yet to be completed	Power Evacuation
20	330KV DC Afam-Onne		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation in Port -Harcourt and the entire South-South region
21	132KV DC Onne-Trans Amadi		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation in Port -Harcourt and the entire South-South region
22	330 DC Ikot Abasi-Ikot Ekpene		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation in Akwa Ibom and the entire South-South region
23	132/33KV Okada SS (New)		South South	April, 2015			Yet to be completed	Power Evacuation
24	132KV Ihovbor SS (Line Bay Ext.)		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation at Ihovbor S/S
25	330/132KV Ihovbor SS (New)		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation at Ihovbor S/S
26	330KV DC Ihovbor-(Benin Main-Oshogbo) (Line A)		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Osogbo and the entire South west region
27	330KV SC Ihovbor-(Benin Main/ Onitsha)		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Benin main, Onitsha and the entire South east region
28	132KV DC Ihovbor-Okada		South South	April, 2015			Yet to be completed	
29	132/33KV Ikom SS (New)		South South	April, 2015			Yet to be completed	power evacuation

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NIPP Projects

30	132/33KV Obudu SS (New)		South South	April, 2015			Yet to be completed	power evacuation
31	132KV DC Abakiliki-Ikom		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Cross River State , and environs.
32	132KV DC Ikom-Obudu		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Cross River State , and environs.
33	330KV Calabar SS (New)		South South	April, 2015			Yet to be completed	power evacuation
34	330KV DC Ikot Ekpene-Alaoji		South South	2015, April			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Alaoji , and the entire South east region
35	330KV DC Calabar-Ikot Ekpene		South South	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation from Calabar PS.
36	330KV DC (Calabar PS-Calabar SS)		South South	Commissioned			Completed	The project provides alternative path for bulk power evacuation from Calabar P/S.
37	132/33KV Calabar SS (1x60MVA Ext.)		South South	April, 2015			Yet to be completed	power evacuation
38	132/33KV Adiabo SS (2x60MVA Ext.)		South South	April, 2015			Yet to be completed	power evacuation
39	132/33KV Calabar EPZ SS (2x60MVA New)		South South	April, 2015			Yet to be completed	power evacuation
40	Construction of 5km 132KV DC OHTL & 8km SC Diversion		South South				Yet to be completed	power evacuation
41	Restranging/Conversion of 4km 132KV SC to 132kV DC line		South South				Yet to be completed	power evacuation
42	132KV DC Construction of two (2) 132kV DC lines each 5km		South South	2015, April			Yet to be completed	power evacuation
43	132KV DC Construction of New Lines and Disconnection of diversion line		South South	April, 2015			Yet to be completed	power evacuation
44	330KV Sapele SS (Rehab. & Ext.)		South South	Commissioned			Completed	Provides Power Evacuation
45	330KV Benin SS (Rehab.)		South South	Commissioned			Completed	Provides Power Evacuation

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NIPP Projects

46	330/132KV Asaba SS (New)		South South	2014, June			Yet to be completed	Provides Power Evacuation
	Projects In South-East Zone							
47	330/132KV New Haven SS (Ext.)		South East	Commissioned			Completed	Provides Power Evacuation
48	330KV Ugwuaji SS (New)		South East	Commissioned			Completed	Provides Power Evacuation
49	330KV DC Ugwuaji-New Haven		South East	Commissioned			Completed	The project provides alternative path for bulk power evacuation to Enugun , and the entire South east region
50	330/132/33KV Owerri SS (New)		South East				Yet to be completed	The project will completed will provide power evacuation
51	330KV Alaoji SS (Line bay ext.)		South East	Commissioned			Completed	The project provides alternative path for bulk power evacuation at Alaoji , and the entire South east region
52	330KV DC Owerri-Nnewi		South East	Stalled by Wayleave issue			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Nnewi, and the entire South east region
53	330KV DC Nnewi-Onitsha		South East	Stalled by Wayleave issue			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Nnewi, and the entire South east region
54	330KV Onitsha SS (Line bay ext.)		South East	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation at Onitsha S/S
55	330KV DC Alaoji-Owerri		South East	April, 2015			Yet to be completed	The project when completed will provide grid re-inforcement.
56	132/33KV Awka SS (New)		South East	April, 2016			Yet to be completed	The project will completed will provide power evacuation
57	132KV DC Nnewi-Ihiala-Orlu		South East	April, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Ihiala, and environs.
58	132/33KV Nkalagu SS (Ext.)		South East	July, 2015			Yet to be completed	The project will completed will provide power evacuation
59	132KV Abakiliki SS (Ext.)		South East	July, 2015			Yet to be completed	The project will completed will provide power evacuation
60	132KV DC Nkalagu-Abakiliki		South East	July, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Abakiliki , and environs.

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61	132/33KV Nsukka SS (New)		South East	July, 2015			Yet to be completed	The project will completed will provide power evacuation
62	330/132/33KV New Haven North SS (Ext.)		South East	July, 2015			Yet to be completed	The project will completed will provide power evacuation
63	132KV New Haven North-Nsukka		South East	May, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Nsukka , and environs.
64	132/33KV Ubulusiuzor (Ihiala) SS (New)		South East	Dec ,2015			Yet to be completed	The project will completed will provide power evacuation
65	132/33kv Orlu SS (New)		South East	June, 2015			Yet to be completed	The project will completed will provide power evacuation
	Projects In South-West Zone							
66	132KV DC Oke Aro-Alausa		South West	June, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Alausa , and environs.
67	132KV DC Oke Aro-(Ikorodu/Maryland)		South West	June, 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Ikorodo/Maryland, and environs.
68	132KV Alausa SS (Line bay ext.)		South West	June, 2015			Yet to be completed	The project will completed will provide power evacuation
69	132/33KV Aiyede SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation
70	330KV DC Ganmo-(Jebba/Osogbo SC - Turn in/Turn out)		South West	Commissioned			Completed	The project provides power evacuation
71	132/33KV Agbara SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation
72	132/33KV Ikeja West SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation
73	132/33KV Ojo SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation
74	132/33KV Oworonsoki SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation
75	330/132KV Aja G.I.S. SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation

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76	132KV Aja G.I.S. SS (Ext.)		South West	Commissioned			Completed	The project provides power evacuation
77	330/132/33KV Alagbon G.I.S. SS (New and Ext.)		South West	Oct, 2015			Yet to be completed	The project when completed will provide power evacuation
78	132/33KV Lekki G.I.S. SS (New)		South West	April, 2015			Yet to be completed	The project when completed will provide power evacuation
79	330/132/33KV Lekki G.I.S. SS (New)		South West	Nov, 2015			Yet to be completed	The project when completed will provide power evacuation
80	132KV DC Otta-Ogba Junction-Papalanto		South West	Dec , 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Ogba, and environs.
81	132KV DC Papalanto-Old Abeokuta		South West	Aug , 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to Old Abeokuta, and environs.
82	132KV DC Old Abeokuta-New Abeokuta		South West	April , 2015			Yet to be completed	The project when completed will provide alternative path for bulk power evacuation to New Abeokuta, and environs.
83	132KV DC Lekki-Aja		South West	April , 2015			Yet to be completed	The project when completed will provide grid reinforcement.
84	132/33KV New Abeokuta SS (New)		South West	June ,2015			Yet to be completed	The project when completed will provide power evacuation
85	132/33KV Old Abeokuta SS (New)		South West	Aug ,2015			Yet to be completed	The project when completed will provide power evacuation
86	132/33KV Papalanto SS (Ext.)		South West	Aug ,2015			Yet to be completed	The project when completed will provide power evacuation
87	132/33KV Otta SS (Ext.)		South West	Sept , 2015			Yet to be completed	The project when completed will provide power evacuation
88	330/132KV Papalanto SS (New)		South West	Commissioned			Completed	The project provides power evacuation
89	330KV DC Papalanto-(Ikeja West/Ayede)		South West	Commissioned			Completed	The project provides grid reinforcement and bulk power evacuation to Ikeja West, and environs.
90			South West	Commissioned			Completed	The project provides power evacuation
91	330/132KV Omotosho SS (New)		South West	Commissioned			Completed	The project provides power evacuation

Annex 4.2b

CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES

NIPP Projects

92	330KV DC Omotosho - Ikeja West		South West	Commissioned			Completed	The project provides grid reinforcement and bulk power evacuation to Ikeja West, and environs.
	Projects In North Central Zone							
93	330KV DC Makurdi-Jos		North Central	Commissioned			Completed	The project provides grid reinforcement and bulk power evacuation to Jos , and entire North-west and North-east regions.
94	330/132/33KV Makurdi SS (New)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Makurdi, and environs.
95	330/132KV Jos SS (Ext)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Jos, and environs.
96			North Central					
97	330KV DC Makurdi-Aliade		North Central	April, 2015			Yet to be completed	The project when completed will provide grid reinforcement and bulk power evacuation to Aliade , and entire North-central and North-east regions.
98	330KV DC Aliade-Ugwuaji		North Central	August, 2015			Yet to be completed	The project when completed will provide grid reinforcement and bulk power evacuation to Aliade , and entire North-central and South-east regions.
99	330/132/33KV Ganmo SS (New)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Kwara state, and environs.
100	132KV DC Ganmo-(Ilorin/Oshogbo SC Turn in/Turn out)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Ilorin , and environs.
101	132/33KV Central Area SS (Ext.)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Central area , and environs.
102	330/132KV Katampe SS (Ext.)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Katampe, and environs.
103	330/132/33KV Gwagwalada SS (New)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Gwagwalada, and environs.
104	330KV DC Gwagwalada-Eastmain		North Central	Commissioned			Completed	The project provides grid reinforcement and bulk power evacuation to East mains , and entire FCT.
105	132KV DC Eastmain-Kukwaba		North Central	Commissioned			Completed	The project provides bulk power evacuation to Kukuaba.
106	132KV DC Kukwaba-Apo		North Central	Commissioned			Completed	The project provides bulk power evacuation to Apo.

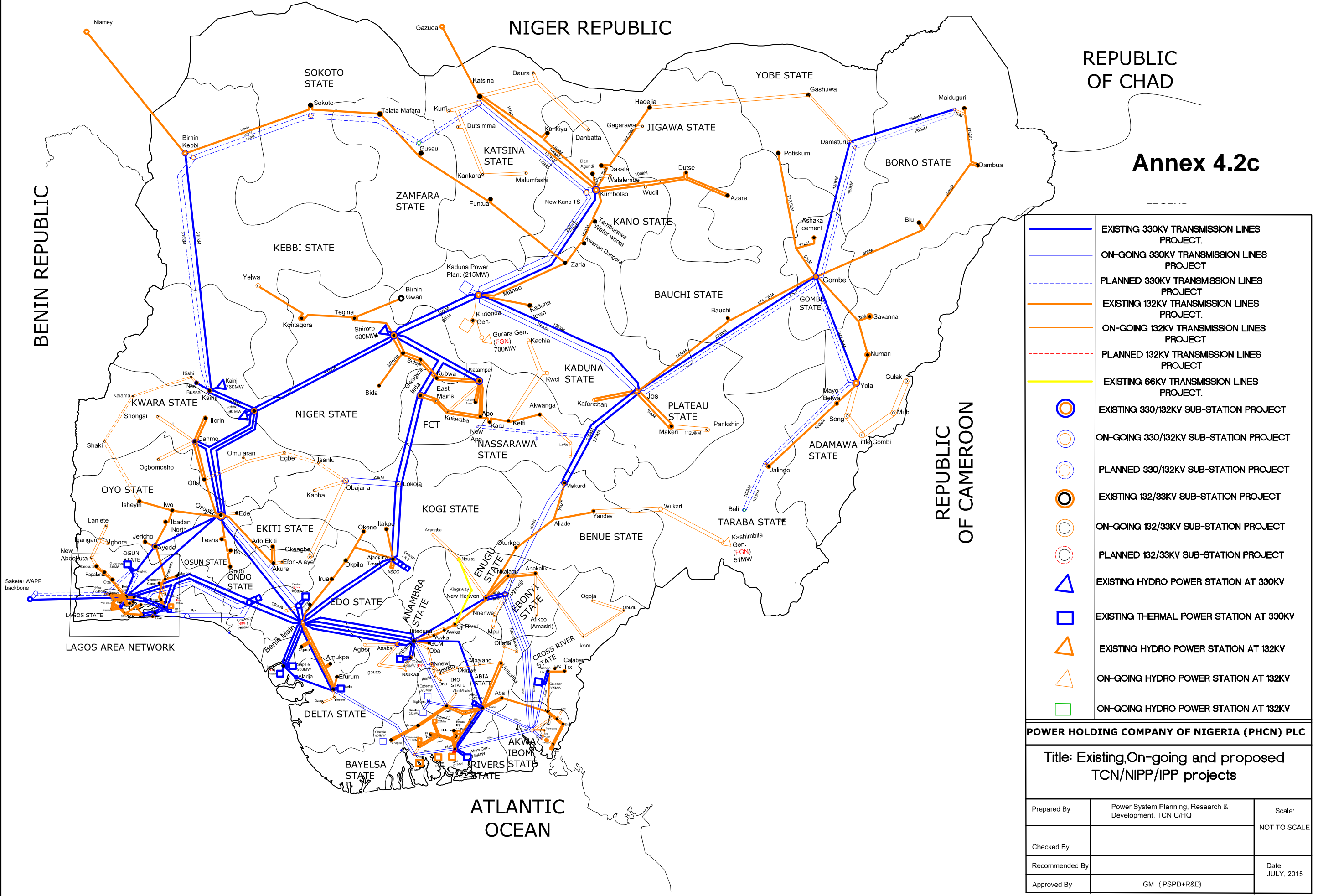
Annex 4.2b

CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES

NIPP Projects

107	132KV/33KV Apo SS (Ext.)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Apo, and environs.
108	132KV/33KV Kukwaba SS (Ext.)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Kukuaba, and environs.
109	330/132/33KV Oke Aro SS (New)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Oke-Aro, and environs.
110	330KV DC Oke Aro-(Oke Aro/Ikeja West/Egbin)		North Central	Commissioned			Completed	The project provides grid reinforcement and bulk power evacuation to Oke-aro.
111	330/132/33KV Lokoja SS (New)		North Central	Dec, 2015			Yet to be completed	The project when completed will provide bulk power evacuation to Lokoja, and entire North-central region.
112	330KV Ajaokuta SS (Line Bay Ext.)		North Central	Commissioned			Completed	The project provides bulk power evacuation to Ajaokuta, and environs.
113	330KV DC Ajaokuta-Lokoja-Gwagwalada		North Central	Commissioned			Completed	The project provides grid reinforcement and bulk power evacuation to Ajaokuta.
	Projects In North West Zone							
114	132/33KV Kumbotso SS (Ext.)		North West	Commissioned			Completed	The provides bulk power evacuation to Kumbotso, and environs.
115	330/132/33KV Mando SS (Ext.)		North West	Commissioned			Completed	The provides bulk power evacuation to Mando, and environs.

NIGERIAN MAP SHOWING THE EXISTING, ON-GOING AND PLANNED PROJECTS FOR 10,000MW TTC



Annex 4.2d1

Proposed Abuja Transmission Ring Project to be financed by AFD					
S/N	REGION		LOCATION	DESCRIPTION	COST [USD]
TRANSMISSION LINES					
1	NORTH CENTRAL	ABUJA	New Apo	Construction of about 172km of new 330kV double circuit line from Lafia 330kV Substation (new) to the proposed New Apo 330/132/33kV Substation.	30,600,000
2	NORTH CENTRAL	ABUJA	Old Apo	Construction of about 7km of new 132kV double circuit line from new Apo 330/132/33kV substation to Old Apo 132/33kV substation:	1,200,000
3	NORTH CENTRAL	ABUJA	Old Kuje	Construction of 35km of new 132kV double circuit line from New Apo 330/132/33kV substation to the proposed Kuje 132/33kV substation.	8,700,000
4	NORTH CENTRAL	ABUJA	West Main Lugbe	Construction of 29km of new 132kV double circuit line from the proposed Kuje 132/33kV Substation to West Main (Lugbe) 330/132/33V substation.	7,800,000
				Sub-total	48,300,000
TRANSMISSION SUBSTATIONS					
5	NORTH CENTRAL	ABUJA	New Apo	Construction of complete new 330/132/33kV substation at New Apo to be equipped with 2No150MVA, 330/132kV transformers and 3No. 60MVA, 132/33kV transformers including 6 X 132kV line bay and 2 X 132kV line bay extension at Old Apo 132kV Substation.	29,800,000
6	NORTH CENTRAL	ABUJA	West Main Lugbe	Construction of complete new 330/132/33kV substation at West Main (Lugbe) to be equipped with 2X150MVA, 330/132kV transformers and 3No. 60MVA, 132/33kV Transformers (with 132kV outdoor GIS Switchgear) including 2 x 330kV line bay, 4X132kV line bays.	25,100,000
7	NORTH CENTRAL	ABUJA	Kuje	Construction of complete new 132/33kV substation at Kuje to be equipped with 3No. 60MVA, 132/33kV transformers including 4 x 132kV Line Bay	7,700,000
8	NORTH CENTRAL	ABUJA	Wumba/Lokogoma	Construction of complete new 132/33kV Substation at Wumba / Lokogoma to be equipped with 2No.60MVA, 132/33kV transformers, 2 X 132kV line bay including 5km underground 132kV XLPE Cable line, from New Apo to Wumba/Lokogoma	19,900,000
9	NORTH CENTRAL	ABUJA	Gwarimpa	Construction of complete new 132/33kV GIS substation at Gwarimpa to be equipped with 2No. 60MVA, 132/332kV transformers including OHL / Underground Cable termination of the existing 132KV Katampe – Suleja Transmission line.	22,000,000
				Sub-total	104,500,000
	NORTH CENTRAL	ABUJA	SCADA		2,000,000
	NORTH CENTRAL	ABUJA	ERM	Establishment of ERP in TCN for effective management of its assets	9,200,000
	NORTH CENTRAL	ABUJA	Project Management	Consultancy and other Runing cost	6,000,000
			Contigencies		-
			Contigencies	Contigencies	-
				Sub-total	17,200,000
				TOTAL	170,000,000

Annex 4.2d2

Lagos/Ogun Transmission Project to be financed by JICA					
S/N	REGION		LOCATION	DESCRIPTION	COST [USD]
TRANSMISSION LINES					
1	SOUTH WEST	Lagos	New Abeokuta	Arigbajo – New Abeokuta 132kV D/C Transmission Line (37.8km)	11,000,000
2	SOUTH WEST	Lagos	Arigbajo	Olorunsogo – Arigbajo 330kV D/C Transmission Line (12.9km)	3,870,000
3	SOUTH WEST	Lagos	Ikeja West	Arigbajo – Ikeja West / Osogbo 330kV D/C Turn in-out (5.9km)	3,120,000
4	SOUTH WEST	Lagos	Arigbajo	Ogijo – Arigbajo D/C Transmission Line (43.7km)	3,120,000
5	SOUTH WEST	Lagos	Shagamu	132kV Quad Line (2.3km) from Ogijo – Existing Ikorodu/Shagamu 132 kV 2x D/C Transmission Line	2,000,000
6	SOUTH WEST	Lagos	Redeem	132kV D/C Transmission Line (10.3km) from Ogijo – Redeem.	2,750,000
7	SOUTH WEST	Lagos	Ikeja West	MFM – Existing Benin (Omotosho)/Ikeja West 330kV 2 x D/C Transmission Line (4.2km)	1,200,000
8	SOUTH WEST	Lagos	New Agbara	Arigbajo – New Agbara 330kV D/C Transmission Line (30.6km)	7,980,000
9	SOUTH WEST	Lagos	Agbara	New Agbara – Agbara 132kv D/C Transmission Line (20.8km)	5,392,000
10	SOUTH WEST	Lagos	Badagry	New Agbara – Badagry 132kv D/C Transmission Line (34.2km)	7,800,000
				Sub-total	48,232,000
TRANSMISSION SUBSTATIONS					
11	SOUTH WEST	Lagos	Ogijo	2x300MVA 330/132kV + 2 x 100MVA 132/33kV Transformer capacity at Ogijo, Lagos	37,000,000
12	SOUTH WEST	Lagos	Redeem	2x60MVA, 132/33kV Substation at Redeem.	12,500,000
13	SOUTH WEST	Lagos	MFM	2x150MVA, 330/132kV + 2x100MVA 132/33kV Substation at MFM	32,000,000
14	SOUTH WEST	Lagos	New Agbara	2x150MVA, 330/132kV + 2x100MVA 132/33kV Substation at New Agbara	32,000,000
15	SOUTH WEST	Lagos	Badagry	2x60MVA, 132/33kV substation at Badagry.	14,500,000
16	SOUTH WEST	Lagos	Arigbajo	Arigbajo +Olorunsogo+New Abeokuta line bay extensions	8,000,000
				Sub-total	136,000,000
				Contingencies	10,000,000
				Consultancies/Supervision	5,768,000
				TOTAL	200,000,000

Annex 4.2d3

Proposal for North East Transmission Infrastructure Project to be financcec by AFDB						
S/N	REGION		SUBSTATION	DESCRIPTION	COST [USD]	Feasibility Studies
PACKAGE 1 - Substations						
Lot 1						
1	North East	Bauchi	Manguno	Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Old Maiduguri 132/33kV Substation.	7,000,000	Not Available
2	North East	Bauchi	Marte	Construction of 2 x 60MVA 132/33kV Complete substation	7,000,000	Not Available
3	North East	Bauchi	Dikwa	Construction of 1 x 60MVA 132/33kV Complete substation	3,500,000	Not Available
4	North East	Bauchi	Bama	Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at New Maiduguri 330/132kV Substation.	7,000,000	Not Available
5	North East	Bauchi	Gwoza	Construction of 1 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Gulak132/33kV Substation.	3,500,000	Not Available
				SUB TOTAL LOT 1	28,000,000	
LOT 2						
3	North Central	Bauchi	Jada	Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Mayo Belwa 330/132kV Substation.	7,000,000	Not Available
4	North East	Bauchi	Ganye	Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Mayo Belwa 330/132kV Substation.	7,000,000	Not Available
				SUB TOTAL LOT 2	14,000,000	
LOT 3						
1	North East	Bauchi	Uba	Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Mubi 132/332kV Substation.	7,000,000	Not Available
2	North East	Bauchi	Chibok	Construction of 1 x 60MVA 132/33kV Complete substation	3,500,000	Not Available
4	North Central	Bauchi	Biu	Construction of 1x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Biu 132/33kV Substation.	2,050,000	Not Available
5	North East	Bauchi	Bunyadi	Construction of 1 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension each at Damaturu 330kV Substation and Biu 132/33kV Substation respectively	3,500,000	Not Available
6	North East	Bauchi	Kwaya Kusar	Construction of 1 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension each at Damaturu 330kV Substation and Biu 132/33kV Substation respectively	7,000,000	Not Available
				SUB TOTAL LOT 3	23,050,000	
TOTAL PACKAGE 1 = LOTS 1+ 2+ 3 + 4					65,050,000	
PACKAGE 2 - New 132kV Double Circuit Transmission Lines						
PACKAGE 2A						
1	North East	Bauchi	Maiduguri - Manguno - Marte - Dikwa - Bama	Construction of a New 321km, 132kV Double Circuit Line Between Maiduguri - Manguno - Marte - Dikwa -Bama	45,903,000	Not Available
2	North East	Bauchi	Maiduguri - Bama - Goza - Gulak	Construction of a New 165km, 132kV Double Circuit Line from Maiduguri - Bama - Goza - Gulak	23,595,000	Not Available
				SUB TOTAL PACKAGE 2A	69,498,000	
PACKAGE 2B						
1	North East	Bauchi	Mayo Belwa - Jada - Ganye	Construction of a New 78km, 132kV Double Circuit Line from Mayo Belwa - Jada - Ganye.	11,154,000	Not Available
2	North East	Bauchi	Biu - BuniYadi - Damaturu	Construction of a New 134km, 132kV Double Circuit Line from Biu - BuniYadi - Damaturu	19,162,000	Not Available
3	North East	Bauchi	Dambua - Chibok - Uba - Mubi	Construction of a New 130km, 132kV Double Circuit Line from Dambua - Chibok - Uba - Mubi	18,590,000	Not Available
				SUB TOTAL PACKAGE 2B	48,906,000	
PACKAGE 2 = 2A + 2B					118,404,000	
PACKAGE 3						
1	Consultancy Services			Project Management and Consultancy Services	4,000,000	
				SUB TOTAL PACKAGE 3	4,000,000	
				GRAND TOTAL (GOODS, WORKS, CONSULTANCY SERVICES COMPENSATION COST)	187,454,000	
				CONTIGENCIES	12,546,000	
				TOTAL	200,000,000	

Annex 4.2d4

PROPOSED NETAP PACKAGE to be financed by World Bank					
SUBSTATION REINFORCEMENT AND REHABILITATION					
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
Lot 1					
1	North West	Kaduna	Kumbotso	Reinforcement with 1 x 300MVA 330/132kV Power Transformer, High Voltage Switchgears and Associated Equipment, Replacement of Control and Relay Panel with Digital Control System	4,500,000
2	North West	Kaduna	Dakata	Reinforcement with 1 x 100MVA 132/33kV Power Transformer, Switchgears , Associated Equipment, Digital Control System. Supply & Installation of Additional 3 No. Feeders Bay and Rehabilitation of Control Room	3,144,326
3	North west	Kaduna	Kankia	Replacement of Faulty 1 x 30MVA and Upgrading of 1 x 30MVA Transformers to 2 x 60MVA 132/33kV Transformers, High Voltage Switchgears and Associated Equipment Including Digital Control System.	3,960,000
4	North west	Kaduna	Dan Agundi	Reinforcement of 1 x100MVA 132/33kV Transformers, High Voltage Switchgears and Associated Equipemnt including Digital Control System and Rehabilitation of Control Room	2,920,000
5	North West	Shiroro	Birnin Kebbi	Reinforcement with 2 x150MVA 330/132kV and Installation of 1 x 60MVA 132/33kV Power Transformers with associated 3no. Outgoing 33kV Feeders and Rehabilitation of Control Room	10,715,669
5	North Central	Shiroro	Shiroro	Replacement of Obsolate Control and Relay Pannels with Didital Control System, High Voltage 330kV Switchgears and Associated Equipment	4,840,000
6	North Central	Shiroro	Abuja Central Area	Upgrading of 2 x 45MVA with 2 x 100MVA 132/33kV Power Transformer, High Voltage Switchgears, Associated Equipment Including Gas Insulated Substation. Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem.	5,500,000
7	North central	Shiroro	Kainji	Rehabilitation of the 330kV Substation, High Voltage Switchgears, Associated Equipment. Rehabilitation of Control Room including Digital onrol System.	5,500,000
				SUB TOTAL LOT 1	41,079,995
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
Lot 2					
1	South East	Port Harcourt	Alaoji	Rehabilitation of 330kV Substation, 330kV Control room, Digital Control System and Replacement of High Voltage Switchgears and Associated Equipment.	3,905,445
2	South East	Port Harcourt	Aba	Rehabilitation of 132kV Substation, 132kV Control room, Digital Control System and Replacement of High Voltage Switchgears.	2,750,000
3	South East	Port Harcourt	Port Harcourt Main	Reinforcement with 1 x 100MVA 132/33kV Power Transformers, Control Room, High Voltage Switchgears and Associated Equipment.	2,750,000
4	South East	Port Harcourt	Port Harcourt Town	Reinforcement with 1 x 100MVA 132/33kV Power Transformers, Control Room, High Voltage Switchgears and Associated Equipment.	2,750,000
5	South south	Port Harcourt	ItuTS	Reinforcement with 1x 60MVA 132/33kV Power Transformers, High Voltage Switchgears, Associated Equipment. Rehabilitation of Control Room including Digital onrol System.	3,000,000
6	South East	Enugu	New Haven, Enugu	Reinforcement with 1 x 150MVA 330/132/33kV, 2 x 60MVA Transformers with Associated Equipment, Replacement of Hihg Voltage Switchgears and Rehabilitation of Control Room with Digital Control System.	10,780,000
7	South East	Enugu	G C M TS, Onitsha	Reinforcement of 1Nos. 60MVA 132/33kV Power Transformers, High Voltage Switchgears, and Associated equipment.	1,595,000
8	South East	Enugu	Abakaliki	Upgrade of 1x30MVA to 60MVA 132/33kV Power Transformer, High Voltage Switchgears, and Associated Equipment.	1,375,000
9	South East	Enugu	Orji river	Reinforcement of 1Nos. 60MVA 132/33kV power Transformers, Switchgears, associated equipment and devices.	1,595,000
10	South East	Enugu	Ugwuaji	Supply and Installation of 1x75MVar Reactor and 1 x 60MVA 132/33kV High Voltage Switchgears, and Associated Equipment.	3,300,000
11	North Central	Enugu	Otukpo	Upgrading of 7.5MVA Power Transformer to 1x 60MVA 132/33kV Transformer, High Voltage Switchgears and Associated EuiPMENT.	1,760,000
12	North Central	Enugu	Apir, Makurdi	Reinforcement with 1x150MVA 330/132/33kV and 1x 60MVA 132/33kV Power Transformers High Voltage Switchgears and Associated EuiPMENT.	4,950,000
13	South East	Enugu	Umuahia	Reinforcement with 100MVA 132/33kV Power Transformer and Extension of 132kV Bus with 3 No Additional Feeder Bays.	1,760,000
				SUB TOTAL LOT 2	42,270,445
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
Lot 3					
1	North East	Bauchi	Yola	Reinforcement with 1 x 150MVA 330/132kV and 2x 100MVA 132/33kV Power Transformers, High Voltage Switchgears, and Associated equipment with 3 No Additional Feeder Bays	10,450,000
2	North East	Bauchi	Mayo Belwa	Reinforcement with 1Nos. 150MVA 330/132kV power Transformers, High Voltage Switchgears, and Associated Equipment with 3 No Additional Feeder Bays	2,750,000

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3	North East	Bauchi	Jalingo	Upgrading from 132kV to 330kV Substation with 1x150MVA, 330/132/33kV Power Transformers and 1 x 100MVA 132/33kV Transformer, High Voltage Swtichgears and Associated Equipment. Constuction of 330/132kV Control Room	8,280,000
4	North East	Bauchi	Damaturu	Reinforcement with 1Nos. 150MVA 330/132kV power Transformers, High Voltage Switchgears, and Associated Equipment with 3 No Additional Feeder Bays	4,400,000
5	North East	Bauchi	Biu	Reinforcement of 1 x 60MVA 132/33kV Power Transformers, High Voltage Switchgears, Associated Equipment.and Complete Rehabilitation of Substation	2,200,000
				SUB TOTAL Lot 3	28,080,000
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
LOT 4					
1	North East	Bauchi	Damboa	Reinforcement of 2x 60MVA 132/33kV Power Transformers, High Voltage Switchgears, Associated Equipment.and Complete Rehabilitation of Substation	4,400,000
2	North East	Bauchi	Gombe	Reinforcement with 1 x 300MVA 330/132kV and 1x 100MVA 132/33kV Transformers with High Voltage Switchgears, and Associated equipment Bus with 3 No Additional Feeder Bays.	9,900,000
3	North Central	Bauchi	Jos TS	Reinforcement of 1x 300MVA 330/132/33kV & 1 x 100MVA Power Transformers, 330kV High Voltage Switchgears and Associated EuiPMENT. Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem.	11,000,000
4	North East	Bauchi	Maiduguri	Reinforcement with 1Nos. 150MVA 330/132kV power Transformers, High Voltage Switchgears, and Associated Equipment with 3 No Additional Feeder Bays	4,400,000
5	North East	Bauchi	Bauchi	Upgrading of 22.5MVA and 30MVA Transformers to 2X 60MVA 132/33kV Transformers, Rehabilitation of Control Room with Digital Control System and Associated High Voltage Switchgears.	4,015,000
				SUB TOTAL LOT 4	33,715,000
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
LOT 5					
1	South West	Osogbo	Osogbo	Upgrading of 1x 90MVA with 1x300MVA 330/132kV and Reinforcement with 1x100MVA Power Transformers, High Voltage Switchgears and Associated Equipment and 75MX Reactor including the renovation of control room	9,900,000
2	South West	Osogbo	Ilorin	Reinforcement of 2 x100MVA 132/33kV Power Transformers, High Voltage Switchgears, and Associated Equipment. Construction of New Control Room with Digital Control System (DCS)	4,620,000
3	South West	Osogbo	Ondo	Upgrading of 2x 30MVA with 2x 60MVA,132/33kV Power Transformers, Replacememnt of High Voltage Switchgears, Conversion of 6nos. 33kV Indoor to Outdoor. Rehabilitation oif Control Room with Digital Control System, and Perimeter Fencing.	5,280,000
4	South South	Benin	Irrua	Supply and installation of 100MVA 132/33KV power Transformer and associated Switichgears.	2,420,000
5	South South	Benin	Delta IV TS	Reinforcement with 1 x 150MVA 330/132kV Interbus Transformer, 1 x 100MVA Power Transformer, High Voltage Switchgears, and Associated Equipment. Replacement of Obsolate Control and Relay Pannels with Didital Control System	6,050,000
6	South South	Benin	Effurun	Replacement of defective 1x 60MVA 132/33kV with a new 1x 1000MVA 132/33KV Power Transformer, High Voltage Switchgears, and Associated Equipment with 4 No Additional Feeder Bays	2,200,000
7	South South	Benin	Benin TS	Reinfrcement with 1 x 150MVA 330/132kV Power Transformers and 100MVA 132/33KV Power Transformer, High Voltage Switchgears and Associated Equipment. Replacement of Obsolate Control and Relay Pannels with Didital Control System	6,000,000
				SUB TOTAL LOT 5	36,470,000
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
LOT 6					
1	Lagos Area	Lagos	Ijora	Upgrading of 2 x 30MVA with 2 x 100MVA 132/33kV Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem. Equipment.High Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem.	4,950,000
2	Lagos Area	Lagos	Lekki	Supply and installation of 1x 300MVA 330/132kV, 2 x 100MVA 132/33kV Power Transformer, High Voltage Switchgears and Associated Equipment .	4,950,000
3	Lagos Area	Lagos	Alagbon	Supply and Installation of 1x 300MVA 330/132kV, 2x 100MVA 132/33kV Power Transformers, Switchgears, associated Equipment and Devices.	9,460,000
				SUB TOTAL LOT 6	19,360,000
	REGION		SUBSTATION	DESCRIPTION	COST [USD]
LOT 7					
1	Lagos Area	Lagos	Alausa	Reinforcement of 1x 100MVA 132/33kV Power Transformer, High Voltage Switchgears and Associated Equipment.	2,420,000
2	Lagos Area	Lagos	Akoka	Complete Rehabilitation of the Gas Insulated Substation (GIS)	7,700,000
3	Lagos Area	Lagos	Amowu Odoffun	Complete Rehabilitation of the Gas Insulated Substation (GIS)	7,700,000

Annex 4.2d4

4	Lagos Area	Lagos	Itire	Complete rehabilitation of the Gas Insulated Substation (GIS)	7,700,000
5	Lagos Area	Lagos	Otta TS	Upgrading the 1x 30MVA and 1x40MVA with 2x 100MVA 132/33kV Power Transformers, High Voltage Switchgears and Associated Equipment.	4,455,000
6	Lagos Area	Lagos	Maryland	Upgrading of 2 x 30MVA to 2 x 100MVA 132/33kV Power Transformers, High Voltage Switchgears and Associated Equipment.	4,950,000
7	Lagos Area	Lagos	Egbin	Replacement of Obsolate Control and Relay Pannels with Didital Control System, Rehabilitation of Control Room , High Voltage Switchgears and Associated Equipment.	8,800,000
				SUB TOTAL LOT 7	43,725,000
	(PACKAGE) 1 Lots (1+2+3+4+5+6+7) =				244,700,440
132kV LINES RECONDUCTORING					
	"A"				
1	South West	Osogbo	Osogbo- Offa - Ganmo - Ilorin	Reconductoring of 150km, 132kV Line Between Osogbo-Offa/Omuaran to Ganmo and Ilorin TS	3,149,750
2	South West	Osogbo	Ayede - Shagamu	Reconstruction and Conversion of SC to Double Circuit of Ayede -Ajebo-Ishara-Shagamu 132kV Line (54km) and Creation of Additional Bays 132kV Line Bays at Ayede , Ajebo, Ishara and Shagamu.	7,020,000
	South West	Osogbo	Osogbo- Ife / Ilesha	Reconstruction and Conversion to Double Circuit of Osogbo-Ife/Ilesha 132kV Line (39.21 km) and Osogbo-Ilesha 132kV Line Tie-Off (22.1km) and Creation of Additional 132kV Line Bays at Osogbo abd Ilesha.	4,420,000
4	South East	Port Harcourt	Afam - PH Main	Reconstruction of Existing Double 132kV Line Circuit to 4 x 132kV Line Circuit Using the Same Right of Way from Afam to Port Harcourt Main (37.8km), and Creating Additional 3 x 132kV Line Bays	6,804,000
5	South East	Port Harcourt	PH Mian - PH Main	Reconductoring of 132kV Double Circuit of Port Harcourt Main to Port Harcourt Town 132kV Line (6km)	2,310,000
				SUB TOTAL A	23,703,750
"B"					
1	North West	Kaduna	Kumbotso - Hadejia	Reconductoring of Kumbotsho- Hadeji 132kV Line (165km)	4,125,000
2	North West	Kaduna	Kumbotso - Kankia	Reconductoring of Kumbotsho- Kankia 132kV Line (100km)	2,500,000
3	south East	Enugu	Onitsha - Oji River	Reconductoring of Onitsha- Orji 132kV Line (87km) with Turn In- Turn Out Tower at Nibo (Agu Awka) in Awka 132kV Substation.	2,175,000
4	south East	Enugu	Alaoji to Aba Town	Reconductoring of Alaoji - Aba Town Double Circuit 132kV line (8km) Including Rehabilitation of Two Nos. Towers along the Line.	315,000
5	South South	Benin	Irrua - Benin	Reconductoring of Irrua - Benin 132kV line (81km)	4,375,000
6	South South	Benin	Irrua - Okpila	Reconductoring of Irrua- Okpilai 132kV line (43km) .	1,075,000
7	South South	Benin	Okpila - Okene	Reconductoring of Okpilai - Okene 132kV line (65km)	1,625,000
8	South South	Benin	Ajakuta-Okene	Reconductoring of Ajakuta- Okene 132kV line (60km)	1,500,000
9	North East	Bauchi	Gombe-Biu- Damboa-Maiduguri	Reconductering of the Entire Route Length from Gombe - Biu -Damboa - Maiduguri 132kV line of 356km Route Length	8,188,000
				SUB TOTAL B	25,878,000
				SUB TOTAL A+B	49,581,750
SUPPLY OF POWER EQUIPMENT					
1	Supply of Power Equipment to Ojo		3 x 150MVA,10 x100MVA, 10 x 60MVA and Earthing Transformers		21,400,000
2	Additional supplies to OJO		330kV, 132kV and 33kv Instrument Transformers, Isolators, Circuit Breakers and Insulators		9,589,995
				SUB TOTAL	30,989,995
SCADA PROJECT					
	SCADA Device				65,000,596
				SUB TOTAL	65,000,596
SUPPLY AND INSTALLATION OF SVC					
	SVC to Gombe				14,000,000
				SUBTOTAL	14,000,000
CONSULTANCY SERVICES					
	Consultancy Services			Consultancy Services on SCADA, SVC, Environmental and Social Related Studies, Contract Supervisions and other Studies (Such as Double Circuit Lines Quad Conductor from Bauchi - Gombe, Ugwuaji - Aliade - Makurdi - Jos, Omotosho - Akure - Oshogbo, Gashua - Hadejia - Damaturu, Delta - Benin, Benin - Omotosho, Zungeru - Shiroro, Onitsha - Aba and Kano - Kaduna)	35,000,000
				SUB TOTAL	35,000,000
				GRAND TOTAL (GOODS, WORKS AND CONSULTANCY SERVICES)	439,272,781
				OPERATING COST	7,000,000
				CONTIGENCIES	39,727,219
				TOTAL VALUE	486,000,000

Annex 4.3d5

NIGERIA TRANSMISSION EXPANSION PROJECT to be financed by IDB						
S/NO		Region	Station	SCOPE/BACKGROUND	ESTIMATED COST [USD]	STATUS OF FEASIBILITY STUDIES
1	North West	Kaduna	Construction of Quad 330KV on Kaduna-Kano 330KV Single DC Transmission Line	Construction of Double Circuit 330kV Quad Conductor Kaduna-Kano Transmission line.	50,350,000	Not Available
2	North West	Kaduna	Zaria	Turn-in Turn-out and Installation of 2x150MVA 330/132/33kV Transformer, 6x330kV bay extension, 2x60MVA 132/33kV Transformer, associated 132kV line bays and 6 number 33kV feeder bays at Zaria	19,000,000	Not Available
3	North West	Kaduna	Millenium City Kaduna	Turn-in Turn-Out and Installation of 2x150MVA 330/132/33kV Transformer, 2 x330kV bay extension, and 2x60MVA 132/33kV Transformer and 2x3number associated outgoing 33kV feeders.	24,000,000	Not Available
4	North West	Kaduna	Rigasa town, Kaduna	Turn-in Turn-out and Intallation of 2x60MVA 132/33kV Transformer and 5 number outgoing 33kV feeders	7,000,000	Not Available
5	North West	Kaduna	Jaji, Kaduna	Turn-in Turn-out and Installation of 2x60MVA 132/33kV Transformer and 6 number outgoing 33kV feeders	7,000,000	Not Available
6	South South	Benin	Reconstruction of Delta to Benin 330kV Transmission Line	Reconstruction of one of Delta-Benin 330kV Transmission Line Double Circuit to Quad Conductor 330 Double Circuit Line	41,650,000	Not Available
7	South South	Port Harcourt	Reconstruction of Alaoji to Onitsha 330kV	Double Circuit Alaoji-Ihiala-Onitsha to Quad conductor 330kV transmission line	26,000,000	Not Available
8	South South	Ahoda, Gilili and Sapele	Eviromental Impact Assessment and Resettlement Action Plan and Payment of Compensation	Double Circuit(DC) 132kV Ahoda-Gilli-Gilli DC Transmission Line and 2x60MVA 132/33KV Transformer at Gilli Gilli plus associated 6 number outgoing 33kV feeders and DC 132kV Sapele - Odilli DC Transmission Line and 2x60MVA 132/33KV Transformer at Gilli Gilli plus associated 6 number outgoing 33kV feeders	1,500,000	Not Applicable
9	North East	Bauchi	Eviromental Impact Assessment and Resettlement Action Plan and Payment of Compensation	132 line and associated substations: Maiduguri-Manguno-Marte-Dikwa-Bama,Maiduguri-Bama-Gwoza; Hadeja-Nguru-Gashua-Damaturu; Biu-Miringa-Buni Yadi-Damaturu; Dambua-Chibok-Askira-Uba-Mubi; Mayo Belwa-Jada-Ganye	11,000,000	Not Applicable
				Project Management & Coordination	5,000,000	Not Applicable
				SUBTOTAL	192,500,000	
				CONTINGENCY	17,500,000	
				GRAND TOTAL	210,000,000	

Annex 4.2d6

NORTHERN CORRIDOR TRANSMISSION PROJECT to be financed by AFD

S/N	REGION		SUBSTATION	DESCRIPTION	COST [USD]	STATUS OF FEASIBILITY STUDIES
1	North West	SHIRORO	Kainji - Birnin Kebbi 330kV Double Circuit (DC) Line (310km)		59,000,000	Up-to-date Feasibility Studies is available. Feasibility studies was carried out by AF consult in July 2013
2	North West	SHIRORO	Birnin Kebbi-Sokoto 330kV Double Circuit (DC) Line (130km)	(1) Birnin Kebbi-Sokoto 330kV DC Transmission Line on the existing 132KV Birnin-Kebbi Sokoto ROW and reconducting the existing 132kV Single circuit Birnin-Kebbi Line to double its capacity	22,100,000	Brown field project. Feasibility Studies not Available
3	North West	Kaduna	Katsina-Daura-Gwiwa-Minjibir-Kura (234KM)	Construction of length of 330kV DC Twin line between Katsina-Daura-Gwiwa-Jogana- Kura	39,312,000	Green Field (partly financed through Euro 25 Million from EU)
4	North Central	SHIRORO	Lambata (Mina-Suleja Rd)	Turn in Turn out Mina - Suleja 132KV DC and Construction of 1 x 60MVA 132/33kV Complete substation	3,500,000	Green Field
5	North West	SHIRORO	Fakon Sarki-Argungu	Turn in Turn Out on Brinin Kebbi-Sokoto 132KV Line and Construction of 2 x 60MVA 132/33kV Complete substation	7,000,000	Green Field
6	North West	SHIRORO	Yelwa- Yawuri	Construction of 1 x 60MVA 132/33kV Complete substation and High Voltage Switchgears and Associated Equipment.	1,700,000	Brown Field
7	North Central	SHIRORO	Birnin Gwari	Construction of 1 x 60MVA 132/33kV Complete substation and High Voltage Switchgears and Associated Equipment.	2,000,000	Brown Field (Existing 33KV Substation)
8	North West	Kaduna	Daura-Katsina State	Installation of 2x150MVA 330/132/33KV Double Circuit Substation and with associated 132kV bay extension and Installation of 2x60MVA 132/33kV transformers, 6number outgoing 33kV feeder bays	19,000,000	Green Field
9	North West	Kaduna	Jogana-Kano	Installation of 2x150MVA 330/132/33KV Double Circuit Substation and with associated 132kV bay extension and Installation of 2x60MVA 132/33kV transformers, 6 number outgoing 33kV feeder bays	19,000,000	Green Field
10	North West	SHIRORO	330kV Sokoto Transmission Substation	Installation of 2x150MVA 330/132/33KV Transformers at Sokoto New 330 Double Circuit Substation and with associated 132kV bay extension and Installation of 2x60MVA 132/33kV transformers, 6number outgoing 33kV feeder bays	19,000,000	Semi-Brown Feasibility studies required
11	North Central	SHIRORO	Shiroro –Kaduna (Mando) 330kV Lines 1 & 2 SC Transmission Lines (96km)	Reconstruction and upgrading of 2 Single Circuit 330kV Transmission Lines 1 & 2 from Shiroro PS to Mando (Kaduna) to a 2 Double Circuit, Quad conductor Shiroro-Mando (Kaduna) Transmission lines 1 and 2. The line bay extension at Mando and Shiroro	26,688,000	Semi Brown field project. Feasibility Studies not Available
12	NORTH EAST	BAUCHI	Bauchi 330kV Transmission Substation (2km)	Turn in-out of the existing 330kV SC Jos-Gombe line at Bauchi, and installation of 2x150MVA 330/132/33kV Transformers with associated 132kV bay extension and 2x60MVA 132/33kV transformers, 6number outgoing 33kV feeder bays	19,000,000	Semi green field project. Feasibility Studies not Available
13	North Central	SHIRORO	Rehabilitation work at Kainji TS	Urgent Replacement of Kainji/Jebba 330kV line 1 - 330kV Circuit Breaker at Kainji TS.	148,000	Brown field project. Feasibility Studies not Applicable
14	North Central	SHIRORO	Rehabilitation Work at Jebba TS	Replacing the existing very old(1968) Marilli 80MVA 330/132/13.8kV, 2T1 transformer with 1x150MVA 330/132/33kV plus 1X60MVA, 132/33kV transformer and 3 number 33KV Feeder Control and protection	3,800,000	Brown field project. Feasibility Studies not Applicable
15	North Central	SHIRORO	Rehabilitation Work at Jebba TS	Urgent Replacement of 1nos. Jebba T/S 75MX reactor 2R2 CB - that exploded.	235,000	Brown field project. Feasibility Studies not Applicable
16	North Central	SHIRORO	Rehabilitation Work at Jebba TS	Replacement of 11nos. 330KV Circuit Breakers at Jebba 330kV Switchyard. The existing CB's are obsolete no parts and spares available.	160,000	Brown field project. Feasibility Studies not Applicable
17	North Central	SHIRORO	Rehabilitation Work at Jebba TS	Replacement of 9 spans of Sky wire for 330kV Jebba-Osogbo lines 1 & 2 and 330kV Jebba- Ganmo line	15,000	Brown field project. Feasibility Studies not Applicable
18	North Central	SHIRORO	Rehabilitation work at Jebba Power Station Transmission Switch yard.	Replacement of 8nos. 330KV obsolete Circuit Breakers.. The existing CB's are obsolete no parts and spares available.	1,200,000	Brown field project. Feasibility Studies not Applicable
19	North Central	SHIRORO	Rehabilitation work at Shiroro TS	Replacement of 330KV obsolete hydraulic SF6, Circuit Breakers and associated motorized Isolators at Shiroro TS	150,000	Brown field project. Feasibility Studies not Applicable
20	North Central	SHIRORO	Rehabilitation work at Shiroro TS	Replacement of 28 spans of Sky wire for 330kV 330kV Shiroro- Jebba line 2	15,000	Brown field project. Feasibility Studies not Applicable
21	North Central	SHIRORO	Rehabilitation work at Minna TS	Reinforcement of Minna with 1x60MVA 132/33kV Transformer to relief the existing overloaded 1x30MVA 132/33kV Transformer with complete 132kV Bay extension and additional 3 number 33kV Feeder Control and protection panels. Control room rehabilitation	1,800,000	Brown field project. Feasibility Studies not Applicable
22	North Central	SHIRORO	Rehabilitation work at Minna TS	Replacement of 32 spans of Sky wire for 132kV Minna- Bida line	13,000	Brown field project. Feasibility Studies not Applicable
23	North Central	SHIRORO	Karu -Keffi -Akwanga 132kV Transmission line (103km)	Reconductoring of 132kV SC Karu-Keffi-Akwanga transmission Line	1,035,000	Brown field project. Feasibility Studies not Applicable
24	North Central	SHIRORO	Keffi TS Transmission Line Rehabilitation	Replacement of 36 spans of Sky wire for 132kV Apo-Keffi line	14,000	Brown field project. Feasibility Studies not Applicable
SUBTOTAL					245,885,000	
CONTINGENCY					21,613,000	
TECHNICAL ASSISTANCE AND CAPACITY DEVELOPMENT/PROJECT MANAGEMENT					5,000,000	
GRAND TOTAL					272,498,000	

Transmission Lines - Technical Data

Annex 4.3

Kaduna Region

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Shiroro	Kaduna I	R1M	96	Single Circuit	Bison Twin	2	350mm ²	110	1969		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Shiroro	Kaduna II	R2M	96	Single Circuit	Bison Twin	2	350mm ²	117	1969		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Kaduna	Kano	M6N	250	Single Circuit	Bison Twin	2	350mm ²	481	1976		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Kaduna	Jos	M2S	197	Single Circuit	Bear Twin	2	350mm ²	230	1977		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Kano	Zaria	Kano-Zaria	145	Single Circuit	Wolf, Single	1	150mm ²	436	1968		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Kano	Hadeija	Kano-Hadeija	188	Single Circuit	Hyena, Single	1	100mm ²	470	1980		65.6	0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Kano	Kankia	Kano-Kankia	113.2	Single Circuit	Wolf, Single	1	150mm ²	375	1985		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Kankia	Katsina	Kankia-Katsina	60	Single Circuit	Wolf, Single	1	150mm ²	194	1985		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Katsina	Gazadua	Katsina-Gazaoa	43.75	Single Circuit	Wolf, Single	1	150mm ²	140	1994		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Kano	Dan Agundi	Kunmbotso-Dan Agundi	8.75	Single Circuit	Wolf, Single	1	150mm ²	28	1968		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Kumbotso	Dakata	Kunmbotso-Dakata	18	Double Circuit	Wolf, Single	1	150mm ²	58	1080		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Kaduna	Kaduna town	Kaduna-Kaduna Town	14	Single Circuit	Wolf, Single	1	150mm ²	42	1968		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Kaduna	Zaria	Kaduna-Zaria	72	Single Circuit	HI-TACSR, Single	1	160mm ²	271	1968		161	0.2272	0.2002	5.4886			
Zaria	Funtua	Zaria-Funtua	70	Single Circuit	Wolf, Single	1	150mm ²	558	1975		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Funtua	Gusau	Funtua-Gusau	120	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Gusau	Talata Mafara	Gusau-Talata Mafara	93	Single Circuit	Wolf, Single	1	150mm ²	366	1988		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Tegina	Birnin Gwari	Tegina-Birnin Gwari	70	Single Circuit	Wolf, Single	1	150mm ²	235	1989		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

Osogbo Region

330kV OHL

Node		Numen- clature		Circuit Type (Sc or, Dc)		No. of Conductor per Phase		No. of Towers		Skywire (Status)		+ve Sequence Impedance					
From												Resistance (Ω/km)		Susceptance (μS/km)		Reactance (Ω/km)	
Osogbo	Ayede	H2A	119	Single Circuit	Bison Twin	2	350mm ²	234	1968		777	0.039	0.331	3.49	0.276	0.985	2.49
Jebba	Osogbo	J1H	157	Single Circuit	Bison Twin	2	350mm ²	170	1968		777	0.039	0.331	3.49	0.276	0.985	2.49
Jebba	Osogbo	J2H	157	Single Circuit	Bison Twin	2	350mm ²	184	1976		777	0.039	0.331	3.49	0.276	0.985	2.49
Jebba	Ganmo	J3G	70	Single Circuit	Bison Twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49
Ganmo	Osogbo	H3G	87	Single Circuit	Bison Twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49
Osogbo	Ihobvor	H7V	226	Single Circuit	Bison Twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49

0.335

2

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Ganmo	Ilorin	Ganmo-Ilorin	10.5	Single Circuit	Hyena, single	1	100mm ²	63				0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Ganmo	Offa	Ganmo-Offa	44.73	Double Circuit		1	100mm ²	267									
Offa	Osogbo	Offa-Osogbo	47.6	Single Circuit	Hyena, single	1	100mm ²	284			65.6	0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Osogbo	Iwo road	Osogbo-Iwo road	80	Single Circuit	Hyena, single	1	100mm ²	478			65.6	0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Iwo road	Isheyin	Iwo-Isheyin	91	Single Circuit	Wolf, Single	1	150mm ²	543			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Iwo road	Ibadan North	Iwo-Ibadan North	36	Single Circuit	Wolf, Single	1	150mm ²	215			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ibadan North	Aiyede	Ibadan-Aiyede	14	Single Circuit	Wolf, Single	1	150mm ²	84			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Aiyede	Jericho road	Ayede-Jericho	6	Single Circuit	Wolf, Single	1	150mm ²	36			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Osogbo	Ilesha	Osogbo-Ilesha	17	Single Circuit	Wolf, Single	1	150mm ²	101			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ilesha	Ife	Ilesha-Ife	19	Single Circuit	Wolf, Single	1	150mm ²	113			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ife	Ondo	Ife-Ondo	58	Single Circuit	Wolf, Single	1	150mm ²	346			90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Osogbo	Akure	Osogbo-Akure	200	Single Circuit	Hyena, single	1	100mm ²	1194			65.6	0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Akure	Ado Ekiti	Akure-Ado Ekiti	35	Double Circuit	Panther, Double	1	250mm ²	209			192.5	0.1363	0.3920	4.0312	0.3150	1.3490	1.3511

Transmission Lines - Technical Data

Annex 4.3

Lagos Region

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Benin	Egbin	B6N	218	Single Circuit	Bison Twin	2	350mm ²		1978		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Egbin	Ikeja West	N6W	62	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Benin	Omotosho	B5M	120	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Omotosho	Ikeja West	M5W & N6K	160	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Egbin	Oke Aro	N7K & N8K	55.8	Double Circuit	Bison Twin	2	350mm ²	124	1980		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Oke Aro	Ikeja West	K7W K8W	27.9	Double Circuit	Bison Twin	2	350mm ²		2012		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Egbin	Aja	N3J&N4J	15	Double Circuit	Bison Twin	2	350mm ²	32	1984		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Ikeja West	Akangba	W3L&W4 L	17.34	Single Circuit	Bison Twin	2	350mm ²	36	1968		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Osogbo	Ikeja West	H1W	256.67	Single Circuit	Bison Twin	2	350mm ²	552	1975		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Ikeja West	Olorunsogo	R1W	77	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Olorunsogo	Ayede	R2A	60	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Ayede	Osogbo	H2A	119	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Aja	Alagbon		26	Double Circuit	Bear, Double	2	250mm ²	69	1985		242	0.0666	0.2728	4.2237	0.3034	1.1932	2.3160
Ikeja West	Oworonshiki		49	Double Circuit	Bear, single	1	250mm ²	107	1982		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Oworonshiki	Akoka		4	Double Circuit	Bear, single	1	250mm ²	11	1982		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Akoka	Alagbon		12.7	Double Circuit	Bear, single	1	250mm ²	38	1982		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Akangba	Amuwo		5	Double Circuit	Bear, single	1	250mm ²	28	1977		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Amuwo	Ojo		12.5	Double Circuit	Bear, single	1	250mm ²	46	1977		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Akangba	Apapa Road		8.3	Double Circuit	Wolf, Twin	2	150mm ²	24	1968		180	0.1113	0.2809	4.0947	0.3481	1.2013	2.2723
Ijora	Akangba		8.3	Double Circuit	Wolf, Twin	2	150mm ²	18	1968		180	0.1113	0.2809	4.0947	0.3481	1.2013	2.2723
Ayede	Shagamu		53.91	Single Circuit	Wolf, Single	1	150mm ²	355	1958		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Shagamu	Ijebu Ode		40.32	Single Circuit	Bear, Single	1	250mm ²	114	1982		121	0.1328	0.3895	2.9432	0.2504	1.0133	1.6979
Ogba	Papalanto		44.28	Single Circuit	Wolf, Single	1	150mm ²	125	1966		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

Lagos Region

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Ikeja West	Agbara		32.04	Double Circuit	Bear, Single	1	250mm ²	89	1988		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ikeja West	Alimosho		18.36	Double Circuit	Bear, Single	1	250mm ²	51	1976		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ikeja West	Ejigbo		13.32	Double Circuit	Bear, Single	1	250mm ²	34	1975		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ikeja West	Otta		11.88	Double Circuit	Bear, Single	1	250mm ²	34	1989		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Otta	Papalanto		11.88	Double Circuit	Bear, Single	1	250mm ²	34	1989		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Egbin GS	Ikorodu		19.96	Double Circuit	Bear, Single	1	250mm ²	55	1987		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ikorodu	Egbin		19.5	Double Circuit	Bear, Single	1	250mm ²	79	1995		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ikorodu	Shagamu		35.16	Single, Circuit	Wolf, Single	1	250mm ²	192	1968		180	0.2220	0.3943	2.7878	0.4625	1.3128	1.5533
Agbara	Ojo		16.37	Single Circuit	Bear, Single	1	250mm ²	62	1989		121	0.1328	0.3895	2.9432	0.2504	1.0133	1.6979
Akangba	Itire		3	Double Circuit	Bear, Single	1	250mm ²	30	1975		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Itire	Ejigbo		8	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ejigbo	Ikeja West		13	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Akangba	Isolo		9	Double Circuit	Wolf, Single	1	150mm ²	34	1968		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Ikeja West	Ilupeju,		17	Double Circuit	Bear, single	1	250mm ²	97	1996 (1-86)		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ilupeju	Maryland		3	Double Circuit	Wolf, single	1	150mm ²				180	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Maryland	Ikorodu		20	Double Circuit	Bear, single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Papalanto	Abeokuta		35	Single Circuit	Bear, Single	1	250mm ²	101	1980		121	0.1328	0.3895	2.9432	0.2504	1.0133	1.6979
Alimosho	Ogba		19	Double Circuit	Bear, Single	1	250mm ²	65	1976		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Ayede	Jericho		2	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ogba	Alausa		7.5	Double Circuit	Bear, Single	1	250mm ²	30	1999		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Osogbo	Ilorin		78.46	Single Circuit	Wolf, Single	1	150mm ²	284	1976		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Osogbo	Omuaran		47.53	Single Circuit	Wolf, Single	1	150mm ²	164	1977		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Osogbo	Ayede		37.15	Single Circuit	Bear, Single	1	250mm ²	61	1977		121	0.1328	0.4019	2.8523	0.3746	1.2824	1.7896
Osogbo	Ife		33.13	Single Circuit	Wolf, Single	1	150mm ²	113	1981		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ife	Ondo		58.05	Single Circuit	Wolf, Single	1	150mm ²	198	1984		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Osogbo	Ilesa		16.4	Single Circuit	Wolf, Single	1	150mm ²	64	1999		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Osogbo	Akure		95	Single Circuit	Wolf, Single	1	150mm ²	366	1999		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

Shiroro Region

330kV Circuit

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conduct or per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Shiroro	Kaduna	R1M	96	Single Circuit	Bison Twin	2	350mm ²	225	1969		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Shiroro	Kaduna	R2M	96	Single Circuit	Bison Twin	2	350mm ²	225	1969		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Jebba	Shiroro	J3R	230.43	Single Circuit	Bear Twin (Lion)	2	250mm ²	557	1969		240	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Jebba	Shiroro	J7R	230.43	Single Circuit	Bear Twin (Lion)	2	250mm ²	581	1969		240	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Kainji GS	Jebba	K2J &	81	Single Circuit	Bear Twin (Lion)	2	250mm ²	183	1969		240	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Kainji GS	Jebba	Kainji – Jebba II	81	Single Circuit	Bear Twin (Lion)	2	250mm ²	189	1979		240	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Jebba GS	Jebba TS	B8J	8	Double Circuit	Bear Twin (Lion)	2	250mm ²	12	1984		480	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Jebba GS	Jebba TS	B9J	8	Double Circuit	Bear Twin (Lion)	2	250mm ²	12	1984		480	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Jebba	Osogbo	J1H	157	Single Circuit	Bison Twin	2	350mm ²	182	1968		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Jebba	Osogbo	J2H	157	Single Circuit	Bison Twin	2	350mm ²	189	1976		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Jebba	Ganmo	J3G	70	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Oshogbo	Ganmo	H3G	83.81	Single Circuit	Bison Twin	2	350mm ²	182	1984		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Kainji	Birnin Kebbi	K3R	310	Single Circuit	Bear Twin (Lion)	2	250mm ²	734	1976		240	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Shiroro	Abuja (Katampe)	R4B	144	Single Circuit	Bison Twin	2	350mm ²	345	2003		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Shiroro	Gwagwalada	R5G	144	Single Circuit	Bison Twin	2	350mm ²	345			777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Gwagwalada	Katampe	G5B	60	Single Circuit	Bison Twin	2	350mm ²				777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Gwagwalada	Eastmain		42	Double Circuit	Bison Twin	2	350mm ²	133	2013		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773

132kV Circuit

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conduct or per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Shiroro	Minna	Shiroro- Minna	68	Double Circuit	Wolf, Single	1	150mm ²	187	1981		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Minna	Suleja	Minna- Suleja	99	Double Circuit	Wolf, Single	1	150mm ²	283	1981		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866

Transmission Lines - Technical Data

Annex 4.3

Shiroro Region

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conduct or per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Suleja	Katampe	Suleja- Abuja	55	Double Circuit	Wolf, Single	1	150mm ²	158	1981		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Karu	Keffi	Abuja- Keffi	67	Single Circuit	Wolf, Single	1	150mm ²	156	1983		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Tegina	Birnin gwari	Tegina- Birnin Gwari	80	Single Circuit	Wolf, Single	1	150mm ³	236	1990		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Keffi	Akwanga	Keffi- Akwanga	62.5	Single Circuit	Wolf, Single	1	150mm ²	178	1983		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Akwanga	Lafia	Akwanga- Lafia	60	Double Circuit	Bear, Double	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Shiroro	Tegina	Shiroro- Tegina	90	Single Circuit	Wolf, Single	1	150mm ²	272	1990		180	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Birnin Kebbi	Niamey	Birnin Kebbi- Niamey	250	Single Circuit	Wolf, Single	1	150mm ²	159	1976		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Birnin Kebbi	Sokoto	Birnin Kebbi- Sokoto	130	Single Circuit	Wolf, Single	1	150mm ²	405	1976		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Sokoto	Talata Mafara	Sokoto- Talata Mafara	142	Single Circuit	Wolf, Single	1	150mm ²	441	1990		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Minna	Bida	Minna- Bida	78.38	Single Circuit	Wolf, Single	1	150mm ²	288	1990		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Tegina	Kontagora	Tegina Kotangora	84.44	Single Circuit	Wolf, Single	1	150mm ²	266	1990		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Eastmain	Kukwaba	East- Kukwaba	24	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Katampe	Kukwaba	Katampe- Kukwaba	8.9	Double Circuit	Cu/XLPE, Single	1	400mm ²		2012		141	0.0470	0.1413	50.272	0.1410	0.4239	16.74686
Kukwaba	Apo	Kukwaba- Apo	24	Double Circuit	Bear, Single	1	250mm ²	93	2012		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Apo	Katampe	Apo- Katampe	25	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Katampe	Central Area	Katampe- Central Area	15	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Karu	Apo	Karu-Apo	10	Single Circuit	Bear, Single	1	250mm ²				121	0.1328	0.3895	2.9432	0.2504	1.0133	1.6979
Eastmain	Kukwaba	Eastmain- Kukwaba	24	Double Circuit	Bear, Single	1	250mm ²	112	2013		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266

Transmission Lines - Technical Data

Annex 4.3

Benin Region

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Benin	Onitsha	B1T & B2T	137	Double Circuit	Bison Twin	2	350mm ²	155	1964		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Benin	Omotosho Phase I	B5M	120	Single Circuit	Bison Twin	2	350mm ²				777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Omotosho Phase I	Ikeja West	M5W	160	Single Circuit	Bison Twin	2	350mm ²		2014		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Benin	Egbin G.S	B6N	218	Single Circuit	Bison Twin	2	350mm ²				777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Osogbo	Ihovbor NIPP	H7V	251	Single Circuit	Bison Twin	2	350mm ²				777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Ihovbor NIPP	Benin	V7B	17.7	Single Circuit	Bison Twin	2	350mm ²	51	2013		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Benin	Ajaokuta	B11J & B12J	205.15	Double Circuit	Bison Twin	2	350mm ²	446	1981		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Sapele	Aladja	S4G	61.25	Single Circuit	Bison Twin	2	350mm ²	145	1983		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Delta GS	Benin	G3B	52.65	Single Circuit	Bison Twin	2	350mm ²	118	1985		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Delta GS	Aladja	G1W	29.5	Double Circuit	Bison Twin	2	350mm ²	27	1983		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Sapele	Benin	S3B & S4B	52.65	Double Circuit	Bison Twin	2	350mm ²	118	1983		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Sapele	Benin	S5B	52.65	Double Circuit	Bison Twin	2	350mm ²	118	1983		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Lokoja	Gwagwalada	L6G	160	Single Circuit	Bison Twin	2	350mm ²		2013		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Ajaokuta	Geregu	R1J	80	Single Circuit	Bison Twin	2	350mm ²		2013		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Ajaokuta	Geregu	R2J	80	Single Circuit	Bison Twin	2	350mm ²		2013		777	0.039	0.3310	3.4900	0.2760	0.9850	2.4900
Ajaokuta	Lokoja	J1L&J2L	38	Double Circuit	Bison Twin	2	350mm ²				1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm2)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Delta GS	Benin	Delta-Benin	102.41	Single circuit	Bear, Single	1	250mm ²	331	Built 1966; Refurbishe d 2001		121	0.1328	0.3895	2.9432	0.2504	1.0133	1.6979
Delta GS	Benin	Delta-Benin	102.41	Double Circuit	Bear, Single	1	250mm ²	331	Built 1966; Refurbishe d 2001		242	0.1330	0.3897	2.9523	0.3698	1.3101	1.8392
Benin	Irrua	Benin-Irrua	81	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Irrua	Ukpilla	Irrua-Ukpilla	43	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

Benin Region

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Ukpilla	Okene	Ukpilla- Okene	33	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Okene	Ajaokuta	Okene- Ajaokuta	60	Single Circuit	Wolf, Single	1	150mm ²	172	1973		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Okene	Itakpe	Tee-off/Itakpe	41.7	Single Circuit	Wolf, Single	1	150mm ²	50	1992		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Delta II	Effurun	Delta-Efurun	32.04	Single circuit	Wolf, single	1	150mm ²	89	1988		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ajaokuta	Itakpe	Ajaokuta- Itakpe	45	Single Circuit	Wolf, Single	1	150mm ²	19	1992		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ajaokuta	Ajaokuta Steel Works	Ajaokuta- Steel Works	3.9	Single Circuit	Wolf, Single	1	150mm ²	13	1992		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ajaokuta	Ajaokuta Town	ajaokuta- Ajaokuta Town	10	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

Port Harcourt Region

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductors per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Afam	Alaoji	F1A & F2A	28.8	Double Circuit	Bison Twin	2	350mm ²	65	1980		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Onitsha	Alaoji	T4A	138	Single Circuit	Bison Twin	2	350mm ²	306	1982		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Calabar PS	Calabar SS		17.7	Double Circuit	Bison Twin	2	350mm ²	43	2013		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductors per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Alaoji	Aba	Alaoji-Aba	7.7	Double Circuit	Wolf, Single	1	150mm ²	23	1960		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Afam GS	Alaoji	Afam-Alaoji	28.7	Double Circuit	HI-TACSR, Single	1	160mm ²	83	1960		322	0.2681	0.2002	5.4886			
Afam GS	Port-Harcourt Main	Afam-Port Harcourt Main	37.8	Double Circuit	HI-TACSR, Single	1	160mm ²	109	1960		322	0.2681	0.2002	5.4886			
Port-Harcourt Main	Port-Harcourt Town	PH Mains-PH Town	3	Double Circuit	Wolf, Single	1	150mm ²				180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Trans Amadi	Ahoada	Trans Amadi-Ahoada		Double Circuit		1											
Aba	Itu	Aba-Itu	85.4	Single Circuit	Wolf, Single	1	150mm ²	245	1986		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Uyo	Eket	Itu-Eket	74.55	Single Circuit	ZTACIR, Single	1	189.1mm ²	214	2012		188	0.2898	0.3168	3.4688			
Uyo	Itu	Uyo-Itu	18	Single Circuit	ZTACIR, Single	1	189.1mm ²		2012		188	0.2898	0.3168	3.4688			
Itu	Calabar	Itu-Calabar	47.36	Single Circuit	Wolf, Single	1	150mm ²	156	1986		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Alaoji	Owerri	Alaoji-Owerri	60	Double Circuit	Wolf, Single	1	150mm ²	175	1983		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Owerri	Ahoada	Owerri-Ahoada	73	Double Circuit	Bear, Single	1	250mm ²	219	2005		242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Aba	Alaoji	Aba-Alaoji	15	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Alaoji	Umuahia	Alaoji-Umuahia	50	Double Circuit	Bear, Single	1	250mm ²				242	0.1328	0.4000	2.8750	0.3806	1.2824	1.9266
Alaoji	Owerri	Alaoji-Owerri	10	Double Circuit	Panther, Single	1	250mm ²				380	0.1363	0.3920	4.0312	0.3150	1.3490	1.35106
Ahoada	Yenagoa	Ahoada-Yenagoa	40	Double, Circuit	Panther, Single	1	250mm ²				380	0.1363	0.3920	4.0312	0.3150	1.3490	1.35106
IBOM G.S	Eket	Ibom-Eket	45	Double, Circuit	Poplar, single	1	200mm ²				136.7	0.1800	0.2060	5.3348			

Transmission Lines - Technical Data

Annex 4.3

Enugu Region

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Onitsha	New Haven	T3H	96	Single Circuit	Bison Twin	2	350mm ²	237	1982		777	0.0390	0.3310	3.4900	0.2760	0.9850	2.4900
Okpai	Onitsha	K1T & K2T	56	Double Circuit	Bison, Twin	2	350mm ²	130	2005		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773
Ugwuaji	New Haven		7	Double Circuit	Bison, Twin	2	350mm ²	17	2014		1554	0.0394	0.3030	3.8120	0.2614	1.0019	2.2773

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Onitsha	Oji River	Onitsha-Oji River	63.85	Single Circuit	Wolf, Single	1	150mm ²	182	1966		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Onitsha	Awka	Onitsha-Awka	30	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Awka	Oji River	Awka-Oji River	33	Single Circuit	Wolf, Single	1	150mm ²				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Onitsha	GCM	Onitsha-GCM	8.05	Single Circuit	Wolf, Single	1	150mm ²	24	1974		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
New Haven	Oji River	New Haven-Oji River	44.1	Single Circuit	Wolf, Single	1	150mm ²	126	Built 1976;Ref		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
New Haven	Oturkpo	New Haven-Oturkpo	160.3	Single Circuit	Wolf, Single	1	150mm ²	458	1978		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Oturkpo	Aliade	Oturkpo-Aliade	39	Single Circuit	Wolf, Single	1	150mm ²	121	2001		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Aliade	Markudi	Aliade-Makurdi	50	Single Circuit	Bear, single	1	250mm ²				121						
Aliade	Yandev	Aliade-Yandev	60	Single Circuit	Wolf, Single	1	150mm ²	208	1978		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
New Haven	Nkalagu	New Haven-Nkalagu	38.85	Double Circuit	Wolf, Single	1	150mm ²	111	1976		180	0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Nkalagu	Abakaliki	Nkalagu-Abakaliki	54.25	Single Circuit	Wolf, Single	1	150mm ²	155	1976		90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

Bauchi Region

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Jos	Gombe	SIE	265	Single Circuit	Bison, twin	2	350mm ²	619	1981		777	0.039	0.331	3.49	0.276	0.985	2.49
Kaduna	Jos	M2S	197	Single Circuit	Bison, twin	2	350mm ²	220	1977		777	0.039	0.331	3.49	0.276	0.985	2.49
Gombe	Damaturu	E1D	160	Single Circuit	Bison, twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49
Damaturu	Maiduguri		260	Single Circuit	Bison, twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49
Gombe	Yola	E1Y	240	Single Circuit	Bison, twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49
Yola	Jalingo		140	Single Circuit	Bison, twin	2	350mm ²				777	0.039	0.331	3.49	0.276	0.985	2.49
Operated as 132 kV																	

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	Conductor Cross-Section (mm ²)	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To											Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Jos	Bauchi, Gombe	Jos-Bauchi-Gombe	320	Single Circuit	Wolf, Single	1	150mm ²	941	1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Jos	Bauchi	Jos-Bauchi	118	Single Circuit	Wolf, Single	1	150mm ²		1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Bauchi	Gombe	Bauchi-Gombe	146	Single Circuit	Wolf, Single	1	150mm ²		1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Gombe	Dadin Kowa	Gombe-Dadin Kowa	49	Single Circuit	Wolf, Single	1	150mm ²	154	1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Dadin Kowa	Biu	Dadin Kowa-Biu		Single Circuit		1	150mm ²					0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Biu	Damboa	Biu-Damboa	142	Single Circuit	Hyena, Single	1	100mm ²	878	1977			0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Damboa	Maiduguri	Damboa-Maiduguri	71	Single Circuit	Hyena, Single	1	100mm ²		1977			0.2712	0.4640	0.0701	0.5620	1.6020	0.0480
Gombe	Ashaka	Gombe-Ashaka	84	Single Circuit	Wolf, Single	1	150mm ²		1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Ashaka	Potiskum	Ashaka-Potiskum	94	Single Circuit	Wolf, Single	1	150mm ²		1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Gombe	Ashaka	Ashaka-(Tee-off)	11	Single Circuit	Wolf, Single	1	150mm ²	33	1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Gombe	Savanah, Yola	Gombe-Savanah-Yola	258.65	Single Circuit	Wolf, Single	1	150mm ²	733	1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Gombe	Savannah	Gombe-Savanah	92	Single Circuit	Hyena, Single	1	100mm ²		1977			0.2712	0.4640	0.0002	0.5620	1.6020	0.0002
Savannah	Numan	Savannah-Numan	85	Single Circuit	Hyena, Single	1	100mm ²		1977			0.2712	0.4640	0.0002	0.5620	1.6020	0.0002
Numan	Yola	Numan-Yola	50	Single Circuit	Wolf, Single	1	150mm ²		1977			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435
Gombe	Savanah	Savanah-(Tee-off)	3	Single Circuit	Dog, Single	1	150mm ²	8	1977								
Jos	Mekeri	Jos-Makeri	28.5	Double Circuit	Wolf, Single	1	150mm ²	98	1984			0.2223	0.4058	2.8285	0.4591	1.3263	1.7866
Makeri	Pankshin	Makeri-Pankshin	109.5	Single Circuit	Wolf, Single	1	150mm ²	365	1984			0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Transmission Lines - Technical Data

Annex 4.3

International Lines

330kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To										Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Ikeja West	Sakete			Single, Circuit	Bison, Twin	2				777						

132kV OHL

Node		Numen- clature	Line Length (km)	Circuit Type (Sc or, Dc)	Conductor Type	No. of Conductor per Phase	No. of Towers	Year Built	Skywire (Status)	Rating (MVA)	+ve Sequence Impedance			Zero Sequence Impedance		
From	To										Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)	Resistance (Ω/km)	Reactance (Ω/km)	Susceptance (μS/km)
Birnin-Kebbi	Niamey	Birnin Kebbi-Niamey	264	Single, Circuit	Areo Z, Single	1				90						
Katsina	Gazuoa	Katsina-Gazuoa	72	Single, Circuit	Wolf, Single	1				90	0.2220	0.4181	2.7368	0.4639	1.2986	1.7435

Annex 4.4

8328P01

FICHTNER

Transformer Data

Annex 4.4

STATION	RATINGS(MVA)	Vrated(kV)	COOLING	VECTOR GROUP	NOMENCL.	MAKE	TYPE	POS. SEQ. IMPEDANCE (%)			ZERO SEQ. IMPEDANCE			Estimated R & X Value for Positive Sequence Impedance (% on Machine Base)		Estimated R & X Value for Zero Sequence Impedance (% on Machine Base)		LOSSES (kW)		Imag (prr)	NO. OF TAPS	NOM. TAP	REG. ABOVE	REG. BELOW	REG. STEP	COMPENSATING WINDING		EARTHING
								Z12	Z13	Z23	Z1N	Z2N	Z3N	R	X	R	X	Pcu	Pfe			POSITION	NOM. (%)	NOM. (%)	(%)			
KUMBOTSO	150	330/132/33			T4A	MBH POWER																						
	30	132/33			T1	TOSHIBA																						
	30/40	132/33			T2	ABB																						
	30	132/33			T3	ABB																						
	60	132/33			T4																							
KATAMPE	150	330/132/33	ONAF/ONAN	YNa0d1	T1	ABB	CORE	11.6	45.4	33.4	37	34.8	9.6								21	6	346.5	280.5	330		NO	GT
	150	330/132/33	ONAF/ONAN	YNa0d1	T2	ABB	CORE	11.6	45.4	33.4	37	34.88	9.6								21	6	345.5	280.5	330		NO	GT
	60	132/34.5	ONAN/ONAF1/ONAF2	YNd11	T1	SIEMENS		14.7			12.789			0.648	14.686	0.564	12.777				17	5	138.6	118.8	132		NO	GT
	60	132/33	ONAN/ONAF	YNd11	T2	ABB		10.1			8.787			0.445	10.09	0.387	8.778				17	9	145.2	112.2	132		NO	GT
	150	330/132/33	ONAN/ONAF1/ONAF2	YNa0d11	T3	AREVA		11.29			9.8223			0.372	11.284	0.323	9.817	53.3	368		21	6	345.5	280.5	330		NO	GT
NEW HAVEN	150	330/132/33	ONAN/ONAF	Yd11	T1A	MITSUBISHI	SHELL	11.32	11.45	12.01	10.57	10.32	9.42								17	5	-1.25	1.25	±1.25			GT
	30	132/33			TR1	LEE CHUM																						
	30	132/33			TR2	LEE CHUM																						
	60	132/33			TR3	LEE CHUM																						
	60	132/33			TR4	EMCO																						
ONITSHA	150	330/132/33	ONAN/ONAF	Yd11	T2A	MITSUBISHI	SHELL	11.32	11.45	12.01	10.57	10.32	9.42								17	5	-1.25	1.25	±1.25			GT
	90	330/132/13.8	ON/OFB	YyOYd1	T1A	MITSUBISHI	CORE	11.35	5.92	2.2	9.8745	5.1504	1.914								17	5	-1.25	1.25	±1.25			GT
	150	330/132/33	ONAN/ONAF	YNad1	T3	SIEMENS		12.18	49.97	35.16	10.5966	43.4739	30.5892								17	5	5	-15	1.18			
	150	330/132/33	ONAN/ONAF	YNa0d11	T4	AVERA		11.93	8.88	4.16	9.96	7.7256	3.6192								17	5	5	-15	1.18			
	30	132/33			MOB	MITSUBISHI																						
	15	132/11			MOB	MITSUBISHI																						
	60	132/33			GCM	LEEC																						
	60	132/33			TR11	HYUNDAI																						
	15	132/11			TR12	TRAFO-UNION																						
	60	132/33			TR13	PAUWEL																						
	40	132/33			TR14	CG ELECT.SYSTEM																						
OSHOGBO	90	330/132/13.8	OB	YyoYd1	T2A	ASGEN	CORE	12.2	6.7	2.26	10.614	5.829	1.9662								17	5	-1.25	1.25	±1.25			GT
	150	330/132/33	ONAN/ONAF1/ONAF2		4T1	TBEA		10.31	47.84	33.81	8.9697	41.6208	29.4147								17	5	-1.25	1.25	±1.18			
	150	330/132/33	ONAN/ONAF1/ONAF2	YNa0d11	4T6	AREVA		11.97	26.5	12.45	10.4139	23.055	10.8315								17	5	-1.25	1.25	±1.18			
	60	132/33	ONAN/ONAF	YNd11	4T3	T & R															17							
	60	132/33	ONAN/ONAF	YNd11	4T4	T&R															17							
	30	132/33	ONAN/ONAF	YNd11	4T5	MITSUBISHI															17							
SHIRORO	90	330/132/13.8	ON/OFB	VyoYd1	4T2	MITSUBISHI	SHELL	11.4	5.92	N/A	9.918	5.1504	#WERT!								17	9a	5	16	1			GT
	150	330/132/33	ONAF/ONAN	YNY0d11	T1	MITSUBISHI	SHELL	11.24	9.38	4.45	9.7788	8.1606	3.8715								17	5	5	15	1.25			DIRECT
	150	330/132/11			T1	EMCO																						
	30	132/33			T1	OEL																						
MINNA	150	330/132/33	ONAF/ONAN	YNY0d11	T2	MITSUBISHI	SHELL	11.24	9.38	4.45	9.7788	8.1606	3.8715								17	5	5	15	1.25			DIRECT
	60	132/33			T1	LEEEC																						
	30	132/33	ONAF(ONAN)	YNd1	T2	TRAFO-UNION		10.3(7.2)			8.961(6.26)			0.57	10.284	0.496	8.947				17	5	138.6	112.2	132	NO		GT
TEGINA	60	132/33	ONAN/ONAF	YNd11	T7	TRANF INDIA															17	5	138.6	112.2	132	NO		GT
	40	132/33	ONAN/ONAF	YNd11	T1	TELK		9.63			8.3781			0.485	9.618	0.422	8.367				17	5	138.6	112.2	132	NO		GT
APO T.S	45/30/20	132/33/11	ONAF/ONAN	YNd1;yn0	T1	TRAFO-UNION		9.74/6.49	14.4/9.60	8.88/4.59											17	5	138.6	112.2	132	NO		GT
	45/30/20	13																										

Transformer Data

Annex 4.4

STATION	RATINGS(MVA)	Vrated(kV)	COOLING	VECTOR GROUP	NOMENCL	MAKE	TYPE	POS. SEQ. IMPEDANCE (%)			ZERO SEQ. IMPEDANCE			Estimated R & X Value for Positive Sequence Impedance (% on Machine Base)		Estimated R & X Value for Zero Sequence Impedance (% on Machine Base)		LOSSES (kW)		Imag (prr)	NO. OF TAPS	NOM. TAP	REG. ABOVE	REG. BELOW	REG. STEP	COMPENSATING WINDING		EARTHING
								Z12	Z13	Z23	Z1N	Z2N	Z3N	R	X	R	X	Pcu	Pfe			POSITION	NOM. (%)	NOM. (%)	(%)			
SOKOTO	`30/40	132/33	ONAN/ONAF		T1	TOSHIBA		10.74			9.3438			0.541	10.726	0.47	9.332											
	40	132/33	ONAN/ONAF	YNd11	T2	TOSHIBA		8.06/10.74			9.3438			0.541	10.726	0.47	9.332				13	4	138.6	112.2	132	NO		GT
	30	132/33	ONAN	Yd11	T3	ELTA		10.43			9.0741			0.577	10.414	0.502	9.06				17	5	138.6	112.2	132	NO		GT
MANDO T. S	60	330/132			T1A	MARELLI																						
	150	330/132			T4A	CROMPTON GREEVES																						
	90	330/132			T2A	ASGEN																						
	150	330/132			T3	MITSUBISHI																						
	150	330/132			T5	AREVA																						
	60	132/33			T1	ABB																						
	60	132/33			T2	PAUWELS																						
	60	132/33			T3	LEEC																						
ZARIA	60	132/33			T3	XFORMER &																						
	40	132/33			T4(MOB)	PAUWELS																						
FUNTUA	7.5	132/33			T1	BRUSH																						
	7.5	132/11			T2	ASEA																						
	30	132/33			T3	PAUWELS																						
GUSAU	30	132/33			T1A	CENEMES																						
	30	132/33			T1B	HAWKER SIDENY																						
T-MAFARA	30	132/33			T1	ABB TECH																						
DAN-AGUNDI	60	132/33			T1	PAUWEL																						
	60	132/33			T3	ABBPOWERTECK																						
DAKATA	60	132/33			T1	ITAL-TRAFO																						
	60	132/33			T2	PAUWEL-TRAFO																						
	30	132/33			T3	PAUWEL-TRAFO																						
KANKIA	30	132/33			T1	PAUWELS																						
	30	132/33			T2	PAUWELS																						
KATSINA	60	132/33			T1	ELKA																						
	30	132/33			T2	PAUWELS																						
	30	132/33			T3	PAUWELS																						
HADEJIA	7.5	132/33			T1	PAUWELS																						
	15	132/33			T2	FERRANTI																						
DUTSE	`30/40	132/33			T1	ABB																						
	`30/40	132/33			T2	ABB																						
AZARE	`30/40	132/33			T1	ABB																						
	`30/40	132/33			T2	ABB																						
K/DANGORA	40	132/33			T1	CHINT																						
TAMBURAWA	`30/40	132/33			T2	TRAFO-UNION																						
TAMBURAWA	`30/40	132/33			T1	TRAFO-UNION																						
BAUCHI	40	132/33			T3	TELK																						
	`30/40	132/33			T4	ABB																						
MAKERI	`60	132/33			T1	ABB																						
	`60	132/33			T2	ABB																						
KAFANCHAN	40	132/33			MOB	IRAN TRANSFO																						
POTISKUM	30	132/33			T1	GEM																						
	30	132/33			T2	TOSHIBA																						
BIU	15	132/33			T1	FERRANTI																						
	`30/40	132/33			T2	TOSHIBA																						
MAIDUGURI	45	132/33			T1	HYUNDAI																						
	45	132/33			T2	HYUNDAI																						
	15	132/33			T3	FERRANTI																						
DAMBOA	30	132/33			T1	TOSHIBA																						
YOLA	150	330/132/33	ONAN/ONAF	Yd11	T1A	SIEMENS		12.19	9.19	4.45	10.6053	7.9953	3.8715								17	5	-15	5	1.176471			
	150	330/132/33	ONAN/ONAF	Yd11	T2A	SIEMENS		12.19	9.19	4.45	10.6053	7.9953	3.8715								17	5	-15	5	1.176471			
	30	132/33			T1-A	LEECHUM																						
	30	132/33			T1-B	LEECHUM																						
SAVANNAH	15	132/33			T1	G.E.M.																						
JALINGO	`30/40	132/33			T1A	STEN																						
	`30/40	132/33			T1B	STEN																						
ILUPEJU	15	132/11			T1	OEL																						
	`45/30/15	132/33/11																										

Transformer Data

Annex 4.4

STATION	RATINGS(MVA)	Vrated(kV)	COOLING	VECTOR GROUP	NOMENCL.	MAKE	TYPE	POS. SEQ. IMPEDANCE (%)			ZERO SEQ. IMPEDANCE			Estimated R & X Value for Positive Sequence Impedance (% on Machine Base)		Estimated R & X Value for Zero Sequence Impedance (% on Machine Base)		LOSSES (kW)		Imag (prr)	NO. OF TAPS	NOM. TAP	REG. ABOVE	REG. BELOW	REG. STEP	COMPENSATING WINDING		EARTHING
								Z12	Z13	Z23	Z1N	Z2N	Z3N	R	X	R	X	Pcu	Pfe			POSITION	NOM. (%)	NOM. (%)	(%)			
ITIRE	30	132/33			T1	MITSUBISHI																						
	60	132/33			T2																							
	40	132/33			T3	ABB POWER TECH																						
MARYLAND	`22.5/30	132/33	ONAN/ONAF	YNd11	T1	MITSUBISHI	CORE														17	10	5	-15	1.176471			
	60	132/33			T2	CHANGODAR																						
	30	132/33	ONAN/ONAF	YNd11	T3	MITSUBISHI	CORE														17	6	10	-6	0.953654			
IKORODU	60	132/33	ONAN/ONAF	YNd11	T1	ABB POWER TECH	CORE														17	9	10	9	1.149733			
	60	132/33	ONAN/ONAF	YNd11	T2	ABB POWER TECH	CORE														17	9	10	9	1.149733			
	100	132/33	ONAN/ONAF	YNd11	T3	LEECC	CORE	10.17			8.8479			0.38	10.163	0.331	8.841				17	5	5	-15	1.176471			
SHAGAMU	15	132/33	ONAN	Yd11	T1	FABRYKA	CORE							0.56	10.14	0.5	9.1				17							
	15	132/33	ONAN	Yd11	T2	FABRYKA	CORE							0.57	10.2	0.5	9.1				17							
OWORONSHOKI	60	132/33	ONAN/ONAF/ONAF2	YNd11	T1	CROMPTON	CORE	8.84			7.6908			0.39	8.837	0.339	7.683				17	5	5	-15	1.18			
	60	132/33	ONAN/ONAF/ONAF2	YNd11	T2	CROMPTON	CORE	8.84			7.6908			0.39	8.837	0.339	7.683				17	5	5	-15	1.18			
ALAGBON	66	132/33		YNd11	T1	ELTA		12.47	12.15	11.21	10.8489	10.5705	9.7527															
	66	132/33		YNd11	T2	ELTA		10.14	9.98	9.61	8.8218	8.6826	8.3607															
APAPA-ROAD	`45/30/15	132/33		YNd11yn0	T1	HYUNDAI		3.01	9.3	4.8	2.6187	8.091	4.176															
	`45/30/15	132/33		YNd11	T2	ITAL TRAFO		18.72	12.53	5.4	16.2864	10.9	4.698															
AKOKA	`45/30/15	132/33		YNd11yn0	T1	TOSHIBA																						
	40	132/33		YNd11	T3	TOSHIBA		18.38			15.99			0.925	18.357	0.805	15.97											
AMUWO-ODOFIN	60	132/33		YNd11	T1	TOSHIBA																						
	30	132/33		YNd11	T2	MITSUBISHI																						
	40	132/33		YNd11	T3	TOSHIBA																						
	40	132/34		YNd11	T4	TOSHIBA																						
LEKKI	60	132/33		YNd11	TR1	AREVA																						
	60	132/34		YNd11	TR2	AREVA																						
OGBA	`60/40/20	132/33			T1	TOSHIBA															17							
	60	132/33			T2	PAUWELL															17							
	60	132/33			T3	MITSUBISHI															17							
	`45/30/20	132/33	ONAN/OFAF	YN.d11.yno	MOB	MITSUBISHI	CORE	18.74	12.41	5.52	16.3038	10.7967	4.8024								21	9	10	-15	1.190476			
	20	132/11				MITSUBISHI															15							
ALIMOSHO	30	132/33	ONAN/ONAF	YNd11	T1	MITSUBISHI		10.7			9.309			0.592	10.684	0.515	9.295				17	4	5	-15	1.567599			
	60	132/33	ONAN/ONAF	YNd11	T2	ABB		10.7			9.309			4.72	10.69	0.41	9.3				17	4	5	-15	1.567599			
	30	132/33	ONAN/ONAF	YNd11	T3	MITSUBISHI		10.7			9.309			0.592	10.684	0.515	9.295				17	5	5	-15	1.176471			
EJIGBO	30	132/33	ONAN/ONAF	YNd11	T1	ITAL TRAFO		10.2			8.874			0.565	10.184	0.491	8.86				21	13	10	-15	1.19			
	30	132/33	ONAN/ONAF	YNd11	T2	ITAL TRAFO		10.2			8.874			0.565	10.184	0.491	8.86				21	13	10	-15	1.19			
	100	132/33	ONAN/ONAF	YNd11	T3	STECO		10.7			9.309			0.4	10.693	0.348	9.3				13	4	5	15	1.54			
AGBARA	`45/30/15	132/33			T1	HYUNDAI															15							
	`45/30/15	132/33			T2	HYUNDAI															15							
	60	132/33			T3	CROMPTOM															17							
ALAUSA	`45/30/15	132/33	ONAN/ONAF	YNd11, yn0	T1	HYUNDAI	CORE	13.01			11.3187			0.63	12.995	0.548	11.304				13	3	5	-15	1.67			
	30	132/33	ONAN/ONAF	YNd11	T2	ELTA	CORE																					
	60	132/33	ONAN/ONAF	YNd11	T3	PAUWELS	CORE	14.54			12.6498			0.641	14.526	0.558	12.538				17	9	10	-5	1.67			
OTTA	40	132/33			T1	MINEL																						
	60	132/33			T2	PAUWELS																						
	30	132/33			T3	BBC																						
	40/30/20	132/33			MOB	CG ELECT.SYSTEM																						
PAPALANTO	15	132/33			T1	TRAFO-UNION																						
	15	132/33			T2	TRAFO-UNION																						
	30	132/33			T3	PAUWELS																						
ABEOKUTA	30	132/33	ONAN	YNd11	T1	ELTA		10.16			8.8392			0.562	10.144	0.489	8.826				17	5	5	-15	1.67			
	30	132/33	ONAN	YNd11	T2	ELTA		10.16			8.8392			0.562	10.144	0.489	8.826				17	5	5	-15	1.67			
	30	132/33	ONAN/ONAF	YNd11, yn0	T3	PAUWEL																						

Transformer Data

Annex 4.4

STATION	RATINGS(MVA)	Vrated(kV)	COOLING	VECTOR GROUP	NOMENCL	MAKE	TYPE	POS. SEQ. IMPEDANCE (%)			ZERO SEQ. IMPEDANCE			Estimated R & X Value for Positive Sequence Impedance (% on Machine Base)		Estimated R & X Value for Zero Sequence Impedance (% on Machine Base)		LOSSES (kW)		Imag (prr)	NO. OF TAPS	NOM. TAP	REG. ABOVE	REG. BELOW	REG. STEP	COMPENSATING WINDING		EARTHING
								Z12	Z13	Z23	Z1N	Z2N	Z3N	R	X	R	X	Pcu	Pfe			POSITION	NOM. (%)	NOM. (%)	(%)			
GANMO	150	330/132/33	ONAN/ONAF1/ONAF2	YNd11yn0	T2A	CROMPTON GREAVES	CORE	18.6	47	33	16.182	40.89	28.71								17	5	5	-15	1.18			
	60	132/33	ONAN/ONAF1	Yd11	T1	SIEMENS								0.74	14.75	0.65	12.8				17	5	4	-15	1.18			
	60	132/33	ONAN/ONAF1/ONAF2	Yd11	T2	SIEMENS								0.65	14.73	0.57	12.8				17	5	4	-15	1.18			
ILORIN	60	132/33	ONAN/ONAF	Yd11	T1A	TOSHIBA	CORE							0.46	10.52	0.4	9.15				13	5	4	-15	1.54			
	45/30	132/33	ONAN/ONAN	Yd11	T2A	HYUNDAI	CORE														13	5	4	-15	1.54			
OMU-ARAN	30	132/33			T1	MITSUBISHI								0.59	10.6	0.511	9.23											
	30	132/33			T2	TOSHIBA								0.68	12.18	0.59	10.59											
ONDO	30	132/33	ONAN	Yd11	T1	ELTA	CORE	10.42			9.11			0.58	10.4	0.5	9.09				17	5	5	-15	1.18			
	30	132/33	ONAN	Yd11	T2	ELTA	CORE	10.42			9.11			0.58	10.4	0.5	9.09				17	5	5	-15	1.18			
ADO EKITI	40/30	132/33	ONAN/ONAF		T1	ABB	TBA43							0.56	11.09	0.49	9.65				17	5	5	-15	1.18			
	40/30	132/33	ONAN/ONAF		T2	ABB	TBA43							0.54	10.69	0.47	9.3				17	5	5	-15	1.18			
AKURE	30	132/33	ONAN/ONAF		T1A	ABB								0.57	10.18	0.49	8.86				17	10	9	-10	1.18			
	30	132/33	ONAN/ONAF	Yd11	T2A	MITSUBISHI								0.55	9.84	0.47	8.56				17	5	5	-15	1.18			
	60	132/33			T3A	PAUWELLS																						
JERICHO	45/30/15	132/33/11	ONAN/ONAF	YdY	T1	MITSUBISHI		18.47	12.49	5.43	16.0689	10.8663	4.724								21	9	10	-15	1.19			
	40	132/33	ONAN/ONAF	YNd11	T2	PAUWELS	CORE							0.67	13.23	0.58	11.52				17	10	9	-10	1.18			
IBADAN NORTH	60	132/33	ONAN/ONAF	YNd11	T1	LEECC	CORE							0.45	10.09	0.39	8.78				17	5	5	-15	1.18			
	60	132/33	ONAN/ONAF	YNd11	T2	TELK	CORE							0.43	9.64	0.37	8.39				17	5	5	-15	1.18			
SAGAMU	30	132/33	ONAN	Yd11	T1	FABRYKA	CORE														17	5		-15	1.18			
	30	132/33	ONAN	Yd11	T2	FABRYKA	CORE														17	5	5	-15	1.18			
IJBEBU-ODE	30	132/33	ONAN	Yd11	T1	ELTA	CORE																					
	30	132/33	ONAN	Yd11	T2	ELTA	CORE																					
ISEYIN T.S	45/30	132/33	ONAN/ONAF	YNd11yn0	T1	HYUNDAI	CORE														13	5	-15	4	1.54			
IWO T.S	30	132/33			T1	LEECC																						
OWERRI	60	132/33/11			TR1	LEECC																						
	60	132/33			TR2	LEECC																						
	40	132/33			T1-MOB	PAUWELLS																						
ABA	7.5	132/6.6			T1A	PARSON																						
	60	132/33			T1B	LEECC																						
	45/30/15	132/33/11	ONAN/ONAF	YNd11	T2B	HYUNDAI		19.45	13.18	4.76	16.9215	11.4666	4.1412								13	5	-15	4	1.538462			
	30	132/33			T(MOB)	MITSUBISHI																						
	60	132/33			T2A	ABB																						
UMUAHIA	15	132/11			T4A(MOB)	MITSUBISHI																						
	40	132/33			T1	STEM ITALY																						
P.H. MAIN	40	132/33			T2	STEM ITALY																						
	60	132/33			T1A	HYUNDAI																						
	60	132/33			T2A	LEECC																						
	60	132/33			T3A	ABB																						
	60	132/33			T1A	FERRANTI																						
P.H. TOWN	60	132/33			T1A	FERRANTI																						
	30	132/33			T2A	PAUWELS																						
	30	132/33			T1B	PAUWELS																						
	45	132/33			T2B	HYUNDI																						
	162	~330/132			T1A	MITSUBISHI																						
AFAM	45	132/33			T1	HYUNDI																						
	64	132/11			T5	SECHERON																						
AFAM IPP	198	~330/132																										

Transformer Data

Annex 4.4

STATION	RATINGS(MVA)	Vrated(kV)	COOLING	VECTOR GROUP	NOMENCL.	MAKE	TYPE	POS. SEQ. IMPEDANCE (%)			ZERO SEQ. IMPEDANCE			Estimated R & X Value for Positive Sequence Impedance (% on Machine Base)		Estimated R & X Value for Zero Sequence Impedance (% on Machine Base)		LOSSES (kW)		Imag (pry)	NO. OF TAPS	NOM. TAP	REG. ABOVE	REG. BELOW	REG. STEP	COMPENSATING WINDING		EARTHING
								Z12	Z13	Z23	Z1N	Z2N	Z3N	R	X	R	X	Pcu	Pfe			POSITION	NOM. (%)	NOM. (%)	(%)			
OTURKPO	7.5	132/33	ONAN/ONAF	YNd11	T1	PAUWELS																						
	30	132/33	ONAN/ONAF	YNd11	T2	ABB																						
NKALAGU	30	132/33	ONAN/ONAF	YNd11	T1A	GEN. ELECT.																						
	30	132/33	ONAN/ONAF	YNd11	T2A	ESPANOLA																						
YANDEV	15	132/33	ONAN/ONAF	YNd11	T1	FERRENTI																						
	60	132/33	ONAN/ONAF	YNd11	T2	LEEEC																						
	45	132/33	ONAN/ONAF	YNd11	MOB	mitsubishi																						
APIR	40	132/33	ONAN/ONAF	YNd11	MOB	ABB																						
ASABA	150	330/132/33	ONAN/ONAF	YNd11	T1																							
	150	330/132/33	ONAN/ONAF	YNd11	T2																							
	60	132/33	ONAN/ONAF	YNd11	TR1																							
	60	132/33	ONAN/ONAF	YNd11	TR2																							
AWKA	30	132/33	ONAN/ONAF	YNd11	TR1	ABB																						
	30	132/33	ONAN/ONAF	YNd11	TR3	PAUWEL TRAFO																						
AGU-AWKA	40	132/33	ONAN/ONAF	YNd11	MOB	LEECC																						
NSUKKA	7.5	66/33	ONAN/ONAF	YNd11	T1A	TRAFO-UNION																						
	7.5	66/33	ONAN/ONAF	YNd11	T1B	FOSTER																						
OJI TS	30	132/33	ONAN/ONAF	YNd11	T1A	PAUWELL																						
	15	132/66	ONAN/ONAF	YNd11	T1B	SAVIGLIANO																						

Generator Data

STATION	NOMEN- CLATURE	TYPE	MAKE	RATING (MVA)	TERMINAL VOLTAGE (kV)	RATED P.F. (pu)	X ["] _{d sat.} (pu)	X ["] _{d unsat} (pu)	X ["] _{q sat.} (pu)	X ["] _{q unsat.} (pu)	X ['] _{d sat.} (pu)	X ['] _{d unsat.} (pu)	X ['] _{q sat.} (pu)	X ['] _{q unsat.} (pu)	X _{d sat.} (pu)	X _{d unsat.} (pu)	X _{q sat.} (pu)	X _{q unsat.} (pu)	X _{2 sat.} (pu)	X _{2 unsat.} (pu)	X _{0 sat.} (pu)	X _{0 unsat.} (pu)	X _{L sat.} (pu)	X _{L unsat.} (pu)	X _p (pu)	X _c (pu)	R ₁ (pu)	R ₂ (pu)	R ₀ (pu)	R _a (mΩ)	R _i (mΩ)	
																																Page 1a
OKPAI (AGIP)	GT1	GAS	ALSTOM	210	15.75+/-5%	0.85	0.14	0.19 +/-10%		0.2		0.25+-10%		0.4		2.53		2.36	0.15	0.19		0.086		0.17	0.25		0.0026	0.015 at 95°C	0.0011at 95°C	1.291	188	
	GT2	GAS	ALSTOM	210	15.75+/-5%	0.85	0.14	0.19 +/-10%		0.2		0.25+-10%		0.4		2.53		2.36	0.15	0.19		0.086		0.17	0.25		0.0026	0.015 at 95°C	0.0011at 95°C	1.291	188	
	ST1	STEAM		210	15.75+/-5%	0.85	0.14	0.19 +/-10%		0.2		0.25+-10%		0.4		2.53		2.36	0.15	0.19		0.086		0.17	0.25		0.0026	0.015 at 95°C	0.0011at 95°C	1.291	188	
DELTA I	GT1	GAS		45																												
	GT2	GAS		45																												
DELTA II	GT3	GAS	MEIDEN	29.725	11.5 +/-5%	0.8	0.13	0.15			0.19	0.21			1.59	1.8																
	GT4	GAS	MEIDEN	29.725	11.5 +/-5%	0.8	0.13	0.15			0.19	0.21			1.59	1.8																
	GT5	GAS	MEIDEN	29.725	11.5 +/-5%	0.8	0.13	0.15			0.19	0.21			1.59	1.8																
	GT6	GAS	MEIDEN	29.725	11.5 +/-5%	0.8	0.13	0.15			0.19	0.21			1.59	1.8																
	GT7	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT8	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
DELTA III	GT9	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT10	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT11	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT12	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT13	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT14	GAS	SIEMENS	29.725	11.5 +/-5%	0.8	0.105	0.129	0.115	0.142	0.151	0.168	0.283	0.313	1.34	1.44	1.16	1.37	0.11	0.136	0.096	0.07		0.105						8.46	93.01	
	GT15	GAS	GE	133.75	11.5 +/-5%	0.85	0.171	0.226	0.166	0.223	0.241	0.319	0.542	0.542	1.905	1.905	1.835	1.835	0.161	0.214	0.077	0.096		0.181			0.004	0.018	0.007	0.004	0.016	
DELTA IV	GT16	GAS	GE	133.75	11.5 +/-5%	0.85	0.171	0.226	0.166	0.223	0.241	0.319	0.542	0.542	1.905	1.905	1.835	1.835	0.161	0.214	0.077	0.096		0.181			0.004	0.018	0.007	0.004	0.016	
	GT17	GAS	GE	133.75	11.5 +/-5%	0.85	0.171	0.226	0.166	0.223	0.241	0.319	0.542	0.542	1.905	1.905	1.835	1.835	0.161	0.214	0.077	0.096		0.181			0.004	0.018	0.007	0.004	0.016	
	GT18	GAS	GE	133.75	11.5 +/-5%	0.85	0.171	0.226	0.166	0.223	0.241	0.319	0.542	0.542	1.905	1.905	1.835	1.835	0.161	0.214	0.077	0.096		0.181			0.004	0.018	0.007	0.004	0.016	
	GT19	GAS	GE	133.75	11.5 +/-5%	0.85	0.171	0.226	0.166	0.223	0.241	0.319	0.542	0.542	1.905	1.905	1.835	1.835	0.161	0.214	0.077	0.096		0.181			0.004	0.018	0.007	0.004	0.016	
	GT20	GAS	GE	133.75	11.5 +/-5%	0.85	0.171	0.226	0.166	0.223	0.241	0.319	0.542	0.542	1.905	1.905	1.835	1.835	0.161	0.214	0.077	0.096		0.181			0.004	0.018	0.007	0.004	0.016	
	ST1	STEAM	BBC	133.97	15.75+/-5%	0.9	0.16	0.16			0.2	0.215			1.77	2.4				0.164		0.087		0.13	0.322						2.21	
SAPELE	ST2	STEAM	BBC	133.97	15.75+/-5%	0.9	0.16	0.16			0.2	0.215			1.77	2.4				0.164		0.087		0.13	0.322						2.21	
	ST3	STEAM	BBC	133.97	15.75+/-5%	0.9	0.16	0.16			0.2	0.215			1.77	2.4				0.164		0.087		0.13	0.322						2.21	
	ST4	STEAM	BBC	133.97	15.75+/-5%	0.9	0.16	0.16			0.2	0.215			1.77	2.4				0.164		0.087		0.13	0.322						2.21	
	ST5	STEAM	BBC	133.97	15.75+/-5%	0.9	0.16	0.16			0.2	0.215			1.77	2.4				0.164		0.087		0.13	0.322						2.21	
	ST6	STEAM	BBC	133.97	15.75+/-5%	0.9	0.16	0.16			0.2	0.215			1.77	2.4				0.164		0.087		0.13	0.322						2.21	
	GT1	GAS	BBC	110	10.5+/-7.5%	0.8	0.133	0.154			0.2	0.21			1.77	2.17						0.083		0.13	0.13						0.92	
	GT2	GAS	BBC	110	10.5+/-7.5%	0.8	0.133	0.154			0.2	0.21			1.77	2.17	</															

Generator Data

STATION	NOMEN- CLATURE	TYPE	MAKE	RATING (MVA)	TERMINAL VOLTAGE (kV)	RATED P.F. (pu)	X ^u _{d sat.} (pu)	X ^u _{d unsat} (pu)	X ^u _{q sat.} (pu)	X ^u _{q unsat.} (pu)	X ^d _{sat.} (pu)	X ^d _{unsat.} (pu)	X ^q _{sat.} (pu)	X ^q _{unsat.} (pu)	X ^d _{sat.} (pu)	X ^d _{unsat.} (pu)	X ^q _{sat.} (pu)	X ^q _{unsat.} (pu)	X _{2 sat.} (pu)	X _{2 unsat.} (pu)	X _{0 sat.} (pu)	X _{0 unsat.} (pu)	X _{L sat.} (pu)	X _{L unsat.} (pu)	X _p (pu)	X _c (pu)	R ₁ (pu)	R ₂ (pu)	R ₀ (pu)	R _a (mΩ)	R _i (mΩ)	
																																Page 2a
AFAM IV	GT16	GAS	BBC	110	11.5± 5	0.8		0.137				0.211				2.37						0.152		0.081								
	GT17	GAS	BBC	110	11.5± 5	0.8	0.133	0.137			0.21	0.211			2.17	2.37	1.95					0.152	0.13	0.081								
	GT18	GAS	BBC	110	11.5± 5	0.8	0.133	0.137			0.21	0.211			2.17	2.37	1.95					0.152	0.13	0.081								
AFAM V	GT19	GAS	SIEMENS	162.69	15.75± 5	0.85	0.2				0.275				2.3		2.2						0.175									
	GT20	GAS	SIEMENS	162.69	15.75± 5	0.85	0.2				0.275				2.3		2.2						0.175									
PAPALANTO (OLORUNSOGO)	GT1	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT2	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT3	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT4	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT5	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT6	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT7	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
	GT8	GAS	GE (FRAME 6)	48	10.5	0.8	0.148				0.22				2.47	2		2		0.19		0.095					0.137	0.0036 at 20 °C	0.132 at 20°C			
OMOTOSO_PHASE I	GT1	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT2	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT3	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT4	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT5	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT6	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT7	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
	GT8	GAS	NANJING	47.5	10.5+/-5%	0.8		0.17		0.17		0.231	0.231			2.38		2.38		0.1941		0.103		0.137							3.84	138.8
GEREGU	GT11	GAS	SIEMENS	174	15.75+/-5%	0.85	0121+/-15%				0.184+/-15%				1.918+/-15%												0.0039			0.0062	5	
	GT12	GAS	SIEMENS	174	15.75+/-5%	0.85	0121+/-15%				0.184+/-15%				1.918+/-15%												0.0039			0.0062	5	
	GT13	GAS	SIEMENS	174	15.75+/-5%	0.85	0121+/-15%				0.184+/-15%				1.918+/-15%												0.0039			0.0062	5	
ALAOJI (NIPP)	GT1	GAS	GE	141.25	15	0.85	0.132	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027 at 75 °C	0.0188at 75°C	0.0041at 75°C	1.2	93	
	GT2	GAS	GE	141.25	15	0.85	0.132	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
	GT3	GAS	GE	141.25	15	0.8	0.132	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
CALABAR (ODUKPANI)	UNIT1	GAS	GE	141.25	15	0.8	0.13	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
	UNIT2	GAS	GE	141.25	15	0.8	0.13	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
	UNIT3	GAS	GE	141.25	15	0.8	0.13	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
	UNIT4	GAS	GE	141.25	15	0.8	0.13	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
	UNIT5	GAS	GE	141.25	15	0.8	0.13	0.164	0.16	0.195	0.19	0.231	0.23	0.33		1.82	1.35	1.66	0.129	0.16		0.08	0.078	0.119	0.196		0.0027at 75°C	0.0188at 75°C	0.0041at 75°C	1.2	93	
EGBEMA	UNIT1	GAS	GE	141.25	15	0.8																										

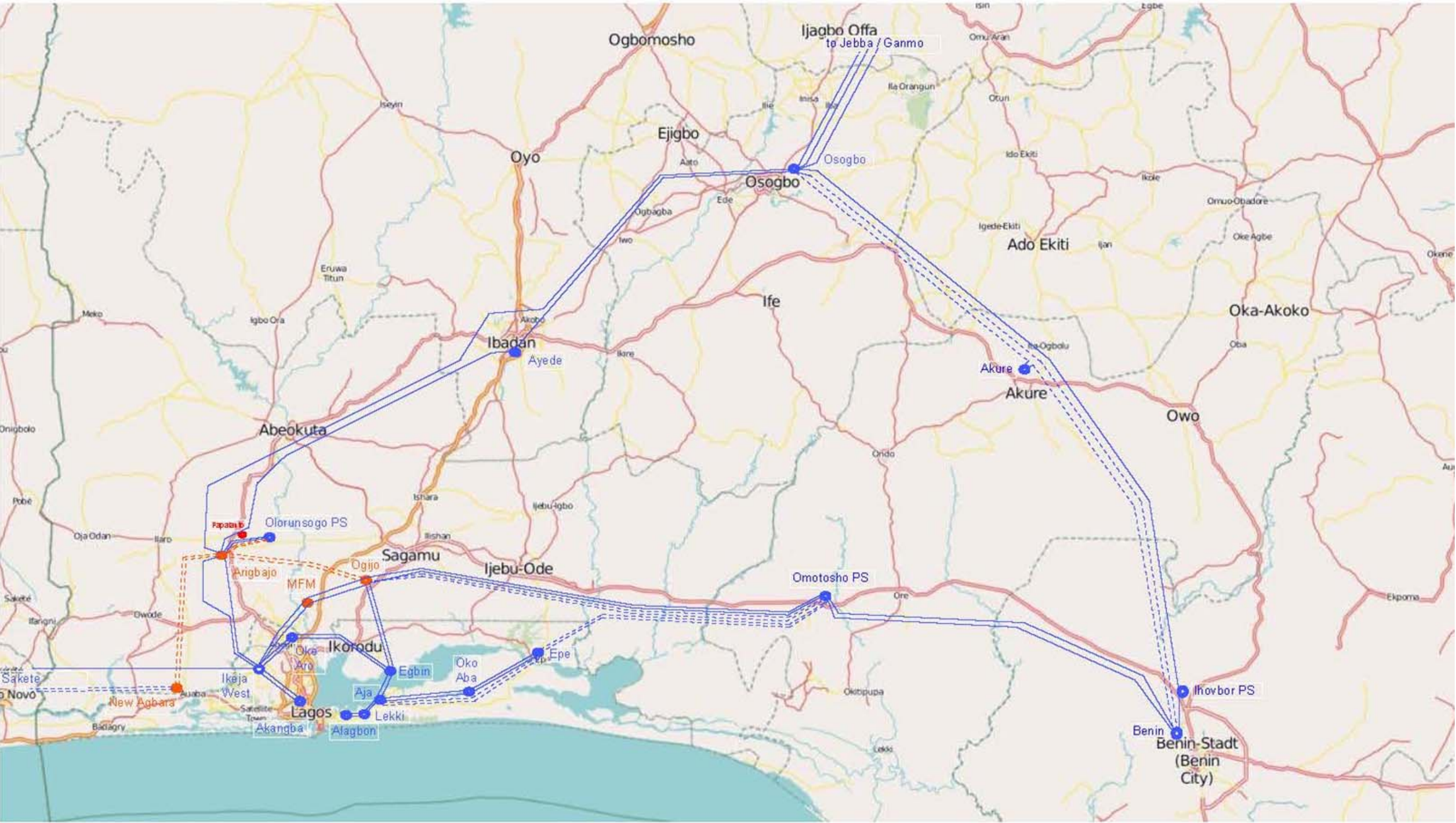
Generator Data

H constant (MWs/MVA)	D constant (MW/Hz)	K _c (***)	T'' _{d0 sat.} (s)	T'' _{d0 unsat.} (s)	T'' _{q0 sat.} (s)	T'' _{q0 unsat.} (s)	T'' _{d sat.} (s)	T'' _{d unsat.} (s)	T'' _{q sat.} (s)	T'' _{q unsat.} (s)	T' _{d0 sat.} (s)	T' _{d0 unsat.} (s)	T' _{q0 sat.} (s)	T' _{q0 unsat.} (s)	T' _{d sat.} (s)	T' _{d unsat.} (s)	T' _{q sat.} (s)	T' _{q unsat.} (s)	T _{d0 sat.} (s)	T _{d0 unsat.} (s)	T _{q0 sat.} (s)	T _{q0 unsat.} (s)	T _{d sat.} (s)	T _{d unsat.} (s)	T _{q0 sat.} (s)	T _{q0 unsat.} (s)	T _a (s)	Excitation Type	Governor Type	Droop Setting	Fixed / Free	Heat Rate (kcal/kWh)	STATION	
Page 1b																																		
1.288		0.46	0.021		0.032		0.016		0.016		10.12		0.93			0.99		0.16								0.54	Brush			5%	Fixed		OKPAI (AGIP)	
1.288		0.46	0.021		0.032		0.016		0.016		10.12		0.93			0.99		0.16								0.54	Brush			5%	Fixed			
1.288		0.46	0.021		0.032		0.016		0.016		10.12		0.93			0.99		0.16								0.54	Brush			5%	Fixed			
																																	DELTA I	
		0.5									5.46																	Brushless			4%	Fixed		
		0.5									5.46																	Brushless			4%	Fixed		
		0.5									5.46																	Brushless			4%	Fixed		DELTA II
		0.5									5.46																	Brushless			4%	Fixed		
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed			
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed		DELTA III	
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed			
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed			
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed			
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed			
		0.748	0.041				0.031				5.87					0.637										0.145	Brush			4%	Fixed			
9.62			0.032		0.075		0.023		0.023		3.713		0.352			0.47		0.352								0.285	Brush			4%	Fixed		DELTA IV	
9.62			0.032		0.075		0.023		0.023		3.713		0.352			0.47		0.352								0.285	Brush			4%	Fixed			
9.62			0.032		0.075		0.023		0.023		3.713		0.352			0.47		0.352								0.285	Brush			4%	Fixed			
9.62			0.032		0.075		0.023		0.023		3.713		0.352			0.47		0.352								0.285	Brush			4%	Fixed			
9.62			0.032		0.075		0.023		0.023		3.713		0.352			0.47		0.352								0.285	Brush			4%	Fixed			
1.18		0.51					0.017				8.61					0.77										0.36	Brush			5.50%	Fixed	2230	SAPELE	
1.18		0.51					0.017				8.61					0.77										0.36	Brush			5.50%	Fixed	2230		
1.18		0.51					0.017				8.61					0.77										0.36	Brush			5.50%	Fixed	2230		
1.18		0.51					0.017				8.61					0.77										0.36	Brush			5.50%	Fixed	2230		
1.18		0.51					0.017				8.61					0.77										0.36	Brush			5.50%	Fixed	2230		
1.18		0.51					0.017				8.61					0.77										0.36	Brush			5.50%	Fixed	2230		
1.41							0.013				8.8					0.8																		
1.41							0.013				8.8					0.8																		
1.41							0.013				8.8					0.8																		
6.5			0.063		0.11		0.055				7.1		1														0.54						EGBIN	
6.5			0.063		0.11		0.055				7.1		1														0.54							
6.5			0.063		0.11		0.055				7.1		1														0.54							
6.5			0.063		0.11		0.055				7.1		1														0.54							
6.5			0.063		0.11		0.055				7.1		1														0.54							
6.5			0.063		0.11		0.055				7.1		1														0.54							
3.1			0.041		0.1						5.87		1																				AES	
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1						5.87		1																					
3.1			0.041		0.1				</																									

Generator Data

Annex 4.5

H constant (MWs/MVA)	D constant (MW/Hz)	K _c (***)	T'' _{d0 sat.} (s)	T'' _{d0 unsat.} (s)	T'' _{q0 sat.} (s)	T'' _{q0 unsat.} (s)	T'' _{d sat.} (s)	T'' _{d unsat.} (s)	T'' _{q sat.} (s)	T'' _{q unsat.} (s)	T _{d0 sat.} (s)	T _{d0 unsat.} (s)	T _{q0 sat.} (s)	T _{q0 unsat.} (s)	T _{d sat.} (s)	T _{d unsat.} (s)	T _{q sat.} (s)	T _{q unsat.} (s)	T _{d0 sat.} (s)	T _{d0 unsat.} (s)	T _{q0 sat.} (s)	T _{q0 unsat.} (s)	T _{d sat.} (s)	T _{d unsat.} (s)	T _{q0 sat.} (s)	T _{q0 unsat.} (s)	T _{d sat.} (s)	T _{d unsat.} (s)	T _{q0 sat.} (s)	T _{q0 unsat.} (s)	T _a (s)	Excitation Type	Governor Type	Droop Setting	Fixed / Free	Heat Rate (kcal/kWh)	STATION	
Page 2b																																						
6.0*		0.5			0.025		5.3		0.46																													
7.45		0.5	0.05		0.1		5.3		0.46			8.8																										
7.45		0.5	0.05		0.1		5.3		0.46			8.8																										
6		0.63	0.06		0.49							9.5																										
6		0.63	0.06		0.49							9.5																										
		0.46			10		0.03					10				0.7																						
		0.46			10		0.03					10				0.7																						
		0.46			10		0.03					10				0.7																						
		0.46			10		0.03					10				0.7																						
		0.46			10		0.03					10				0.7																						
		0.46			10		0.03					10				0.7																						
		0.46			10		0.03					10				0.7																						
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
4		0.49	0.048		0.048		0.0535					10.2		10.2		0.574																0.036	Brushless					
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
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1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
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1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
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1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
1.37		0.59	0.05		0.05		0.04		0.04			15.5		4.7		1.29		0.65																				
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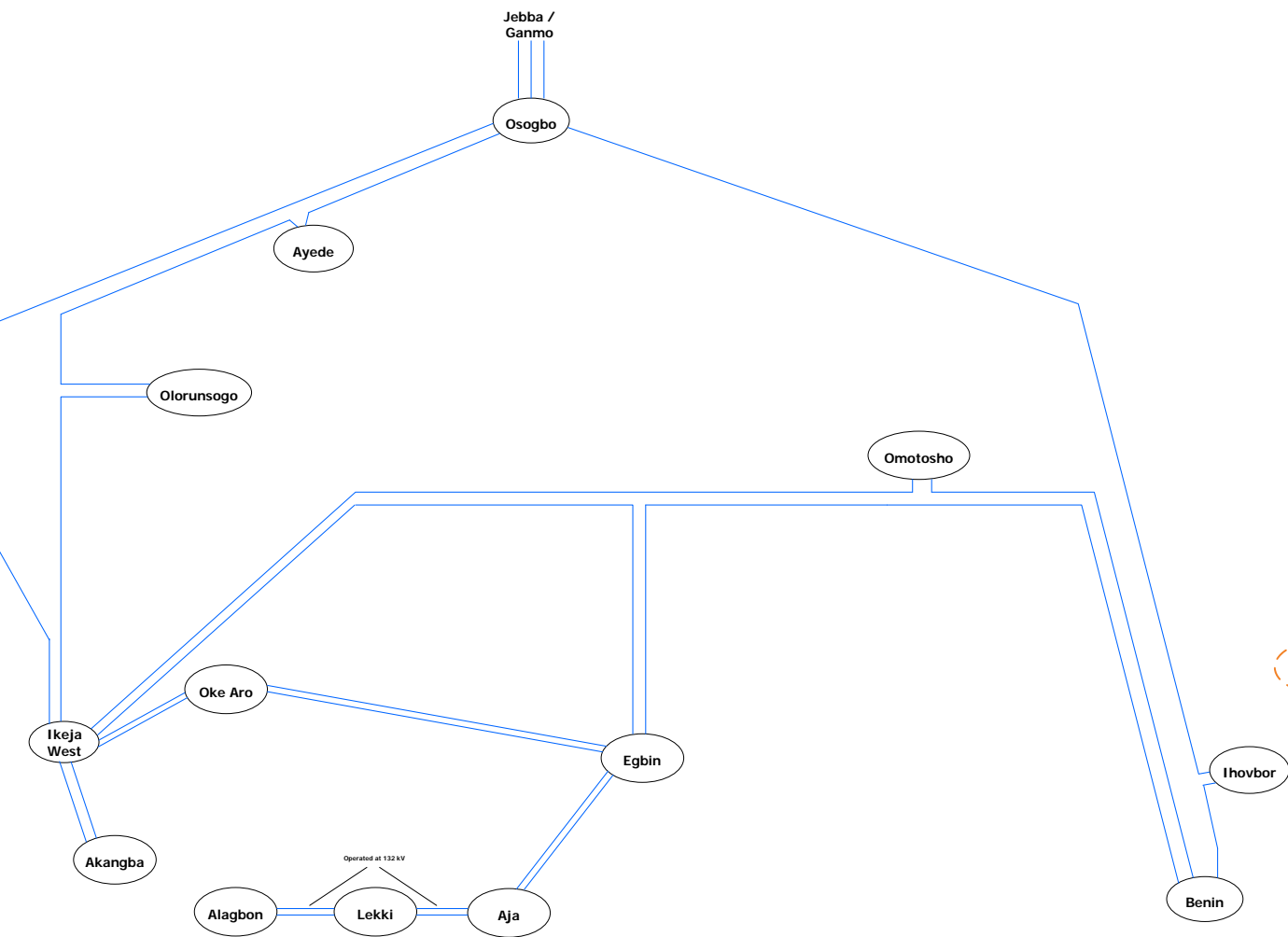
Legend

- 330 kV Lines - Existing
- 330 kV Lines – Ongoing TCN / NIPP Projects
- 330 kV Lines – Planned JICA Projects

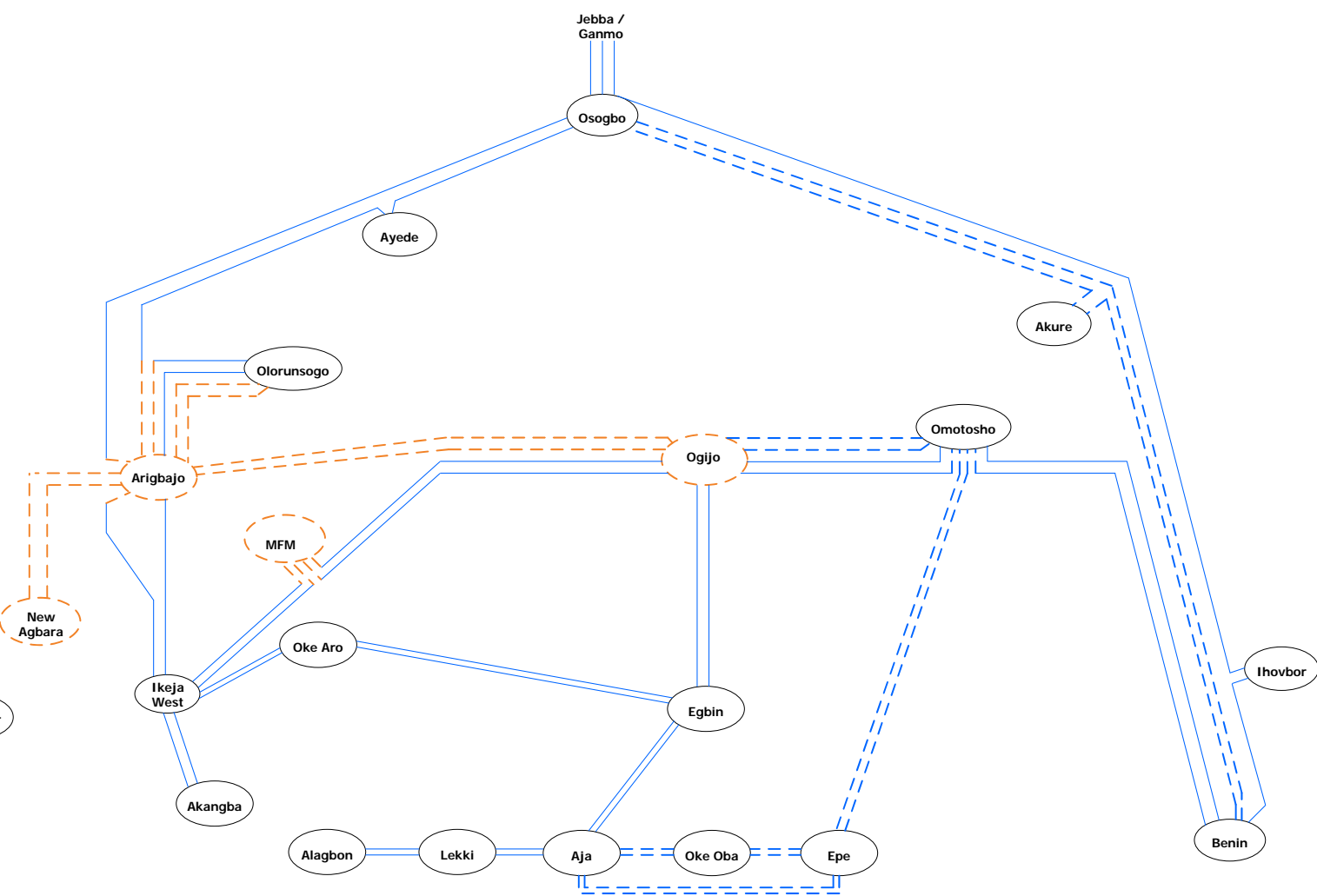
Annex 4.6a

D			
C			
B			
A			
	Date	Name	Note
FICHTNER		330 kV Network in Lagos Region	
	Date	Name	Scale:
Drawn:			Network Extensions under JICA Project
Checked:			
Supersedes:			Sheet: of
Superseded by:		Size:	Project No.: 8328P01
System:		Annex:	File: Drawing No:

Existing 330 kV Network Configuration



Future 330 kV Network Configuration

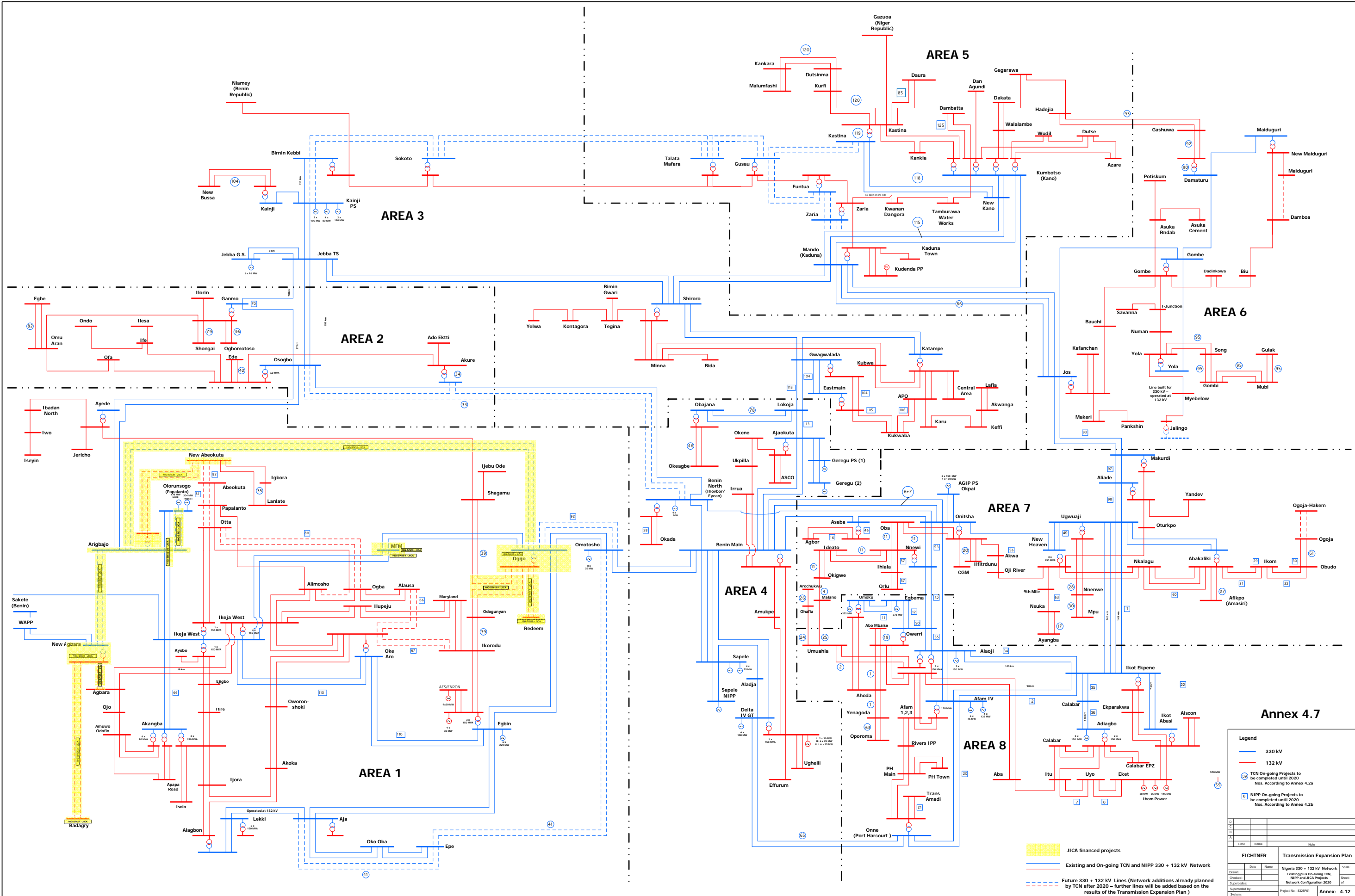


Legend

- JICA Projects
- TCN / NIPP Projects

Annex 4.6b

D			
C			
B			
A			
	Date	Name	Note
FICHTNER		330 kV Network in Lagos Region	
	Date	Name	Scale:
Drawn:			Network Extensions under JICA Project
Checked:			
Supercedes:			Sheet: of
Superceded by:		Size:	Project No .: 8328P01
System:		Annex:	File: Drawing No :



NIGER

NIGER

CHAD

CAMEROON

Annex 7.1

Legend

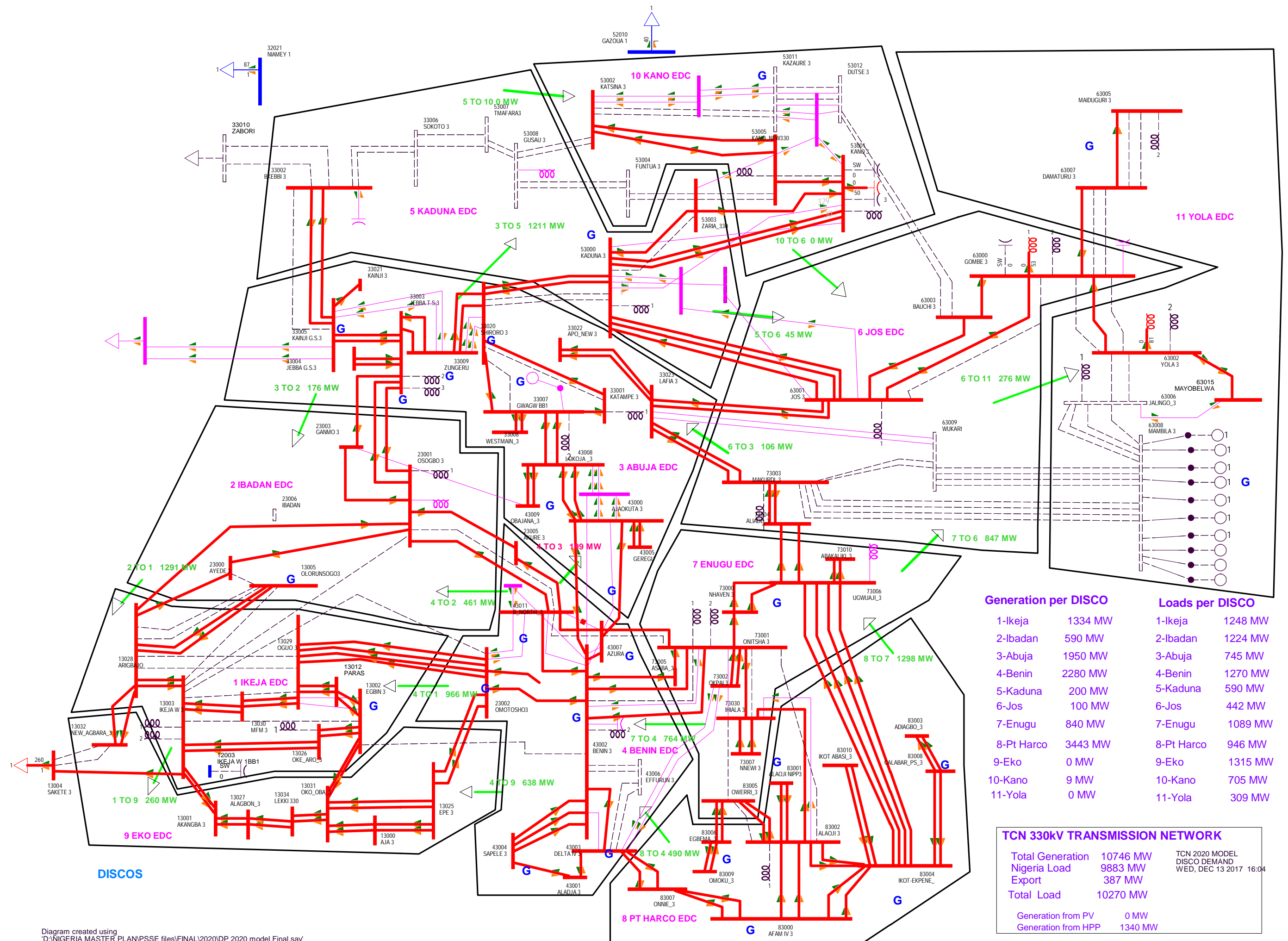
- 330 kV Lines - Existing
- 132 kV Lines - Existing
- 330 kV Lines under Construction TCN +NIPP Projects
- 132 kV Lines under Construction TCN +NIPP Projects
- 330 kV Lines proposed by FICHTNER
- 330 kV Lines Proposed by JICA
- 330 kV Lines financed by AFD
- 132 kV Lines financed by AFD
- 330 kV Lines proposed by TCN
- 132 kV Lines proposed by TCN

- Existing HPP
- Existing TPP
- On-Going/Committed HPP
- On-Going/Committed TPP

D			
C			
B			
A			
	Date	Name	Note
FICHTNER			
	Date	Name	
Drawn:			
Checked:			
Supersedes:			
Superseded by:	Size:	Project No.: 8328P01	File:
System:	Annex:	Drawing No:	

Nigeria
330 + 132 kV Network
Existing + Expansions

Scale:
Sheet:
of



Generation per DISCO		Loads per DISCO	
1-Ikeja	1334 MW	1-Ikeja	1248 MW
2-Ibadan	590 MW	2-Ibadan	1224 MW
3-Abuja	1950 MW	3-Abuja	745 MW
4-Benin	2280 MW	4-Benin	1270 MW
5-Kaduna	200 MW	5-Kaduna	590 MW
6-Jos	100 MW	6-Jos	442 MW
7-Enugu	840 MW	7-Enugu	1089 MW
8-Pt Harco	3443 MW	8-Pt Harco	946 MW
9-Eko	0 MW	9-Eko	1315 MW
10-Kano	9 MW	10-Kano	705 MW
11-Yola	0 MW	11-Yola	309 MW

TCN 330kV TRANSMISSION NETWORK		
Total Generation	10746 MW	TCN 2020 MODEL DISCO DEMAND WED, DEC 13 2017 16:04
Nigeria Load	9883 MW	
Export	387 MW	
Total Load	10270 MW	
Generation from PV	0 MW	
Generation from HPP	1340 MW	

Diagram created using
 'D:\NIGERIA MASTER PLAN\PSSSE files\FINAL\2020\DP 2020 model Final.sav'
 'D:\NIGERIA MASTER PLAN\PSSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

Annex 7.2
330kV transmission 2020

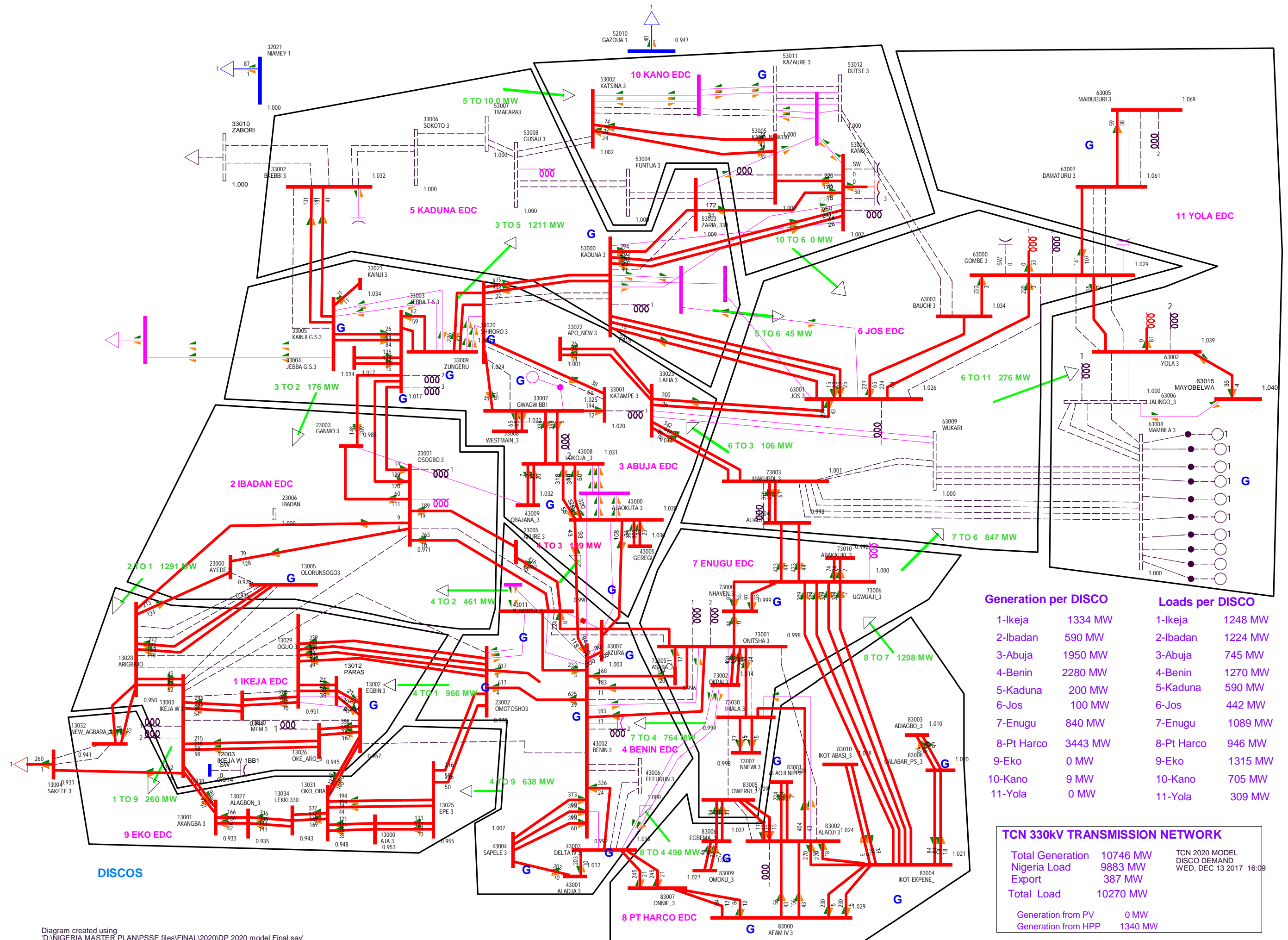


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Annex 7.4a
Dry season Peak 2020

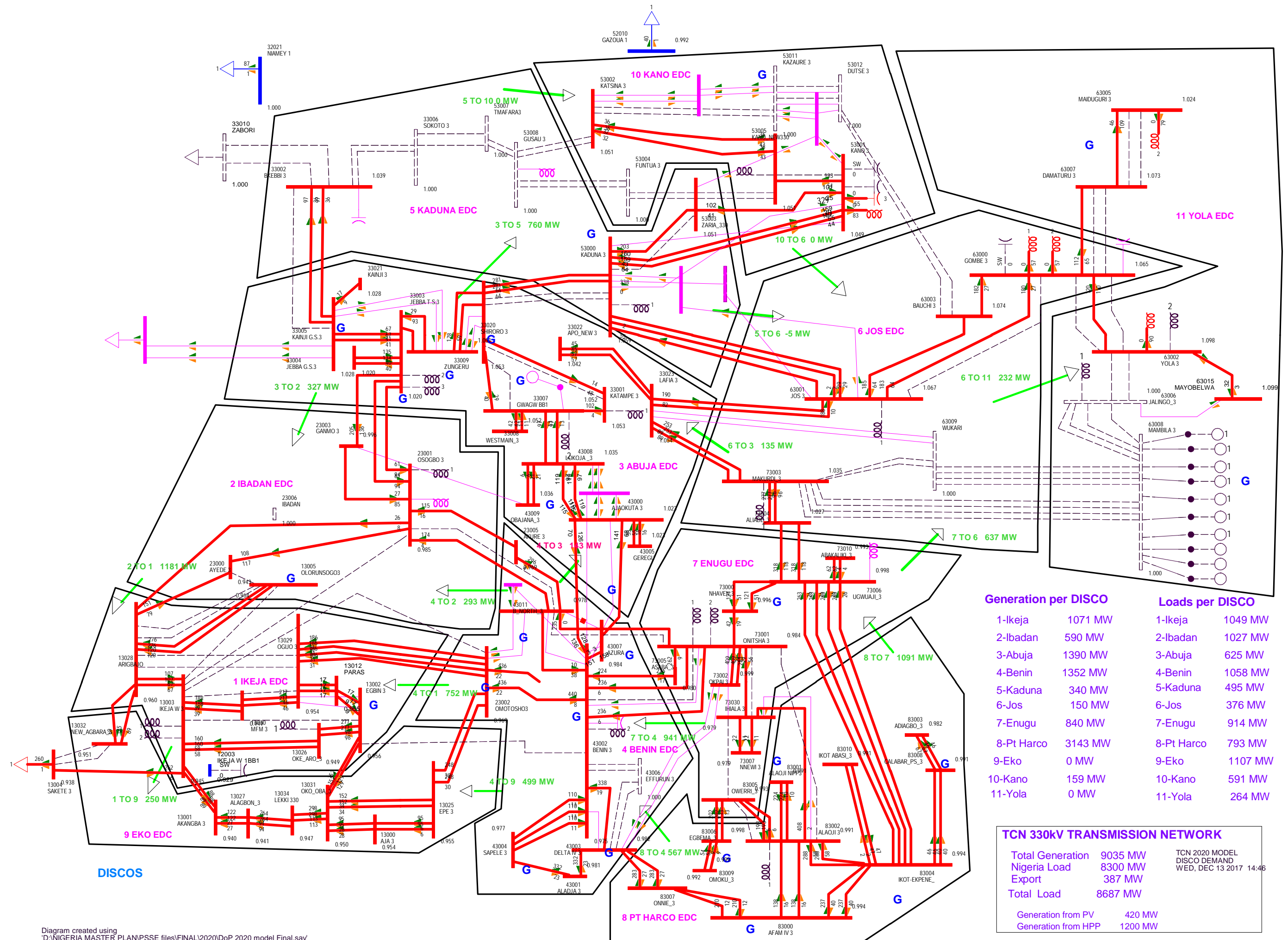


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Annex 7.4b
Dry season Off-Peak 2020

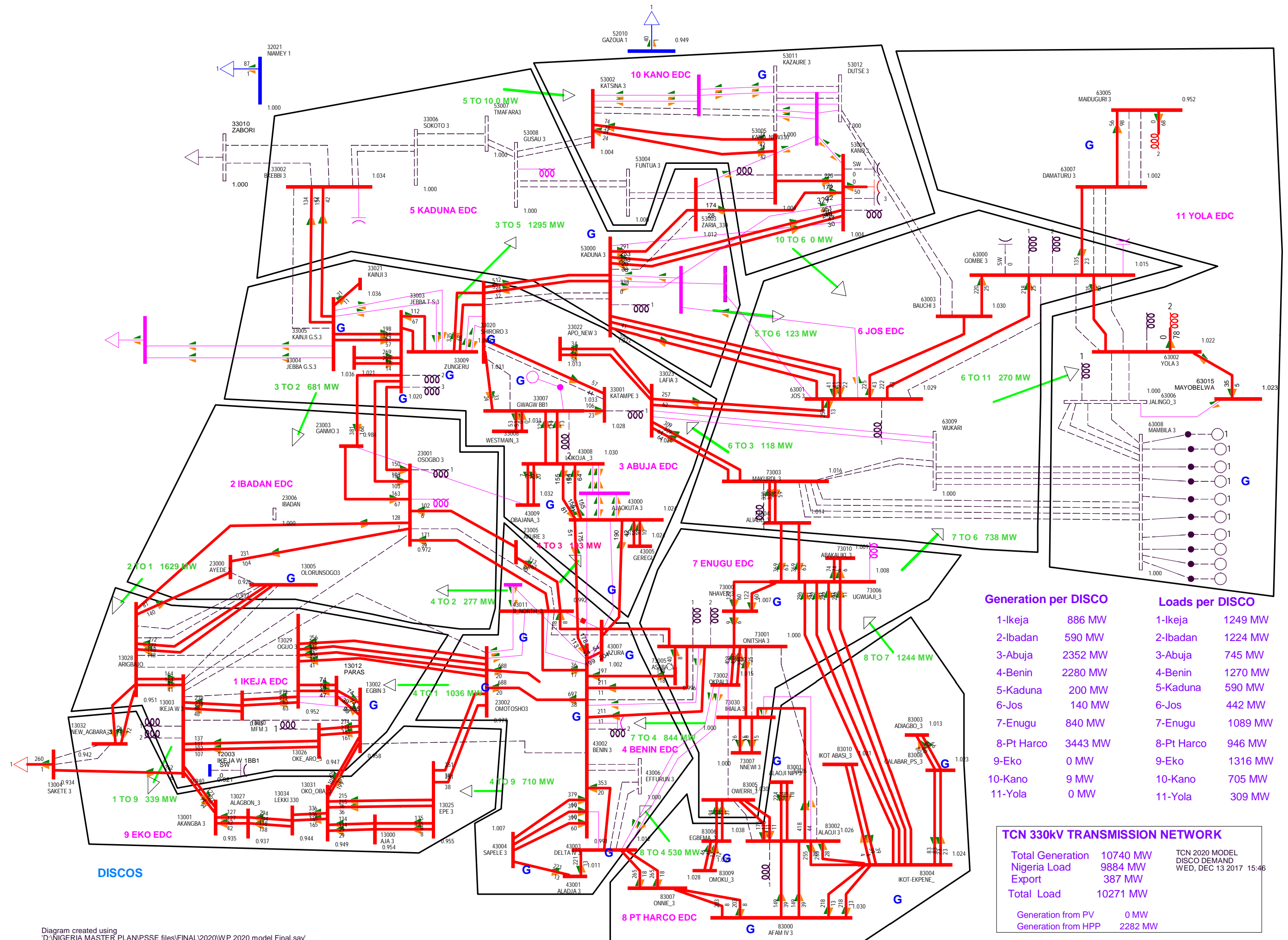


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Annex 7.4c
Wet season Peak 2020

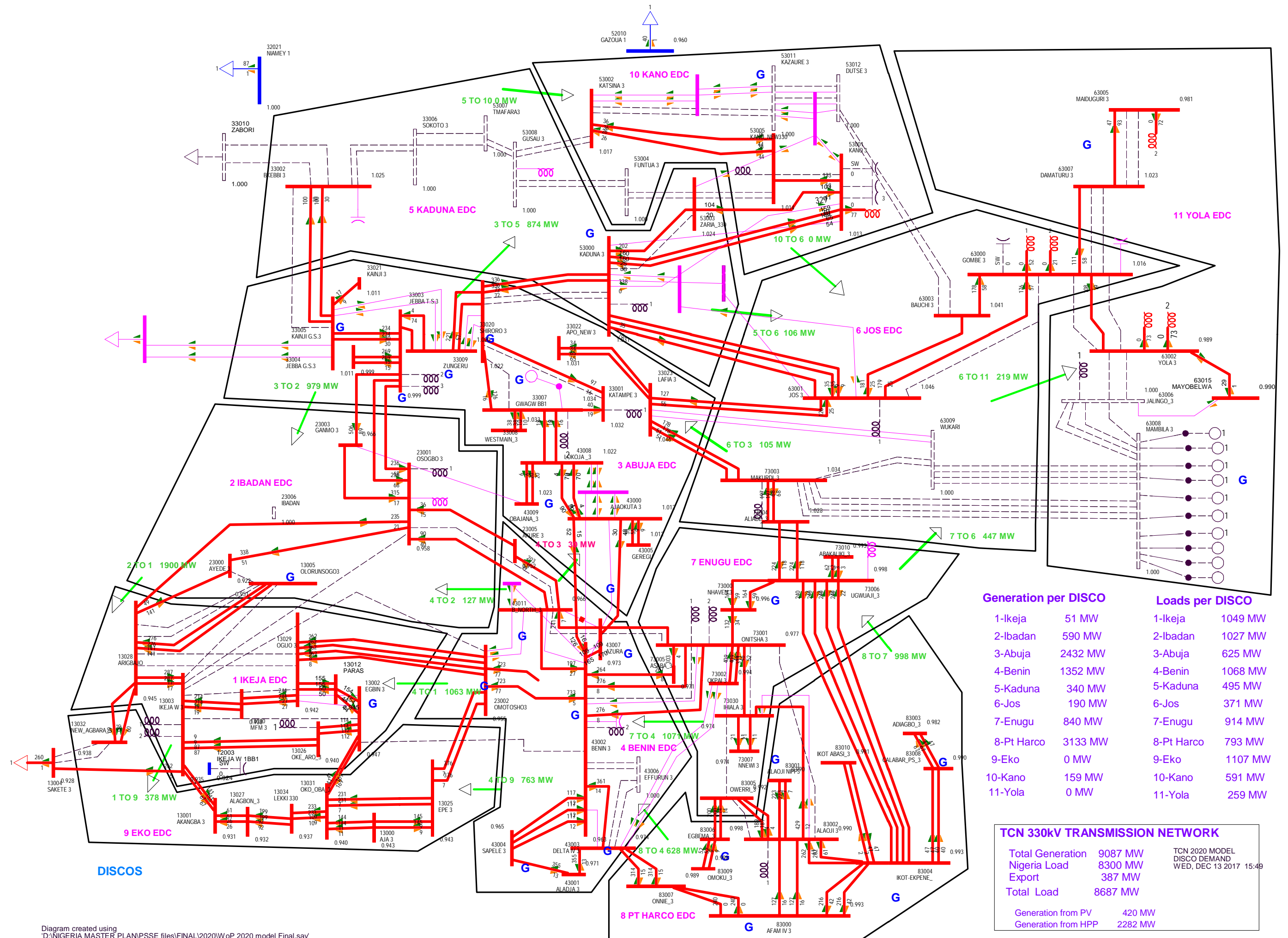
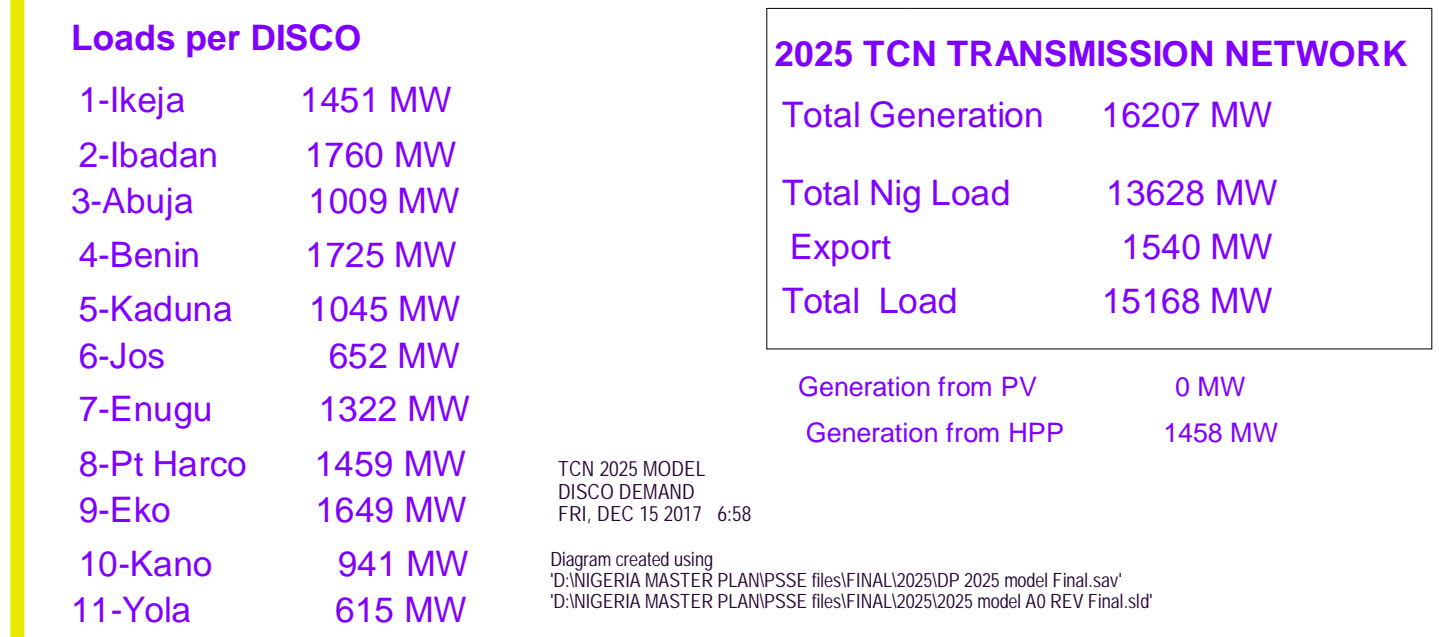


Diagram created using
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Annex 7.4d
Wet season Off-Peak 2020



1



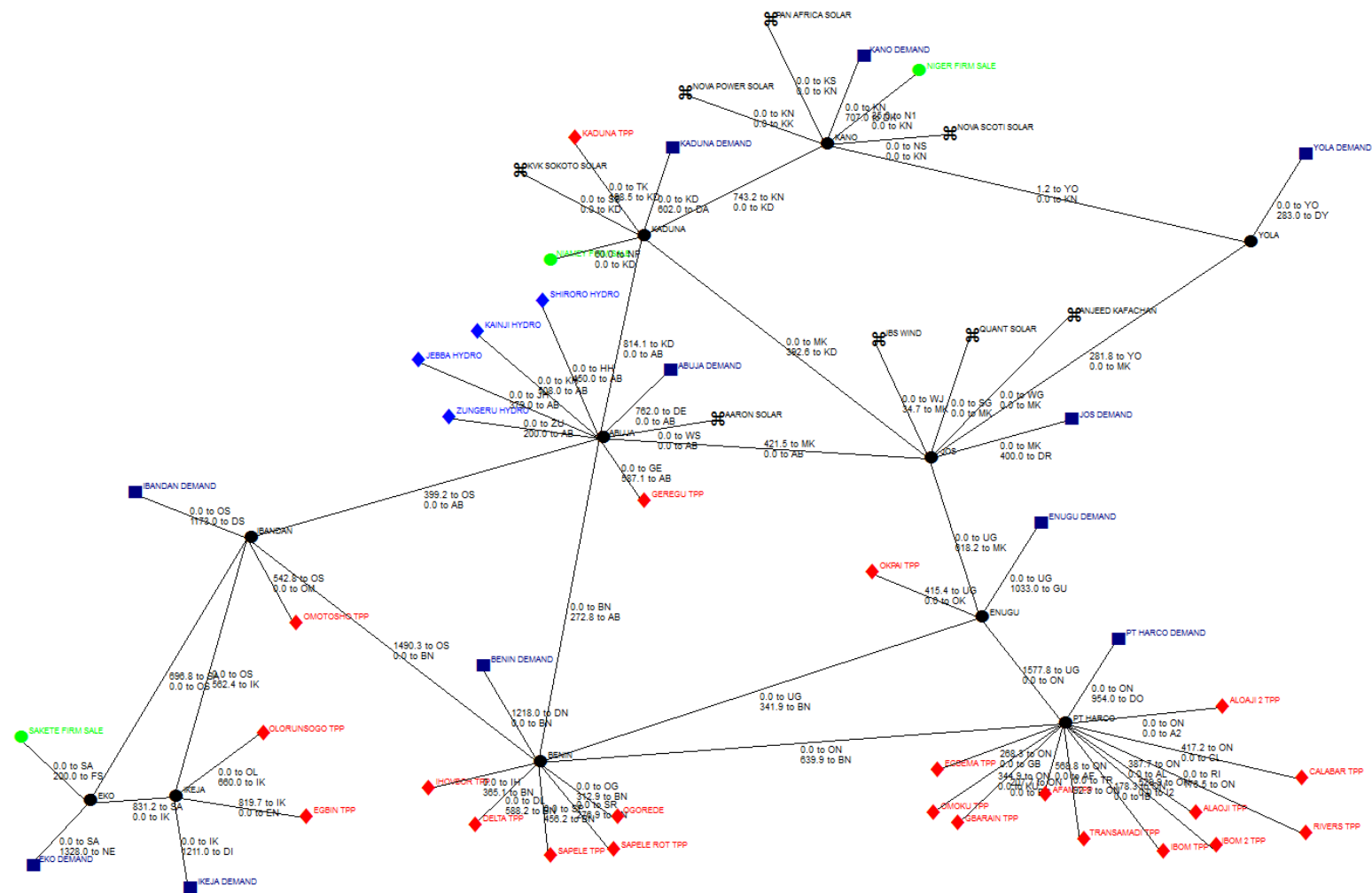


TCN 330kV TRANSMISSION NETWORK		
Total Generation	16207 MW	TCN 2025 MODEL DISCO DEMAND FRI, DEC 15 2017 6:46
Nigeria Load	13628 MW	
Export	1540 MW	
Total Load	15168 MW	
Generation from PV	0 MW	
Generation from HPP	1458 MW	



1

Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	21



Annex 8.3.1

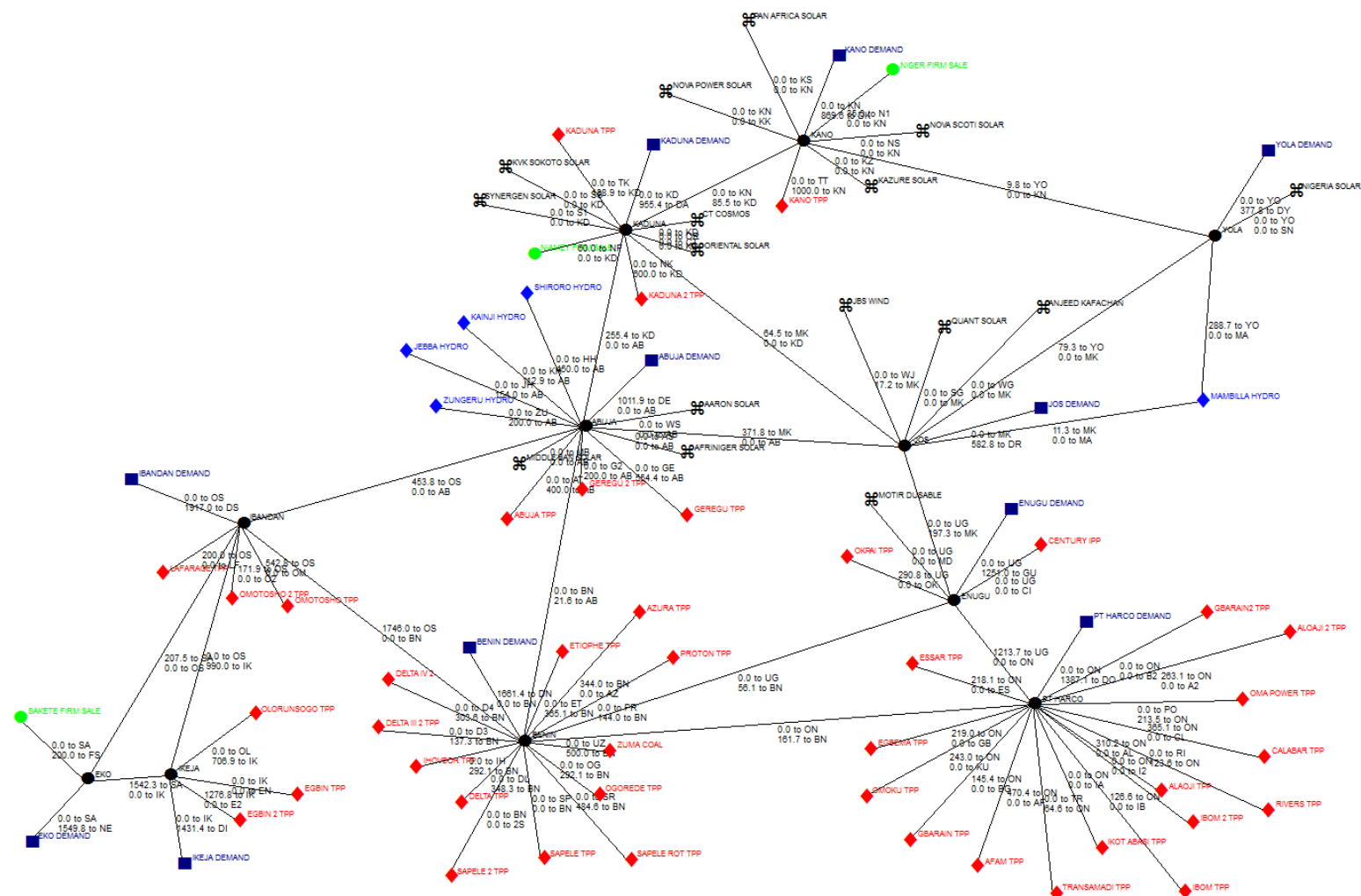
GTMax Topology 2020

Legend:

The values next to the demand node present the demand at the given hour in MW
The values next to the thermal generation node present the generation at the given hour in MW
The values next to the hydro generation node present the generation at the given hour in MW
The values next to the renewable generation node present the generation at the given hour in MW
The values next to the sale node present the sale at the given hour in MW
Each substation presents a DISCO
The values under each equivalent transmission link present the power flows in the one and in the opposite direction in MW

KN	KANO	KD	KADUNA
AB	ABUJA	MK	OS
BN	BENIN	ON	PT HARCO
OS	IBANDAN	IK	IKEJA
SA	EKO	YO	YOLA
UG	ENUGU		

Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	27: 27 Jul W1	Sun.	21



Annex 8.3.2

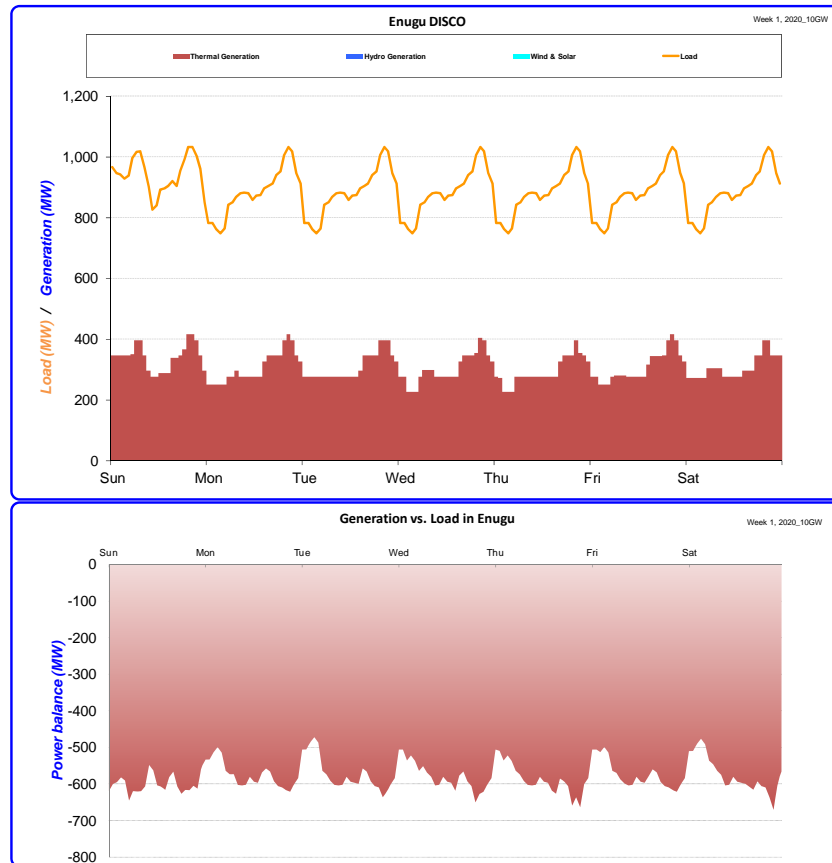
GTMax Topology 2025

Legend:

The values next to the demand node present the demand at the given hour in MW
The values next to the thermal generation node present the generation at the given hour in MW
The values next to the hydro generation node present the generation at the given hour in MW
The values next to the renewable generation node present the generation at the given hour in MW
The values next to the sale node present the sale at the given hour in MW
Each substation presents a DISCO
The values under each equivalent transmission link present the power flows in the one and in the opposite direction in MW

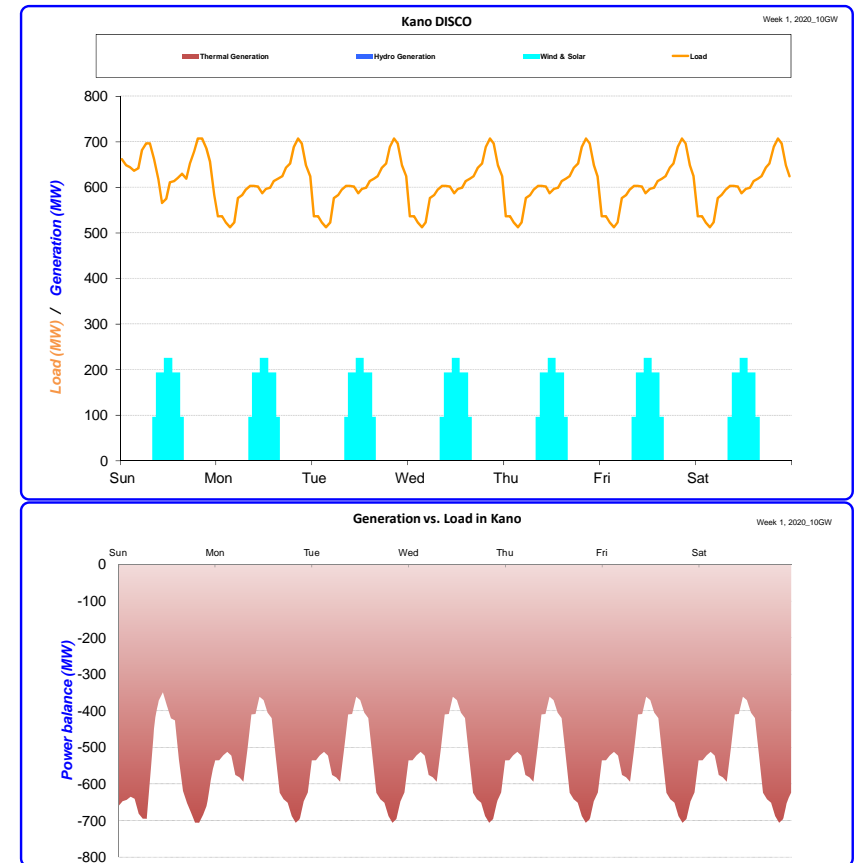
KN	KANO	KD	KADUNA
AB	ABUJA	MK	OS
BN	BENIN	ON	PT HARCO
OS	IBANDAN	IK	IKEJA
SA	EKO	YO	YOLA
UG	ENUGU		

Annex 8.4.1 - Winter 2020 - 10GW



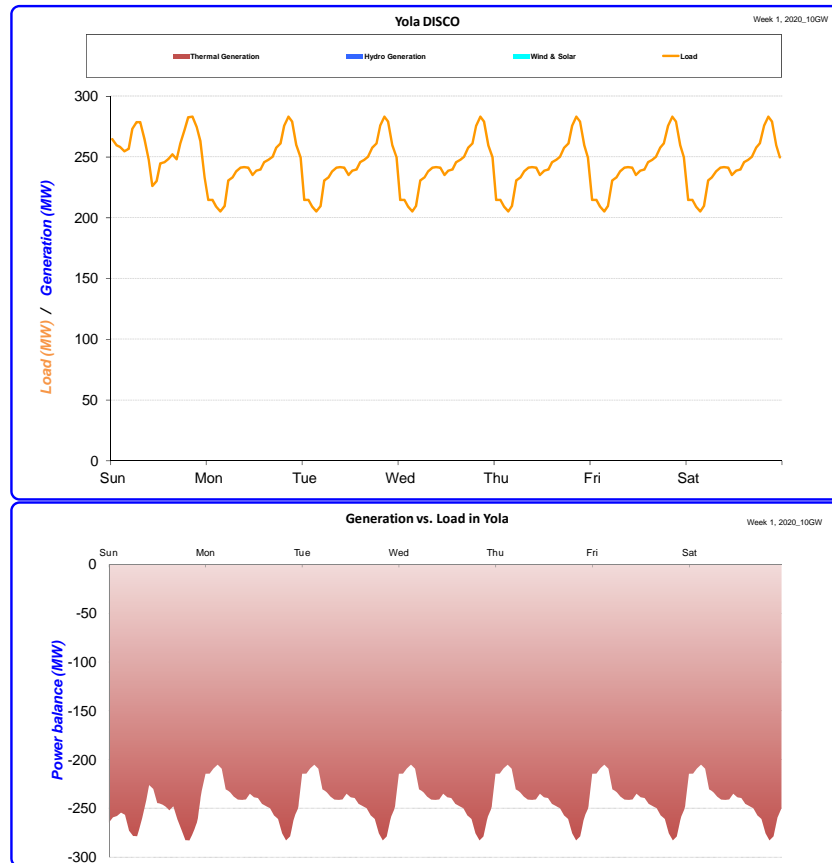
The generation profile of Enugu DISCO is based on thermal power. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 600 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

Annex 8.4.1 - Winter 2020 - 10GW



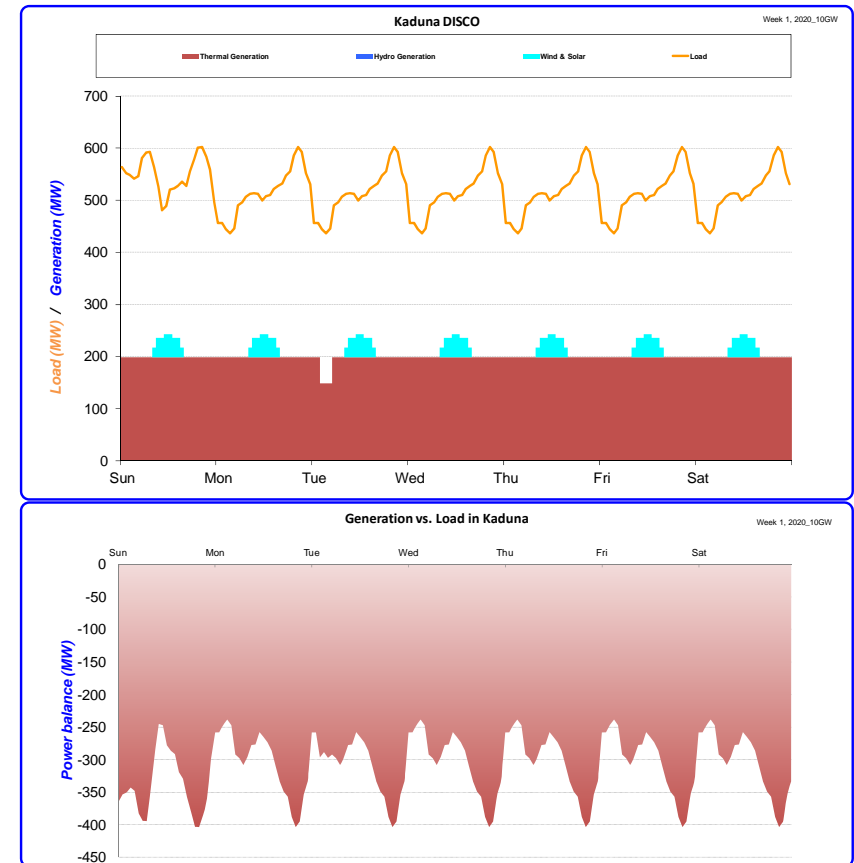
In 2020 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 700 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO.

Annex 8.4.1 - Winter 2020 - 10GW



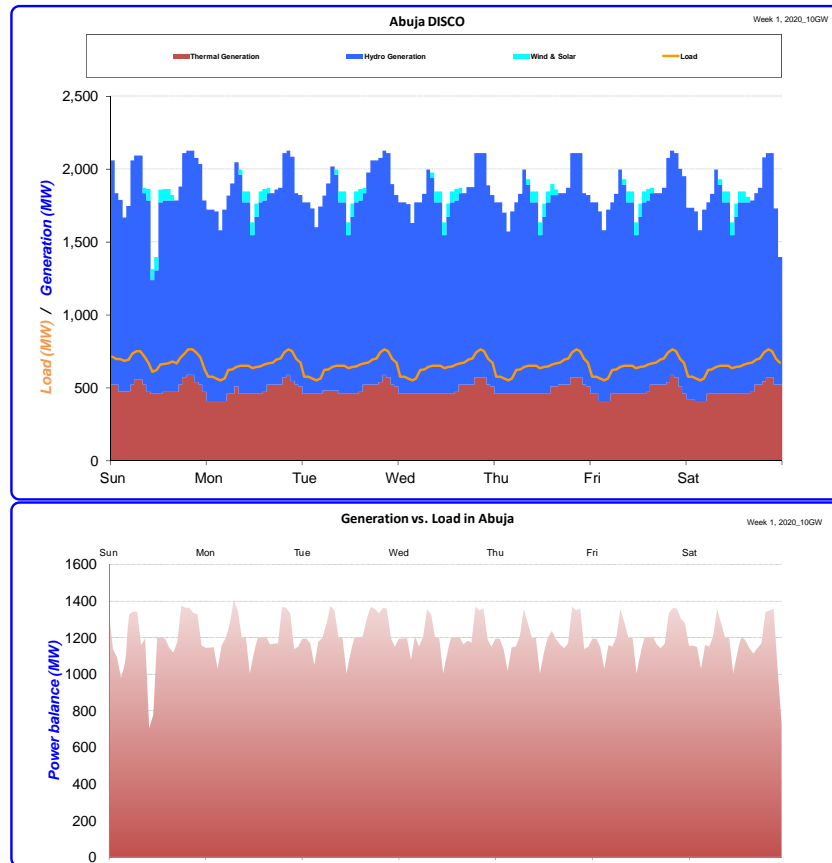
In 2020 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 270 MW and is obtained mainly via transfer from Pt Harco DISCO.

Annex 8.4.1 - Winter 2020 - 10GW



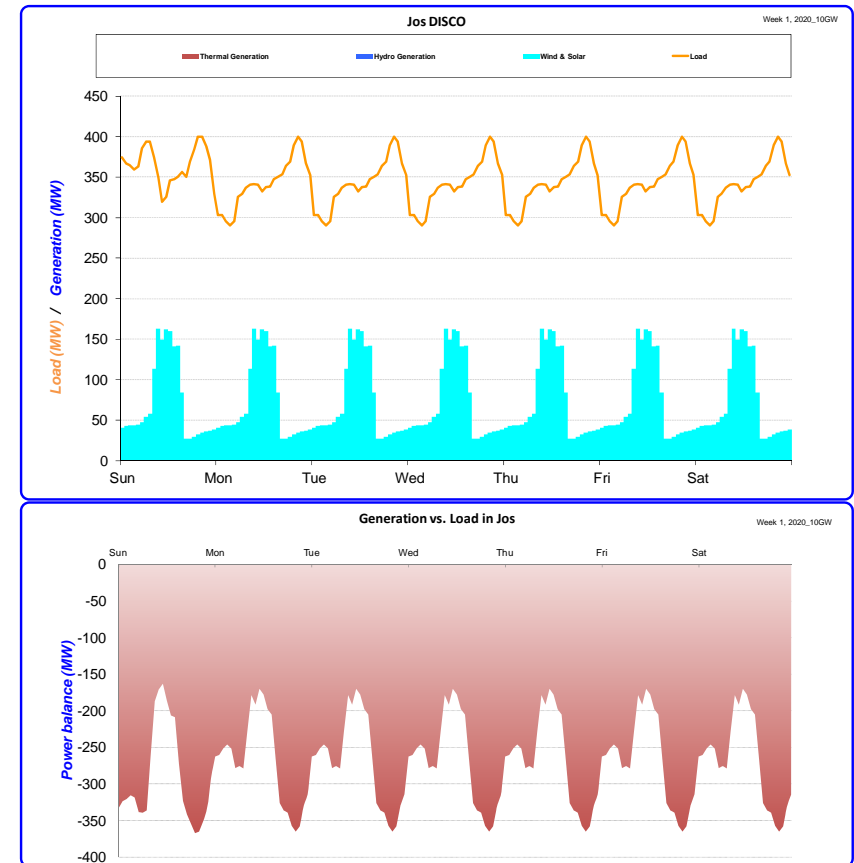
In 2020 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a third of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 400 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.4.1 - Winter 2020 - 10GW



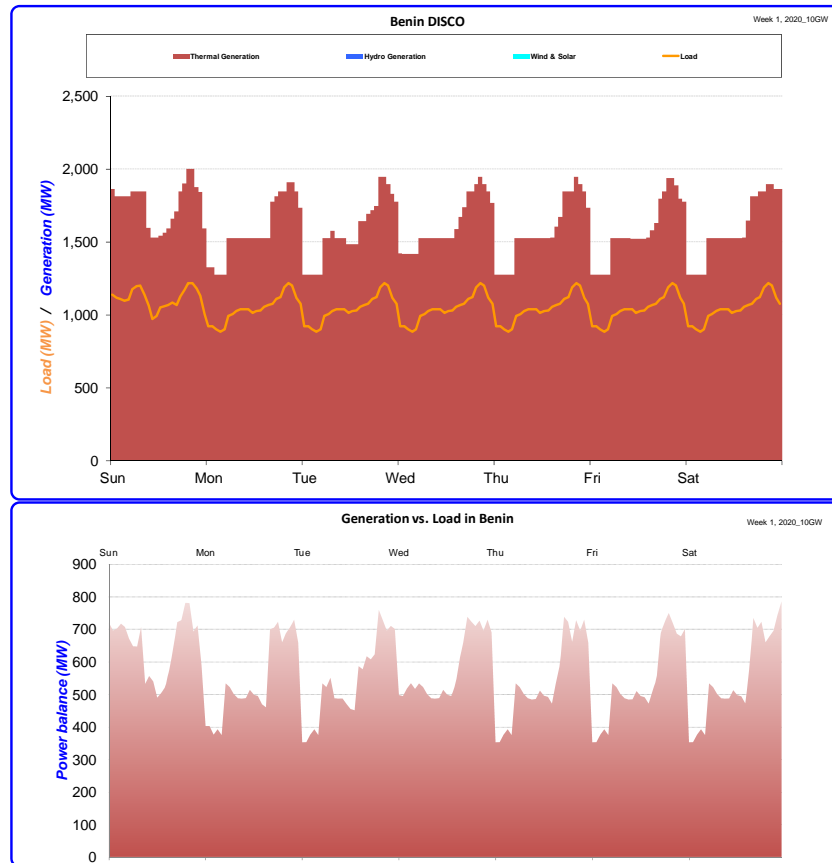
The Abuja DISCO in 2020 is a net exporter of power. The exported power reaches 1300 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria.

Annex 8.4.1 - Winter 2020 - 10GW



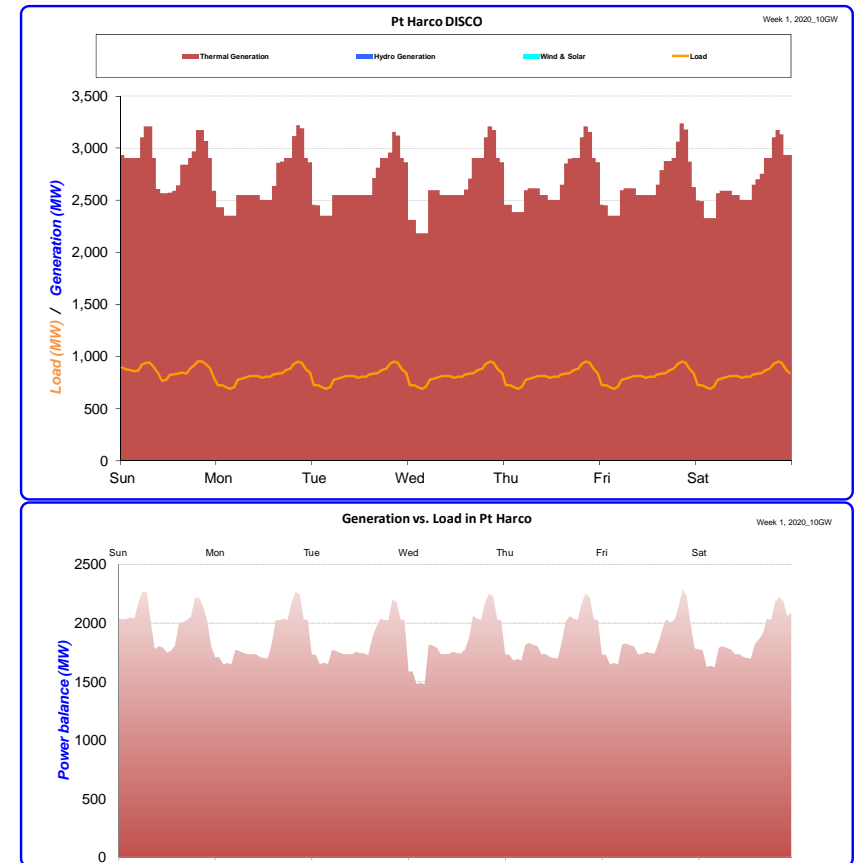
In 2020 Jos DISCO remains a net importer of power. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 360 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

Annex 8.4.1 - Winter 2020 - 10GW



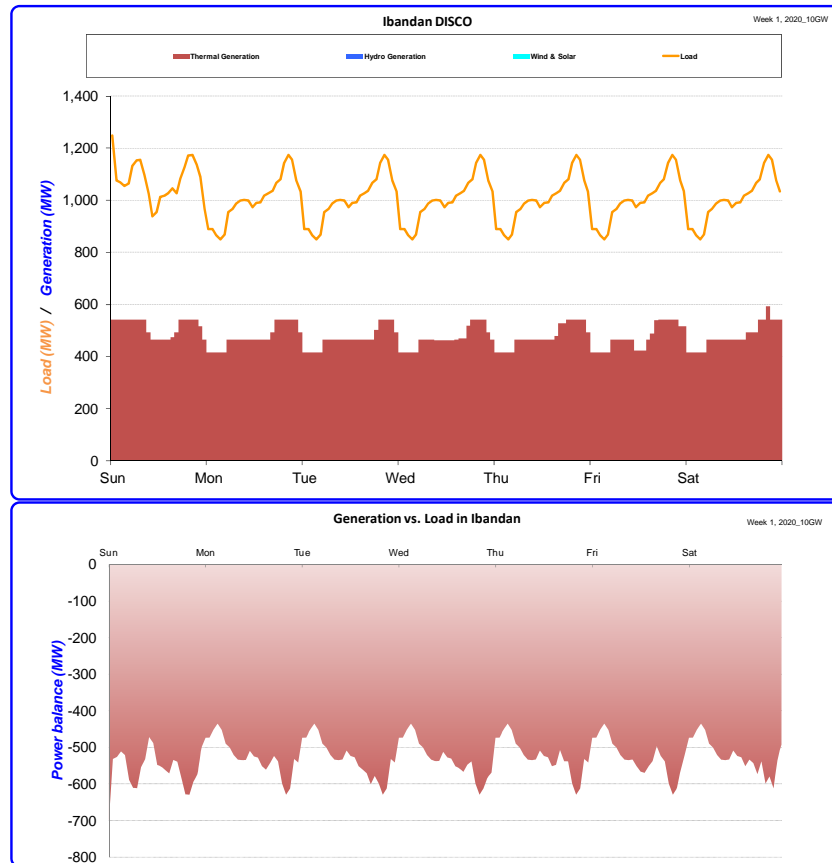
The Benin DISCO in 2020 is a net exporter of power. The exported power reaches 780 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs.

Annex 8.4.1 - Winter 2020 - 10GW



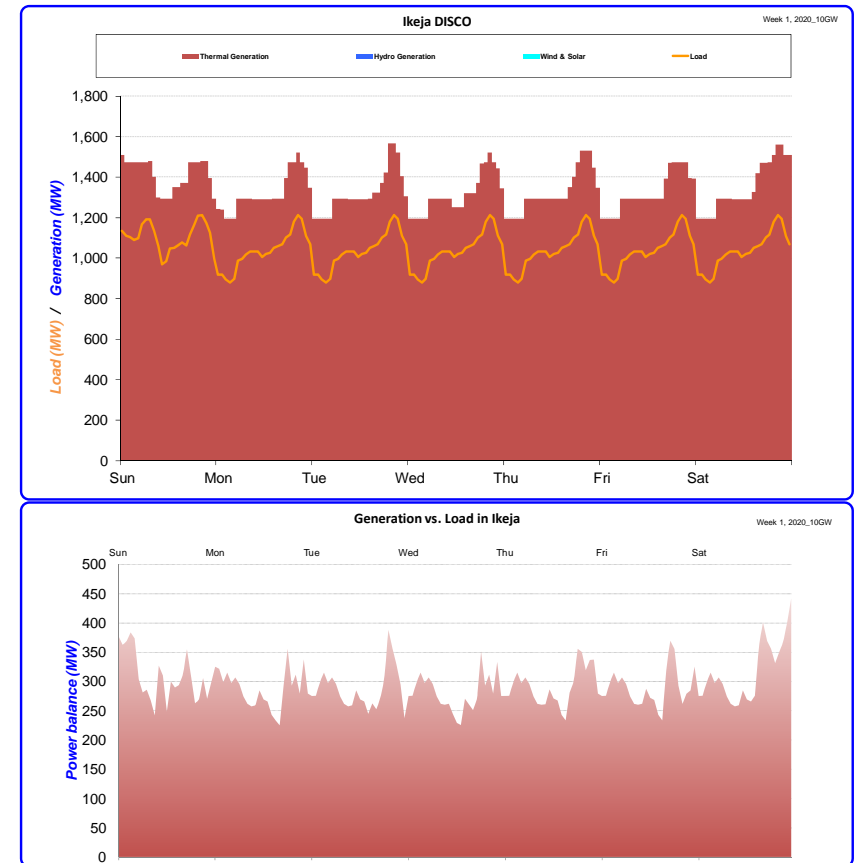
The Pt Harco DISCO in 2020 is a net exporter of power. The exported power reaches 2200MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs.

Annex 8.4.1 - Winter 2020 - 10GW



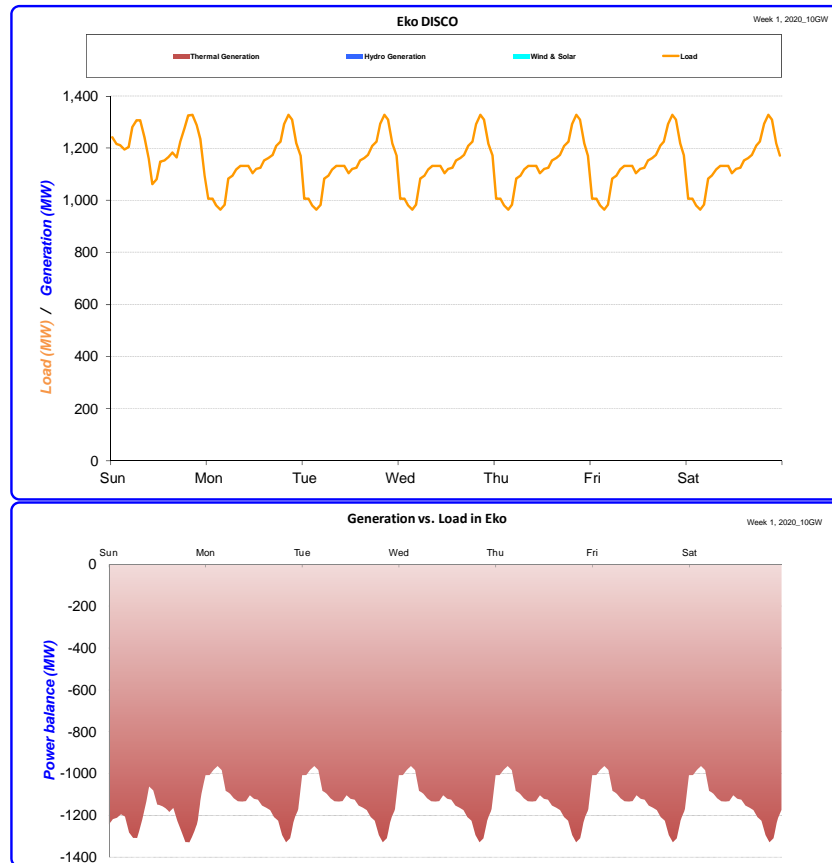
In 2020 Ibandan DISCO remains a net importer of power. The installed thermal power can supply only a third of the load. The imported power peaks to 600 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.4.1 - Winter 2020 - 10GW



The Ikeja DISCO in 2020 is a net exporter of power. The exported power reaches 380 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

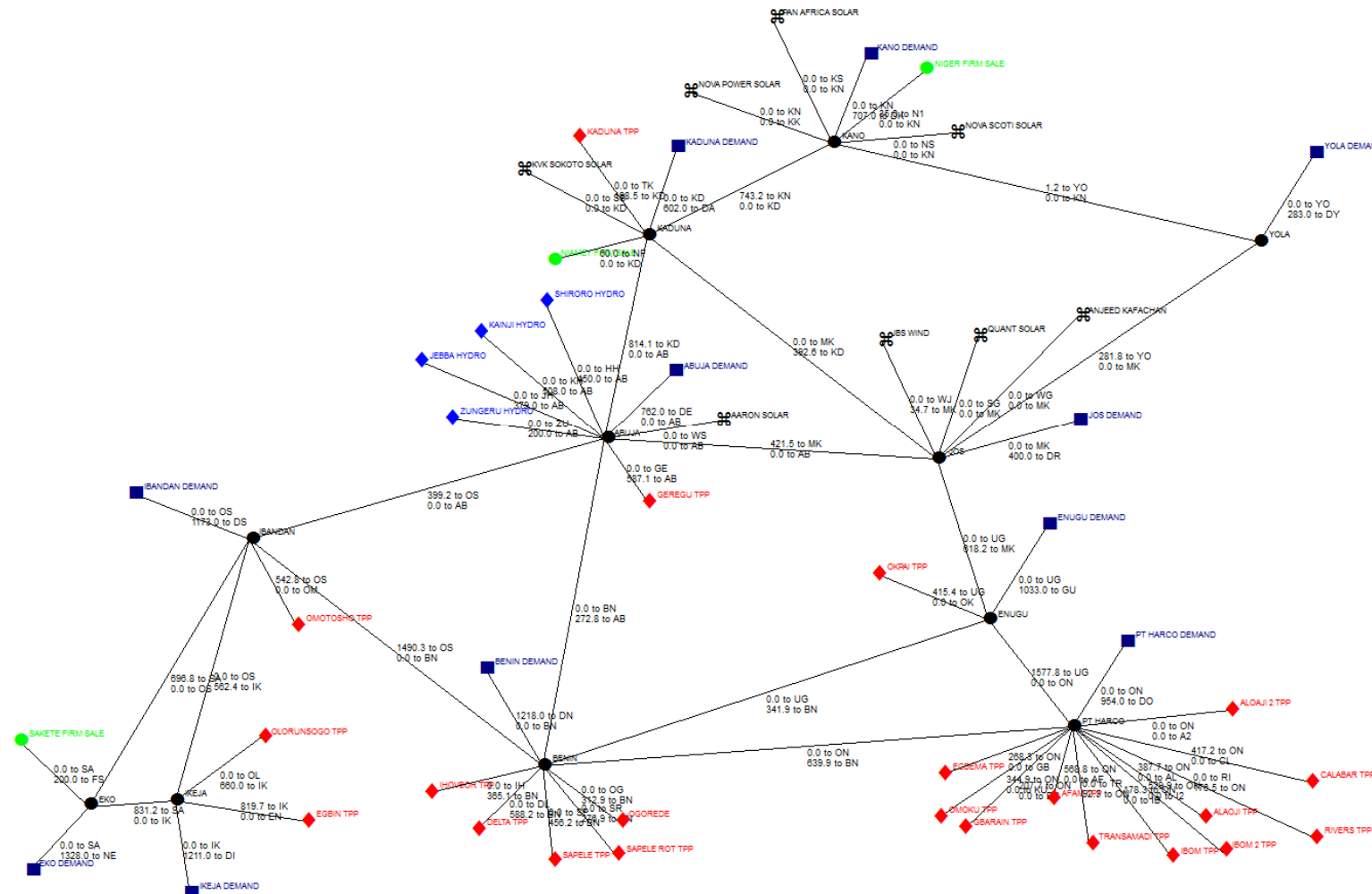
Annex 8.4.1 - Winter 2020 - 10GW



In 2020 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1300 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

Annex 8.4.1 - Winter 2020 - 10GW

Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	21

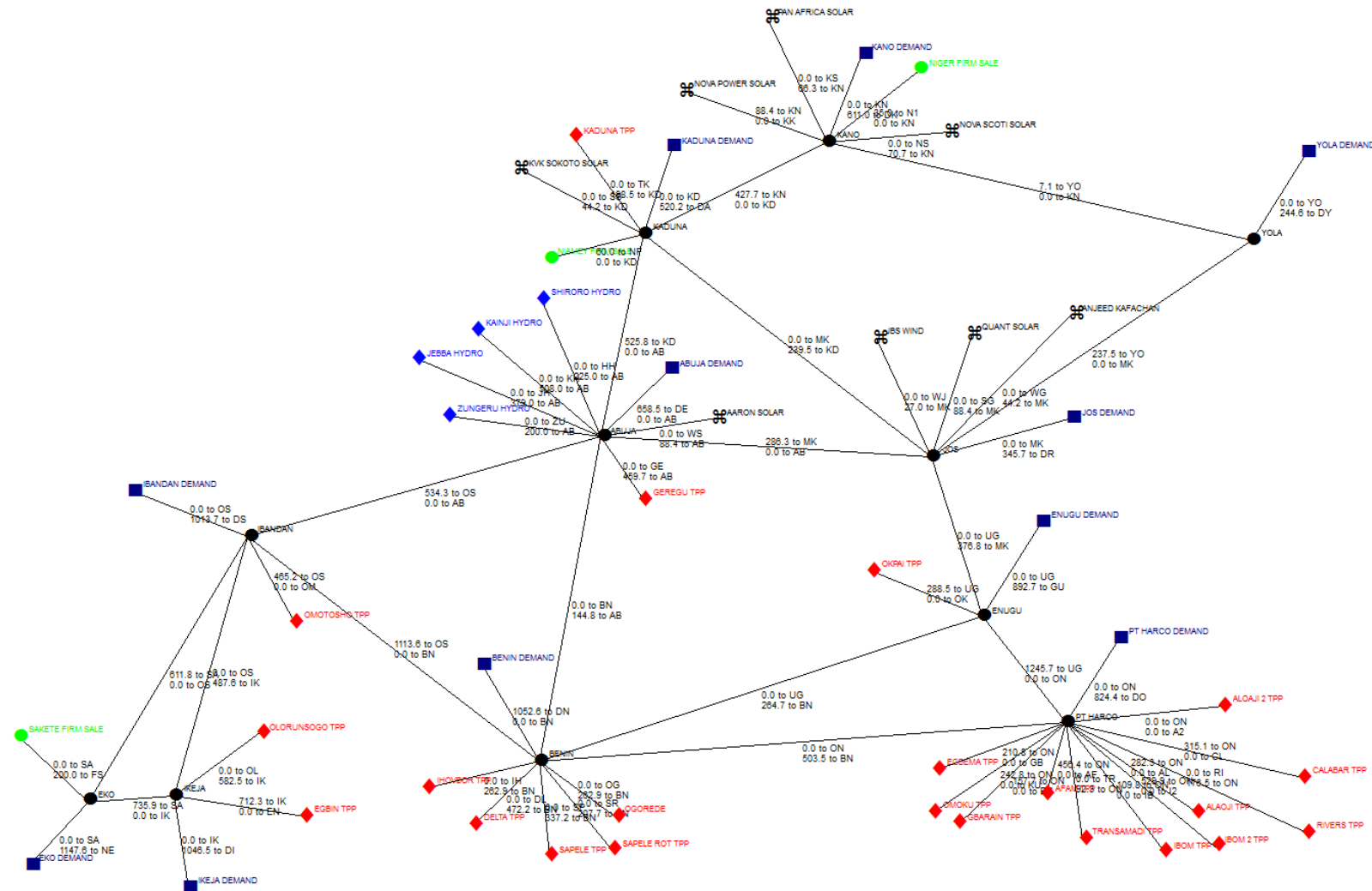


Annex 8.4.1
Winter 2020 - 10GW

Power flow during peak hours: The power flows between the DISCOs in Nigeria for the peaking hours in winter in 2020 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco and Ikeja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

Annex 8.4.1 - Winter 2020 - 10GW

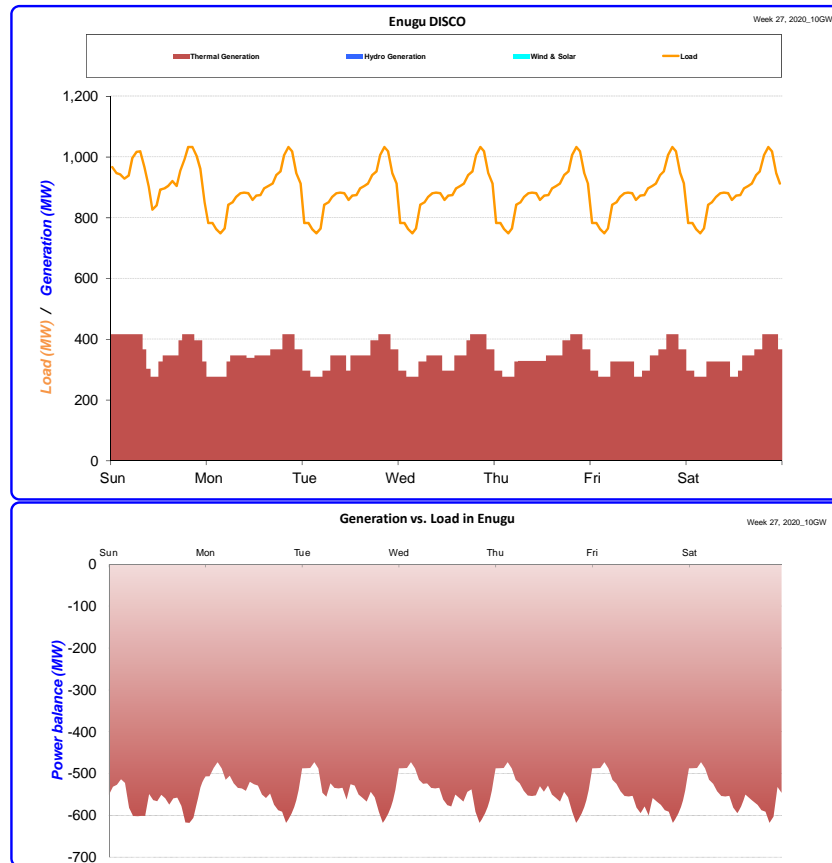
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	13



Annex 8.4.1
Winter 2020 - 10GW

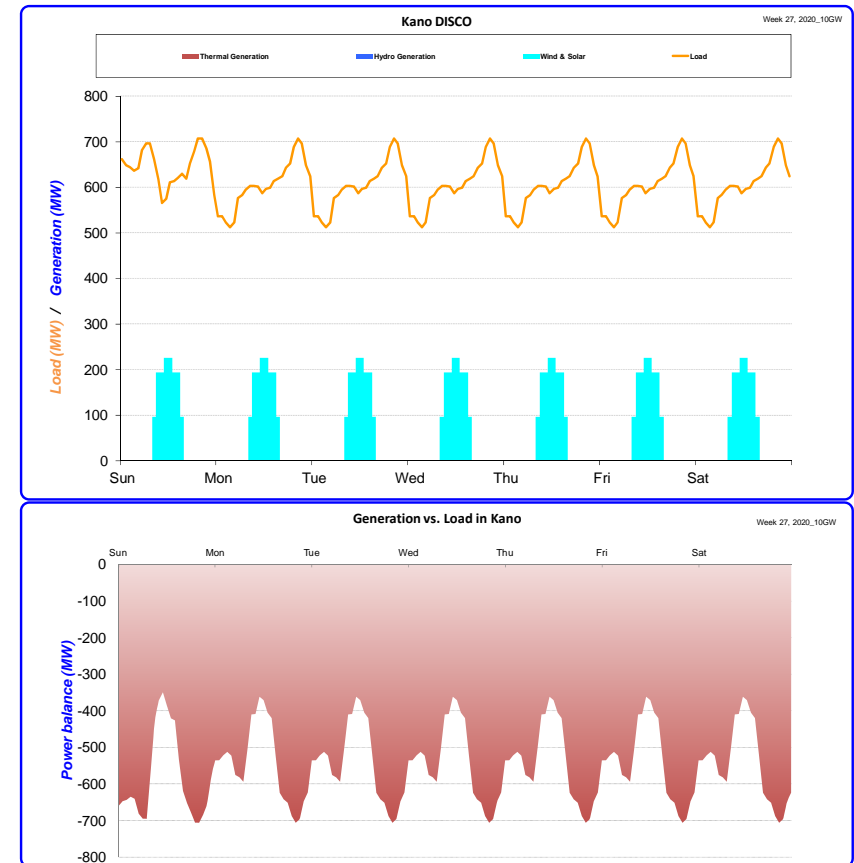
Power flow during Off-peak hours: During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Abuja to Kaduna 526 MW in off peak and 814 MW in peak hours.

Annex 8.4.2 - Summer 2020 - 10GW



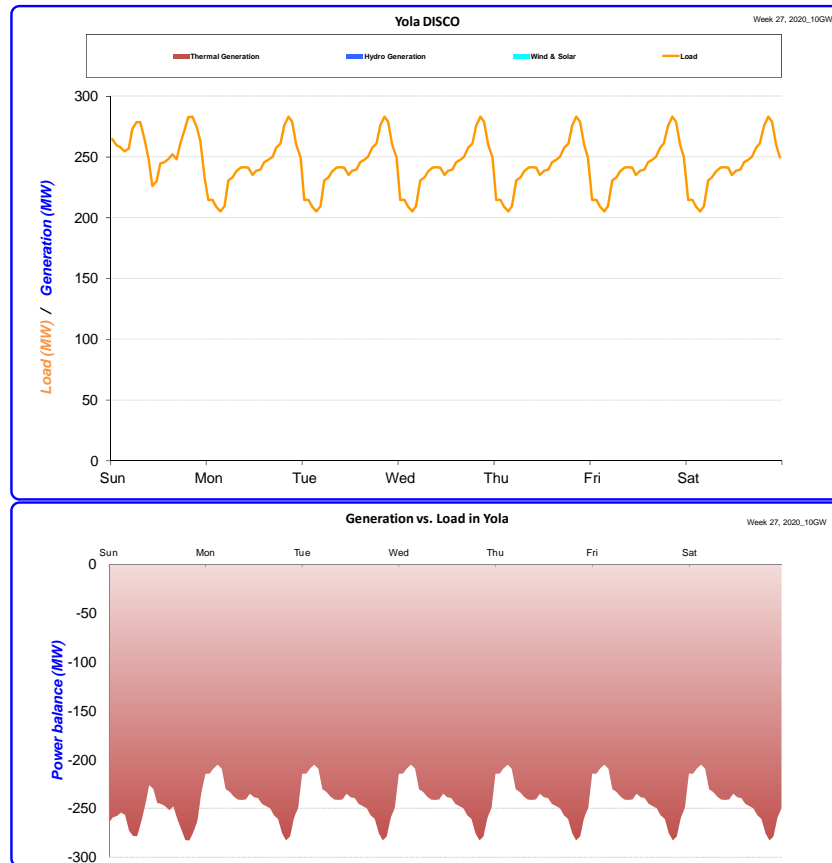
The generation profile of Enugu DISCO is based on thermal power. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco DISCO. The peak of imported power reaches 600 MW which can be transferred via the available transmission infrastructure between the two DISCOs. The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW



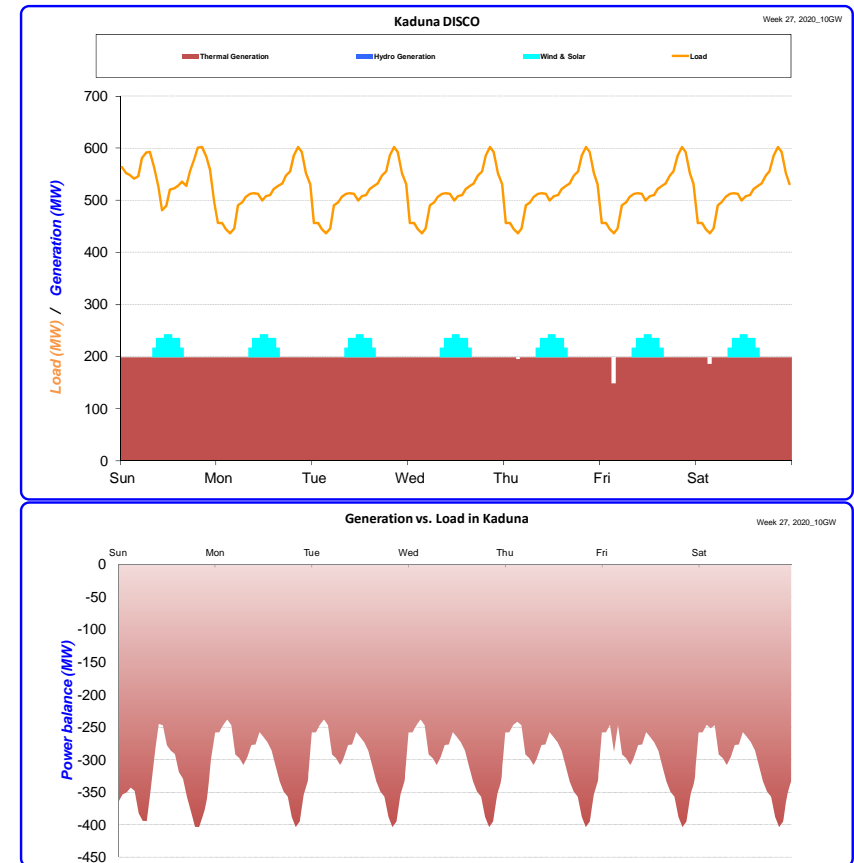
In 2020 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 700 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW



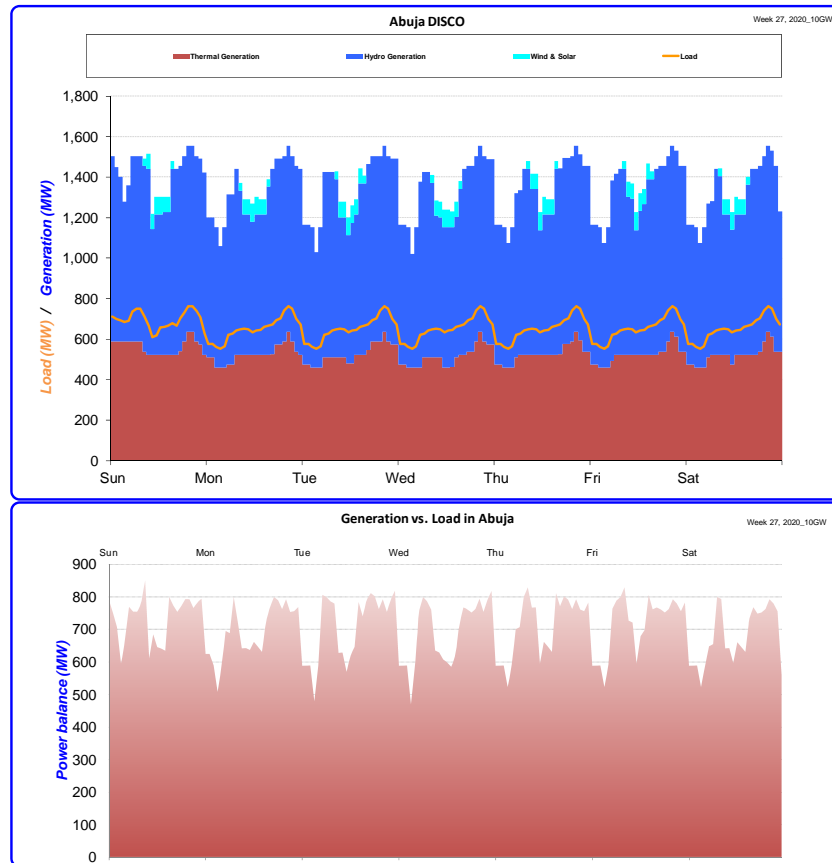
In 2020 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 270 MW and is obtained mainly via transfer from Pt Harco DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW



In 2020 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a third of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 400 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

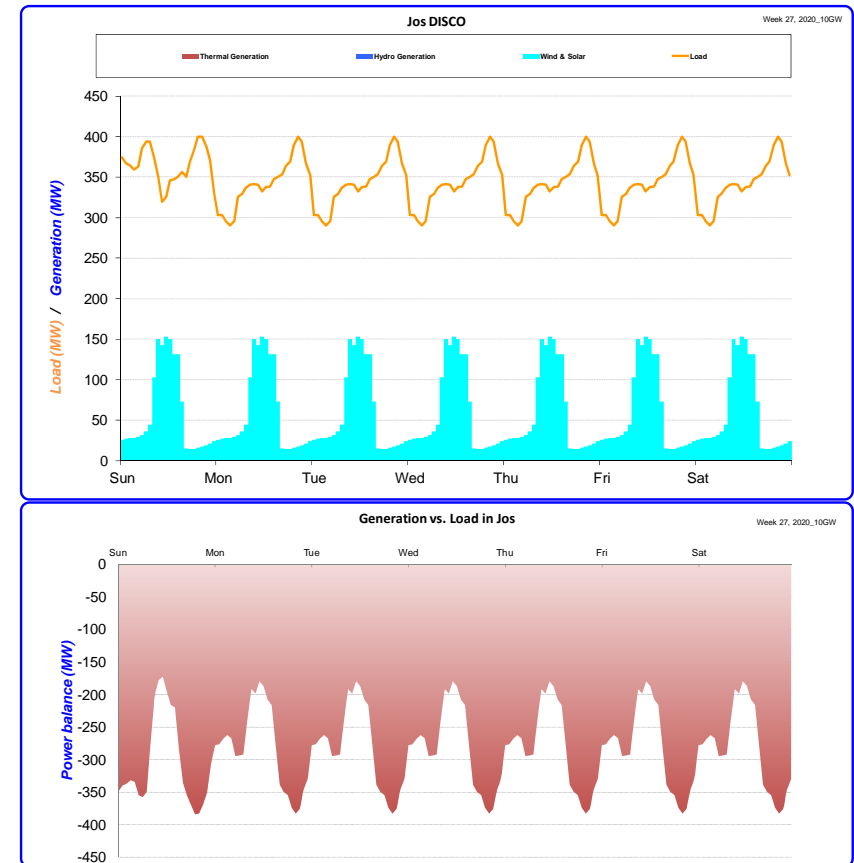
Annex 8.4.2 - Summer 2020 - 10GW



The Abuja DISCO in 2020 is a net exporter of power. The exported power reaches 800 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria.

The summer season is characterized with reduced hydro generation, due to seasonal conditions. Therefore, about 500 MW peaking power less than in the winter season can be exported to the north.

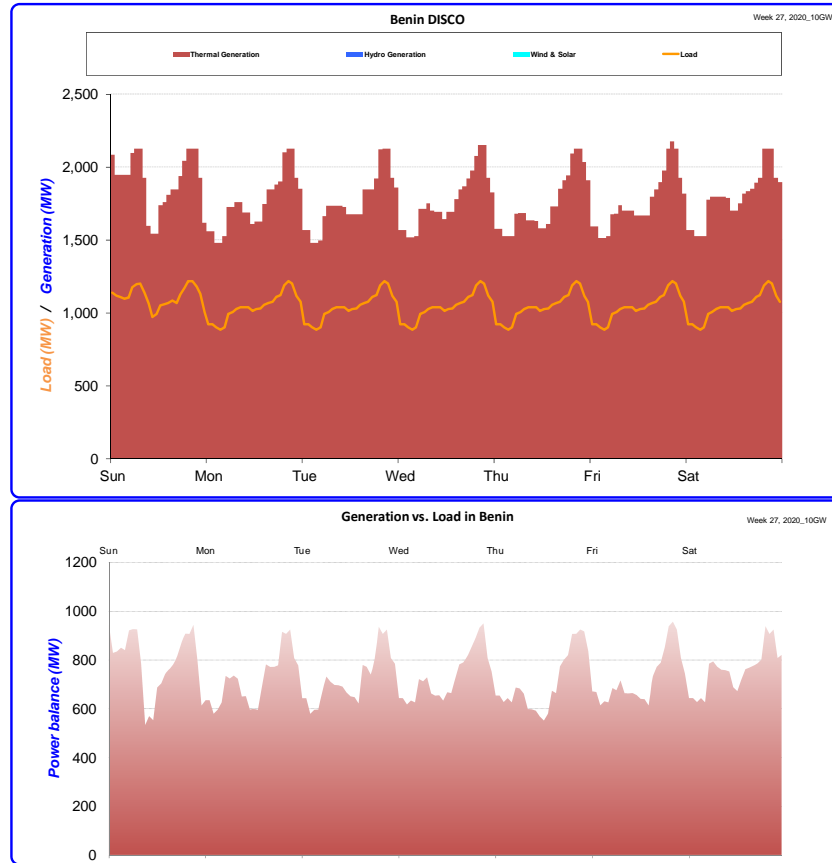
Annex 8.4.2 - Summer 2020 - 10GW



In 2020 Jos DISCO remains a net importer of power. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 360 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

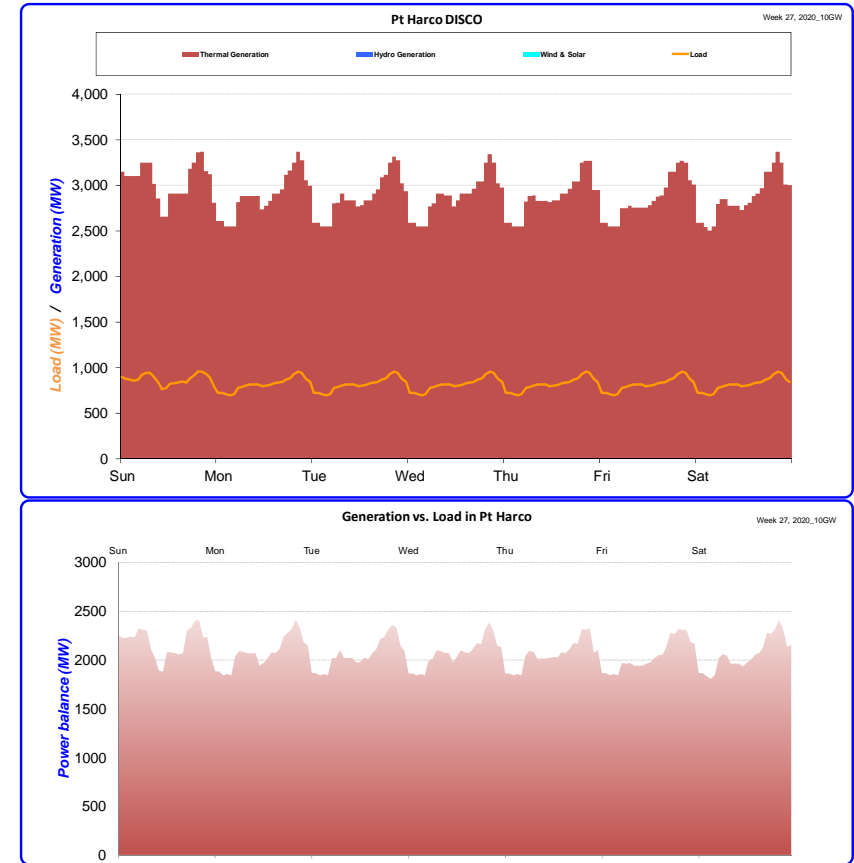
The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW



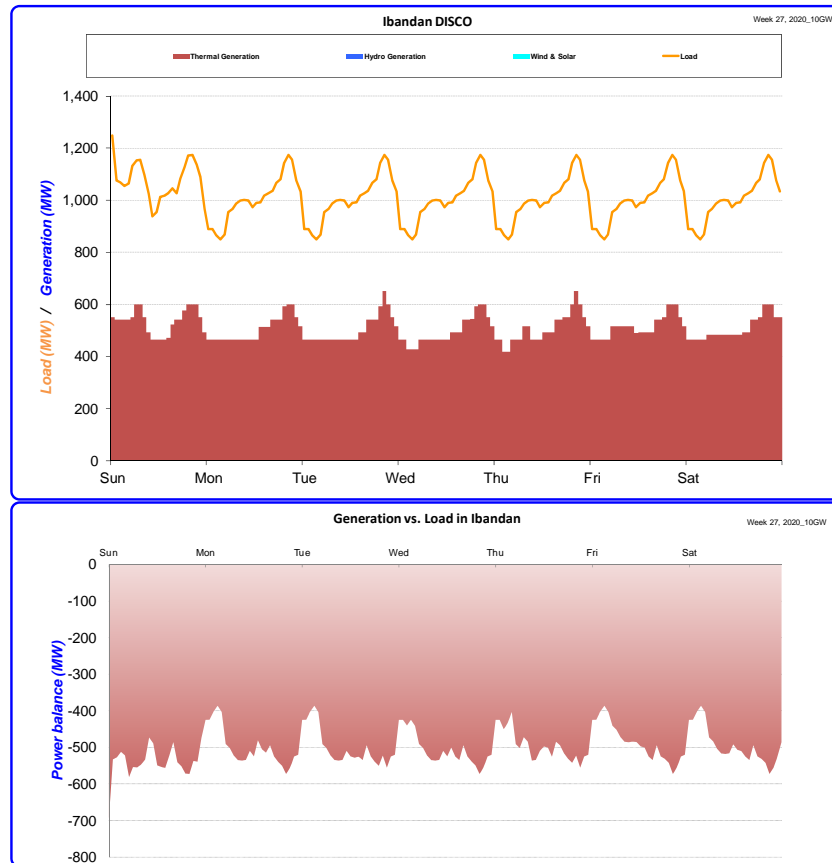
The Benin DISCO in 2020 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. In the summer season the exported power is higher, due to the lower availability of hydro power in Abuja DISCO.

Annex 8.4.2 - Summer 2020 - 10GW



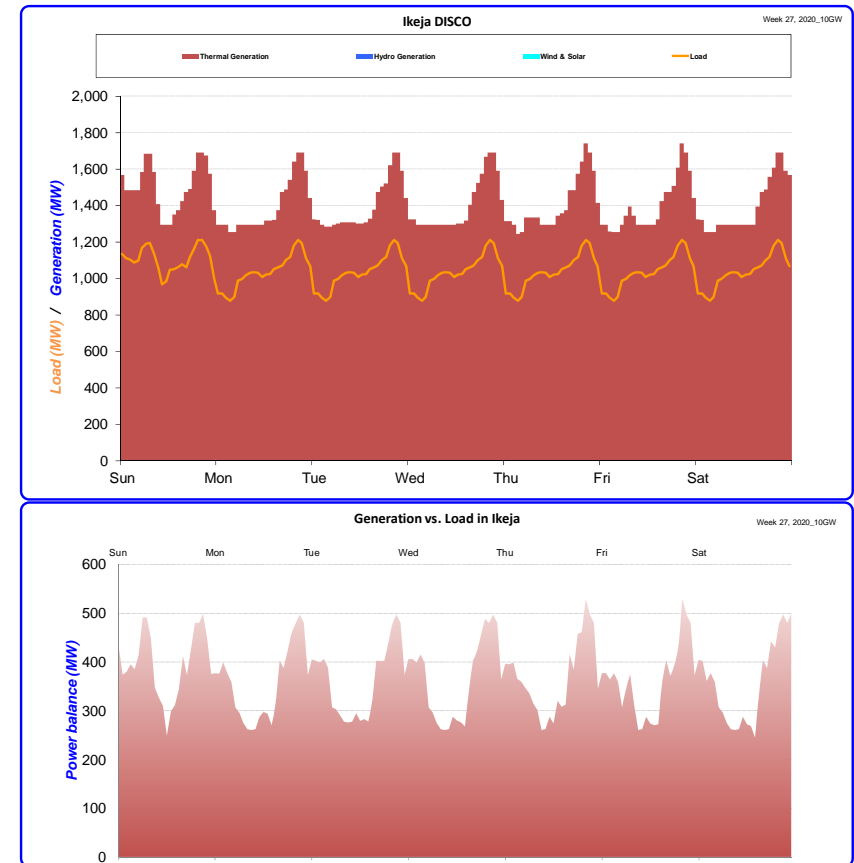
The Pt Harco DISCO in 2020 is a net exporter of power. The exported power reaches 2200MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW



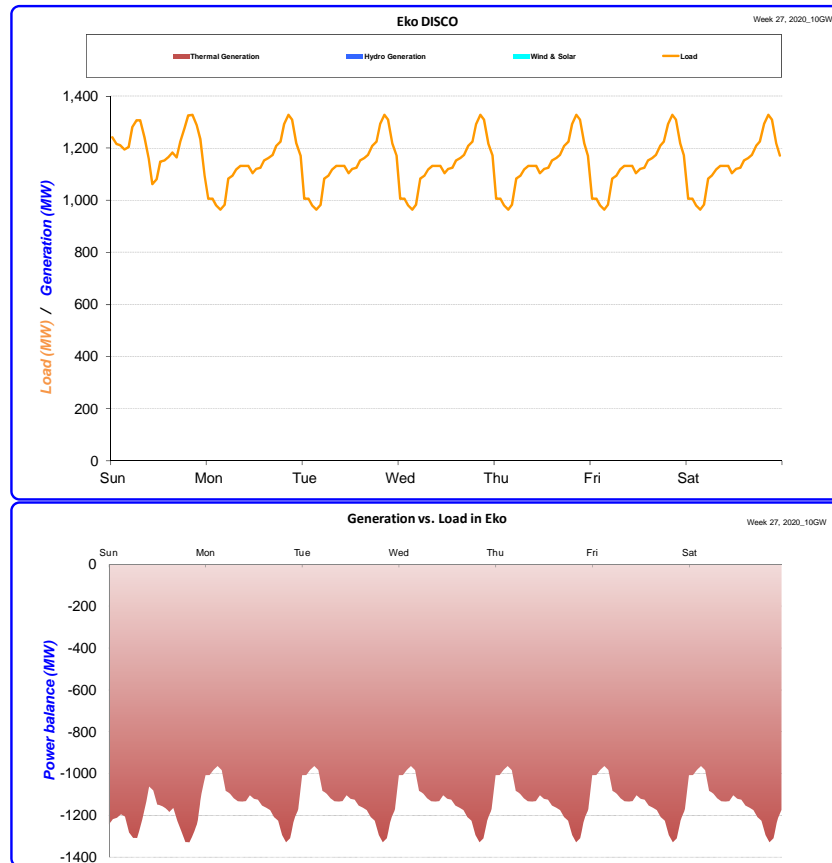
In 2020 Ibandan DISCO remains a net importer of power. The installed thermal power can supply only a third of the load. The imported power peaks to 550 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW



The Ikeja DISCO in 2020 is a net exporter of power. The exported power reaches 500 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

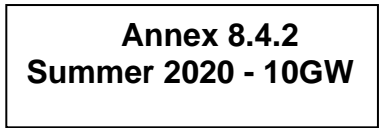
Annex 8.4.2 - Summer 2020 - 10GW



In 2020 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1300 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

Annex 8.4.2 - Summer 2020 - 10GW

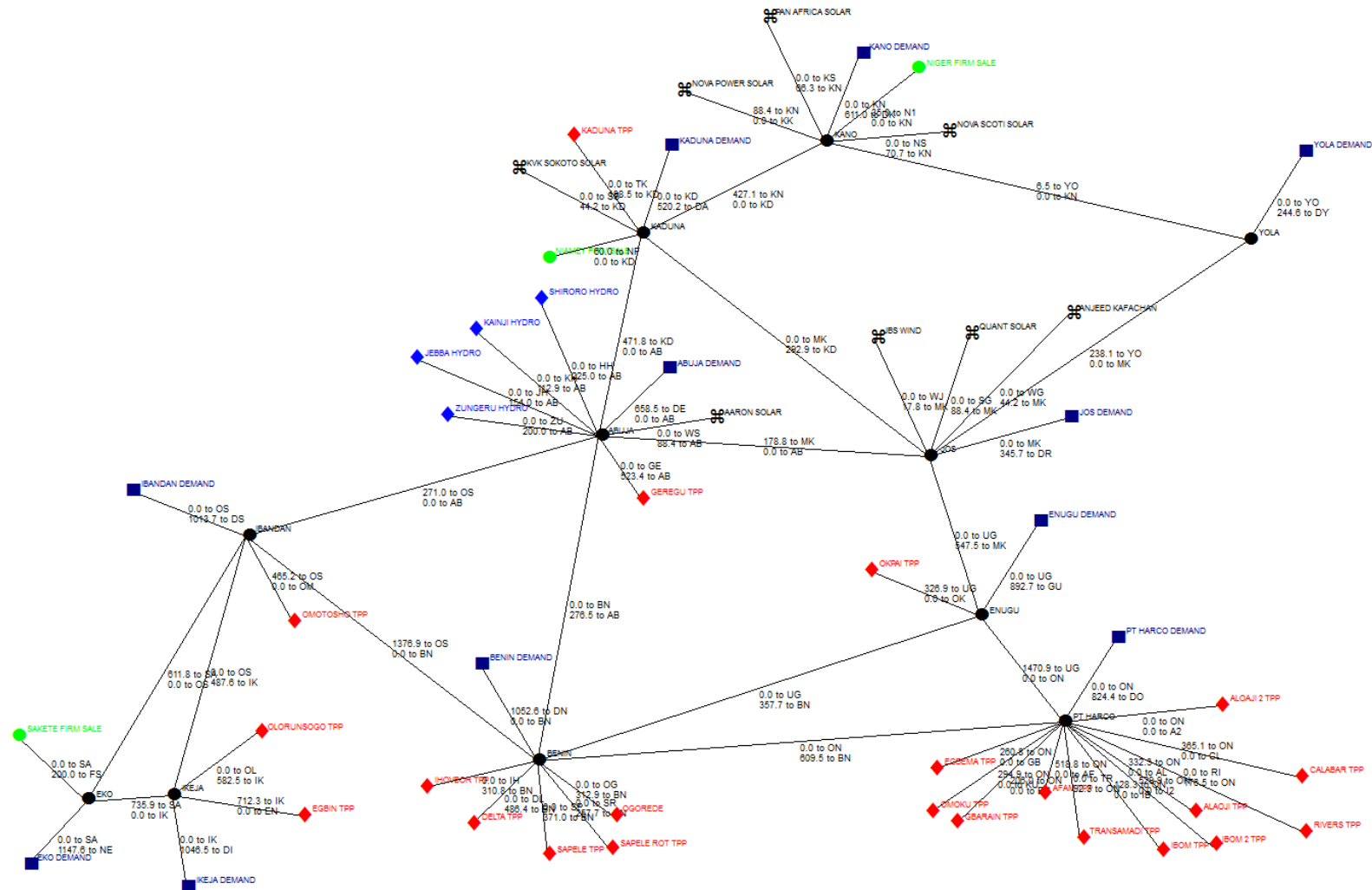
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	27: 27 Jul W1	Sun.	21



Power flow during peak hours: The power flows between the DISCOs in Nigeria for the peaking hours in summer in 2020 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco and Ikeja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

Annex 8.4.2 - Summer 2020 - 10GW

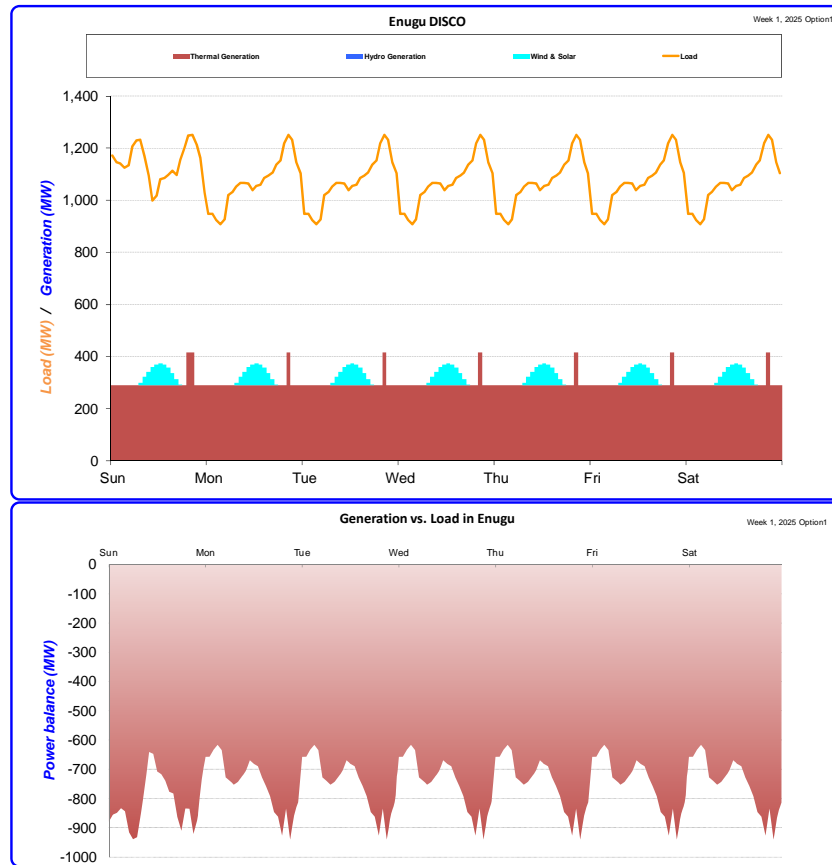
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	27: 27 Jul W1	Sun.	13



**Annex 8.4.2
Summer 2020 - 10GW**

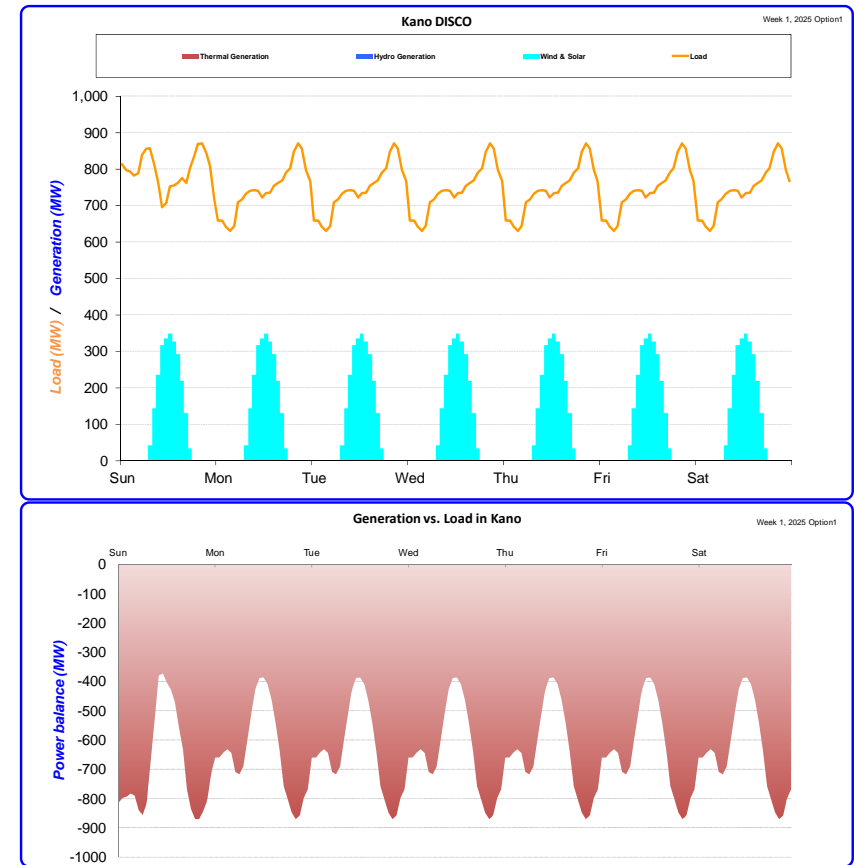
Power flow during Off-peak hours: During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Abuja to Kaduna 471 MW in off peak and 777 MW in peak hours.

Annex 8.5.1 - Winter 2025 - Option 1



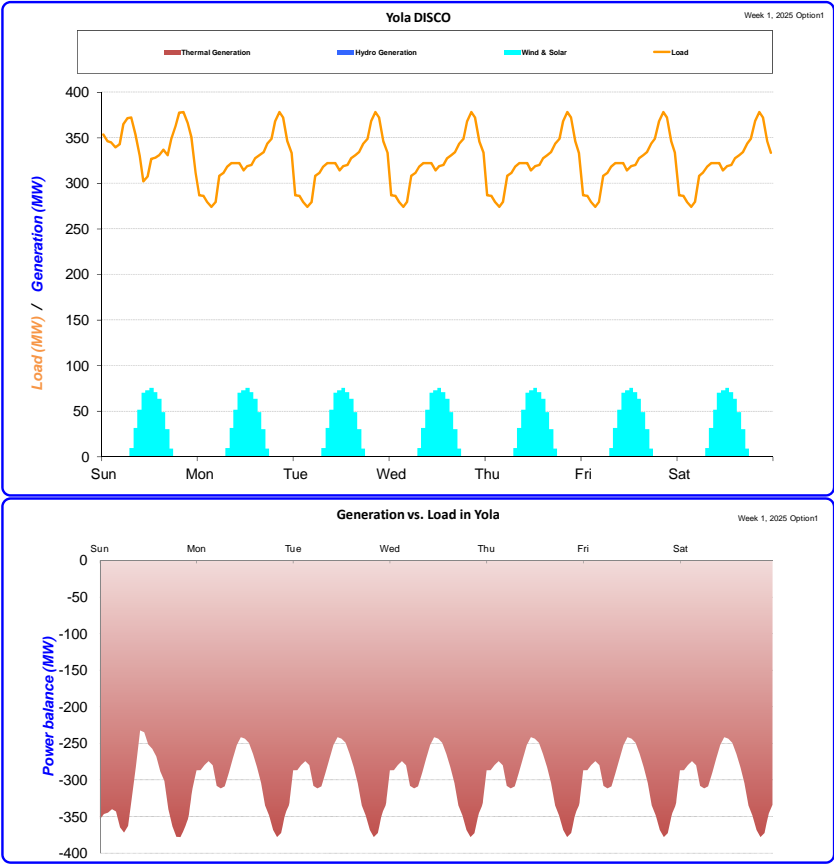
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

Annex 8.5.1 - Winter 2025 - Option 1



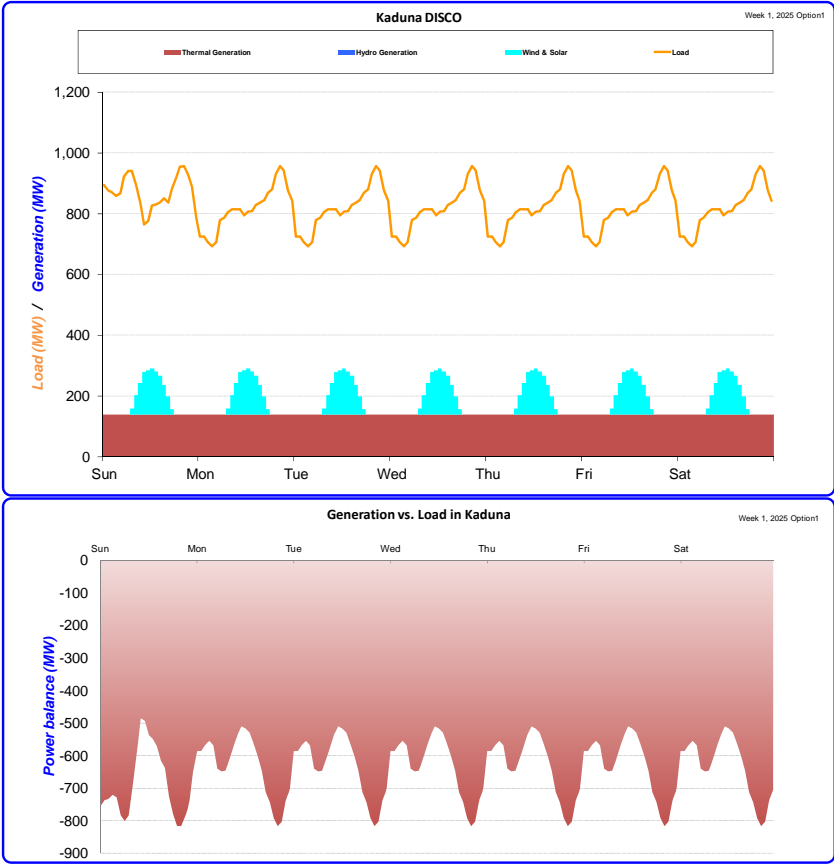
In 2025 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 850 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO.

Annex 8.5.1 - Winter 2025 - Option 1



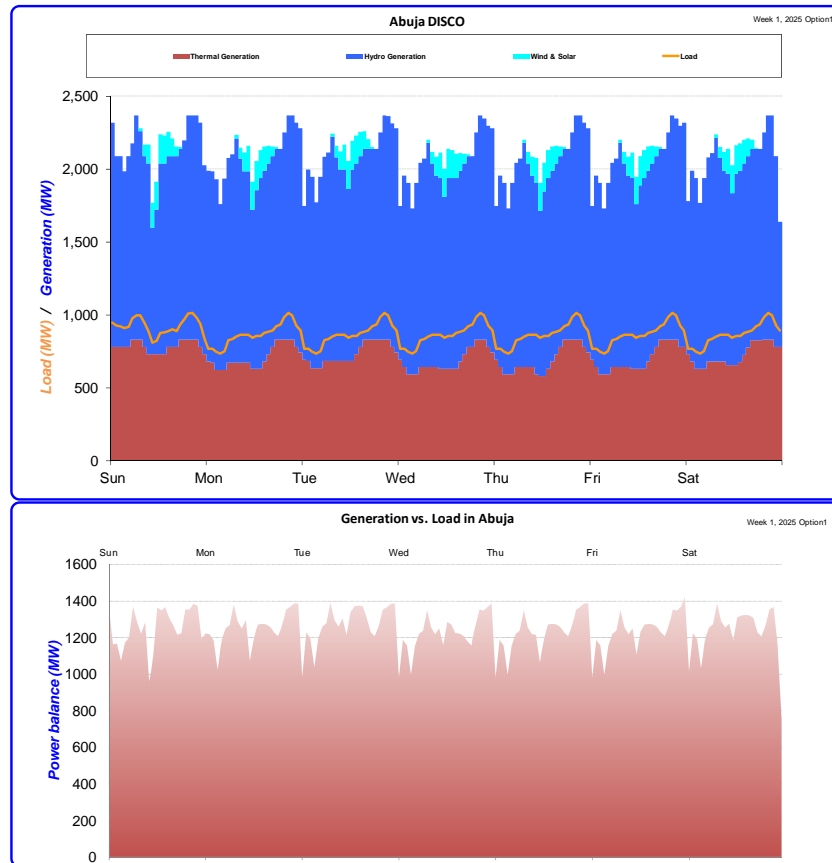
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 350 MW and is obtained mainly via transfer from Pt Harco DISCO.

Annex 8.5.1 - Winter 2025 - Option 1



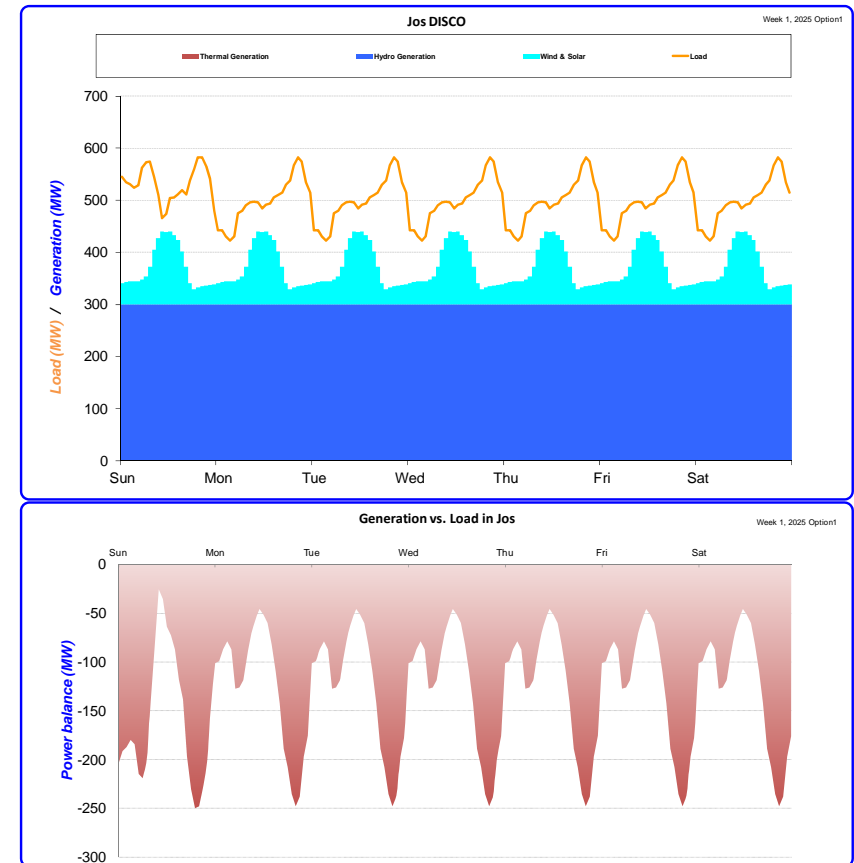
In 2025 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a forth of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 800 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.5.1 - Winter 2025 - Option 1



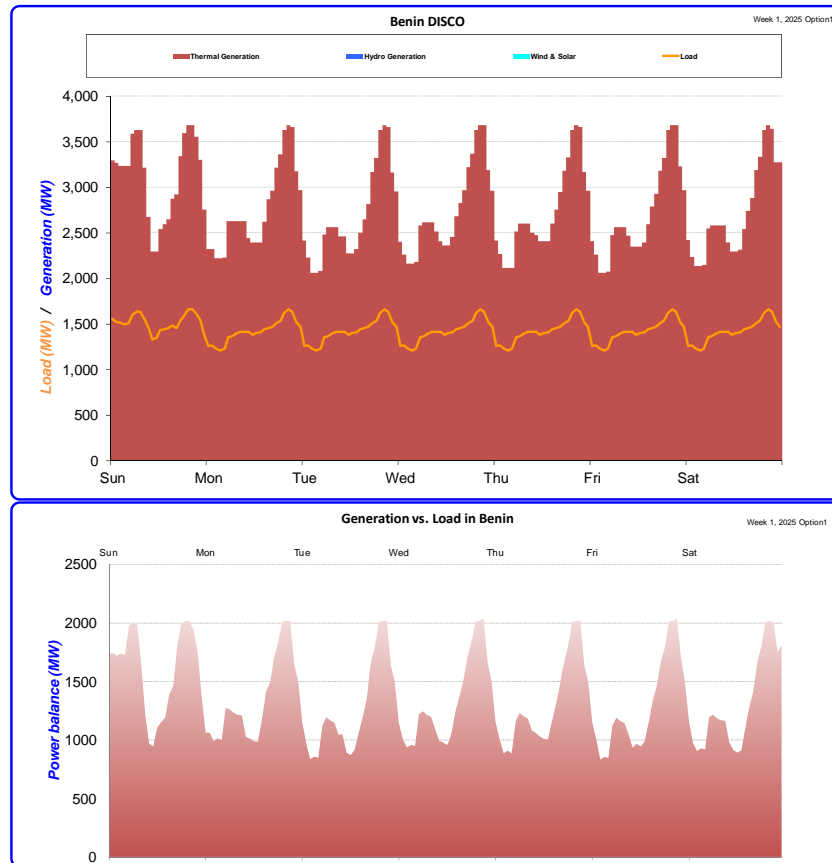
The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 1300 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria.

Annex 8.5.1 - Winter 2025 - Option 1



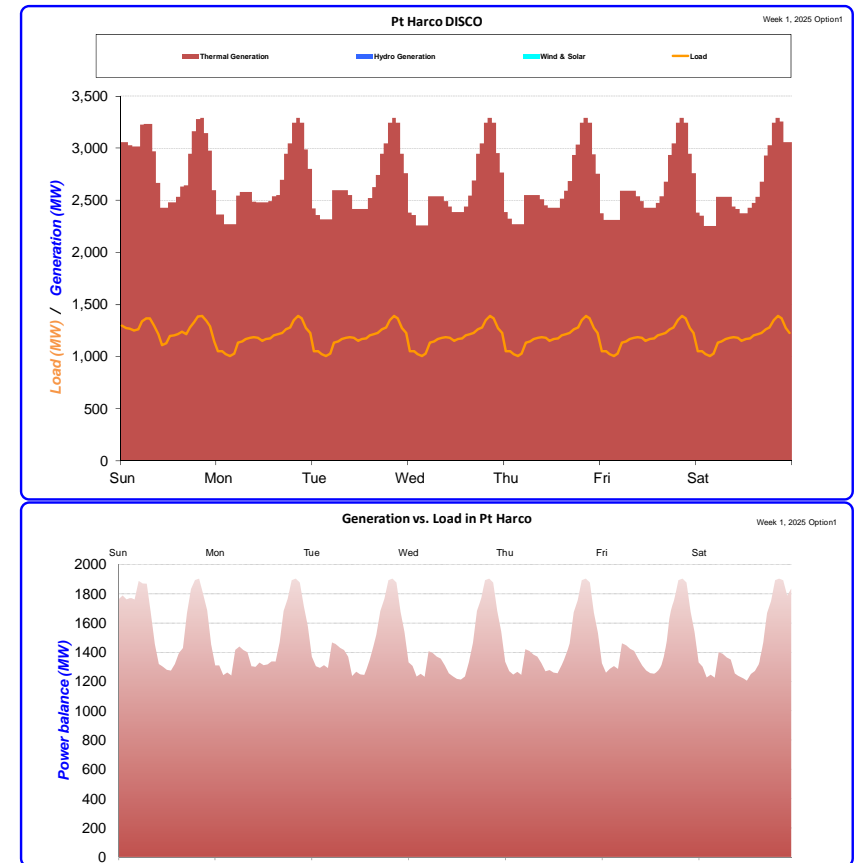
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

Annex 8.5.1 - Winter 2025 - Option 1



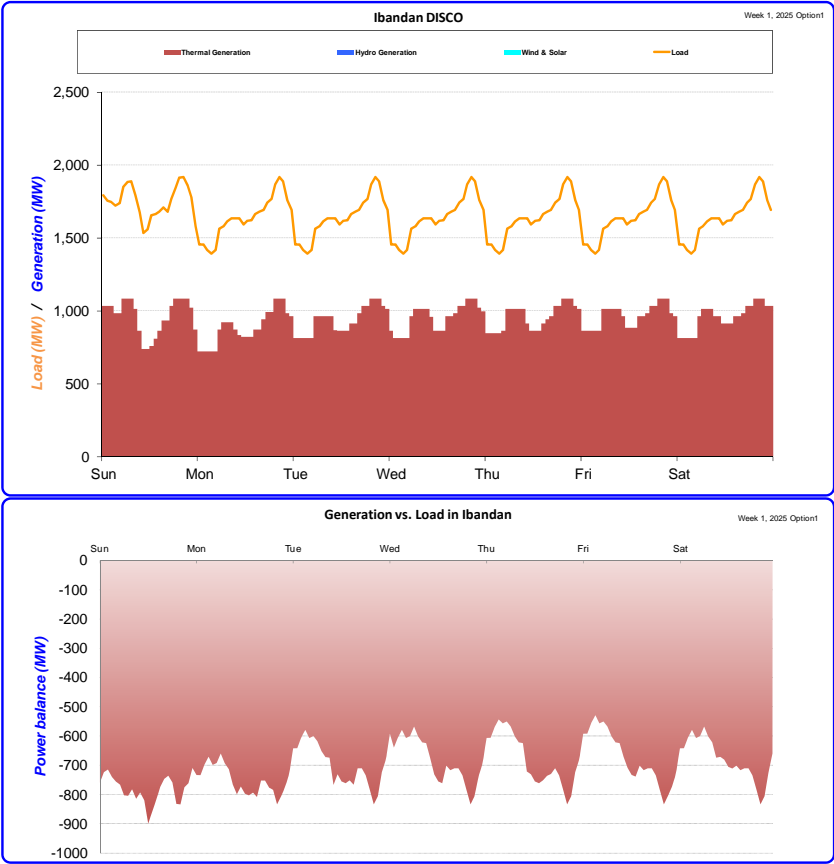
The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 2000 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity.

Annex 8.5.1 - Winter 2025 - Option 1



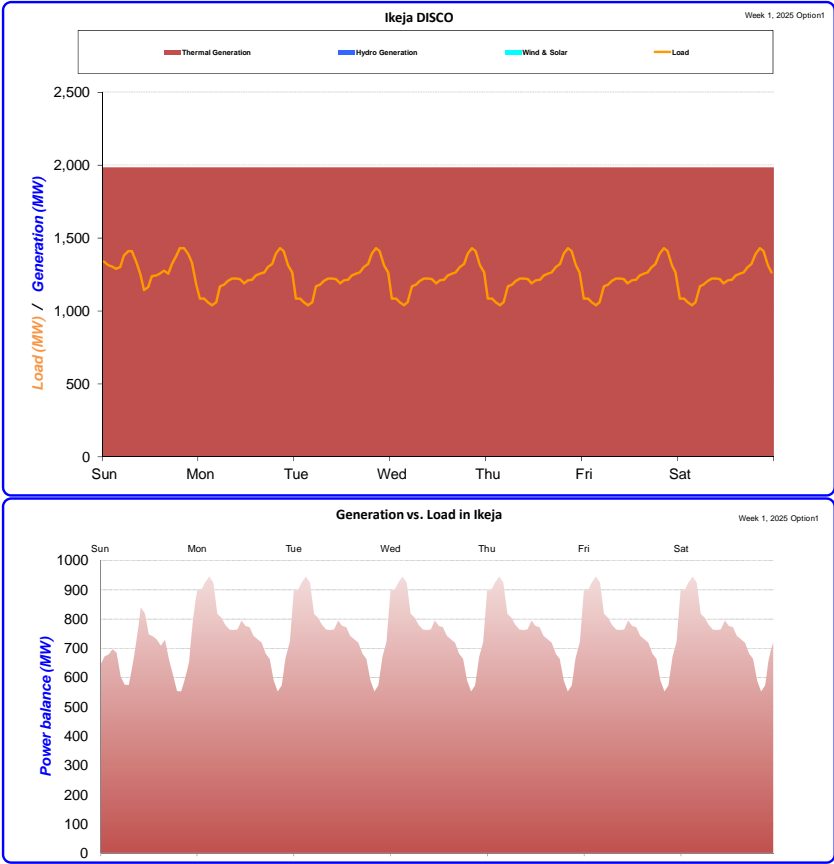
The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 1800MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. The peaking reaches 1800 MW.

Annex 8.5.1 - Winter 2025 - Option 1



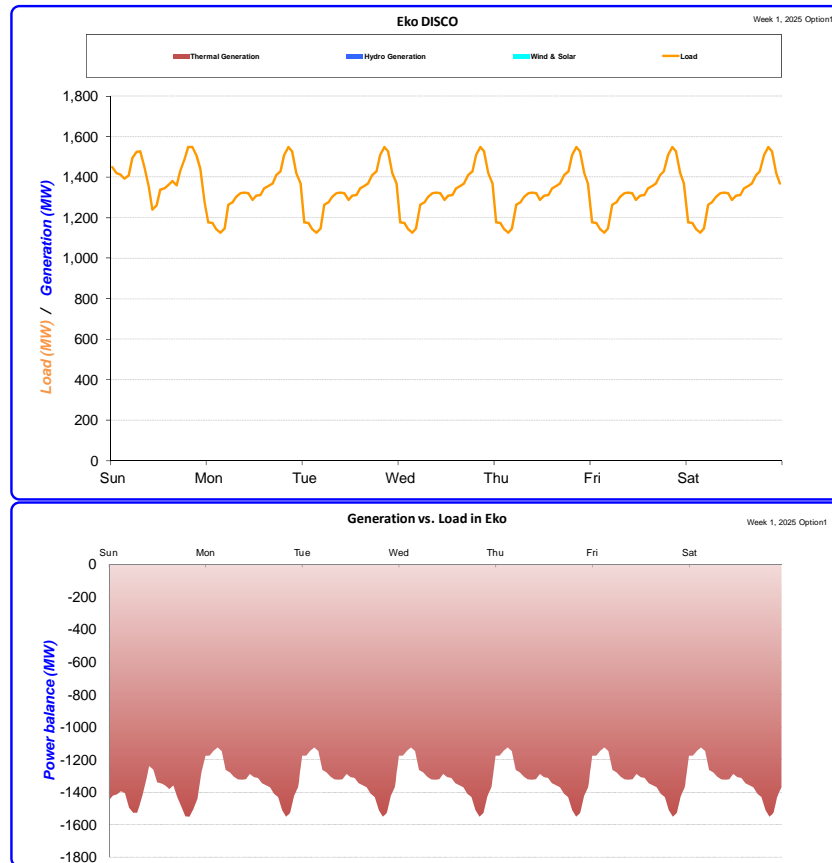
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 850 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.5.1 - Winter 2025 - Option 1



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

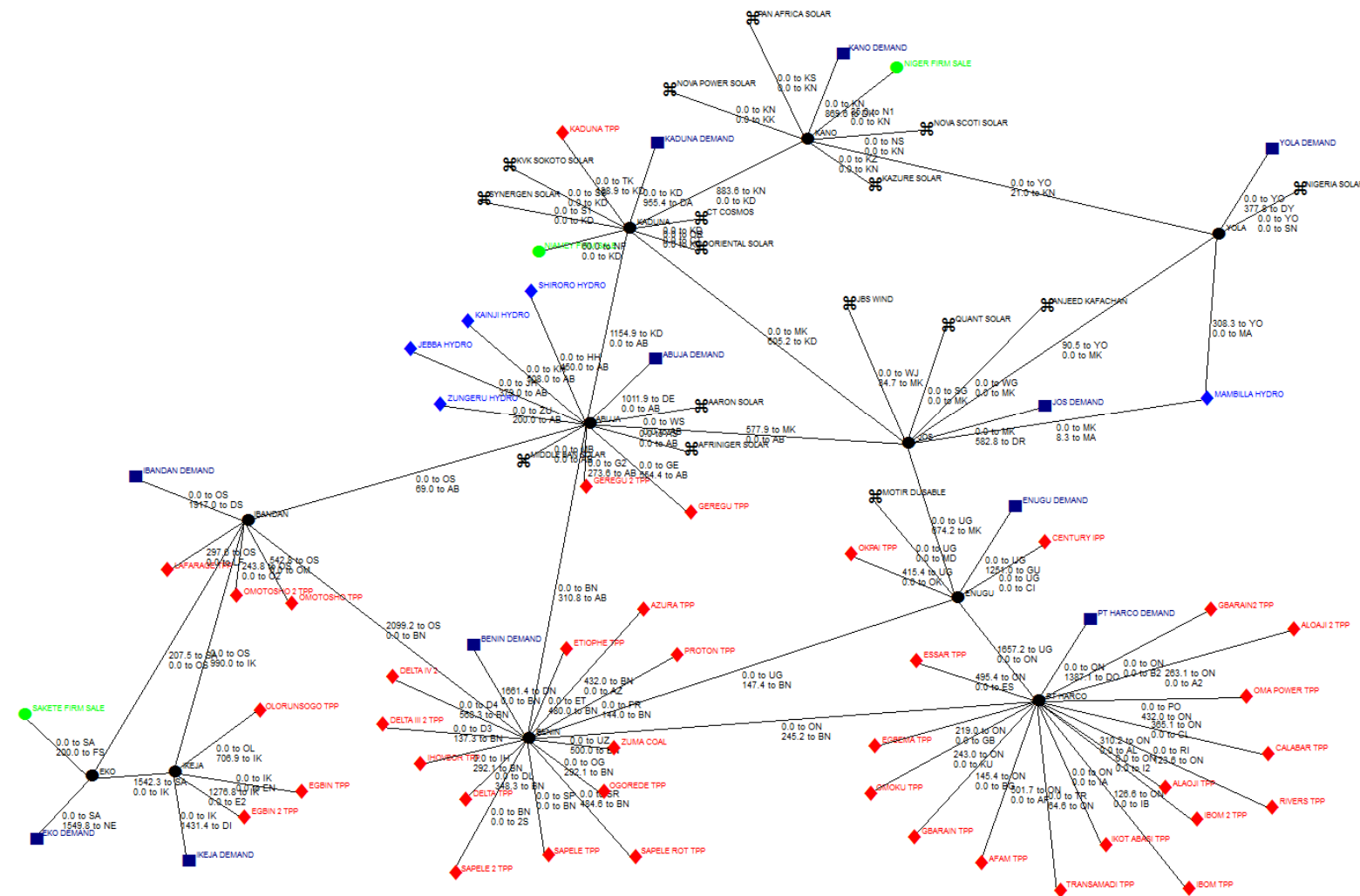
Annex 8.5.1 - Winter 2025 - Option 1



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibadan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibadan DISCO.

Annex 8.5.1 - Winter 2025 - Option 1

Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	21

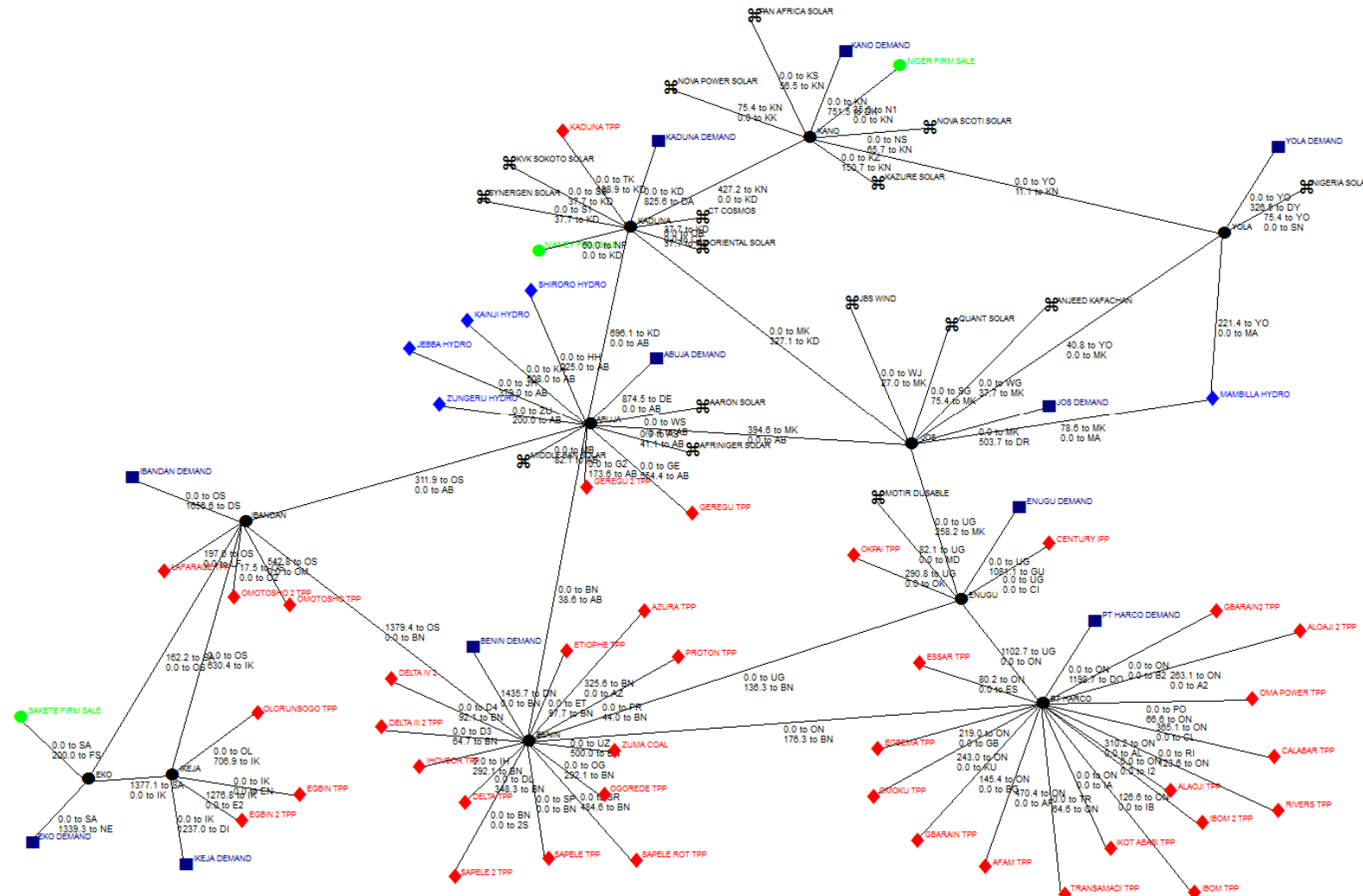


Annex 8.5.1
Winter 2025
Option 1

Power flow during peak hours: The power flows between the DISCOs in Nigeria for the peaking hours in winter in 2025 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco, Abuja and Ikeja. Due to new generation installed in Ibandan DISCO, also Ibandan can export to Eko and Abuja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of

Annex 8.5.1 - Winter 2025 - Option 1

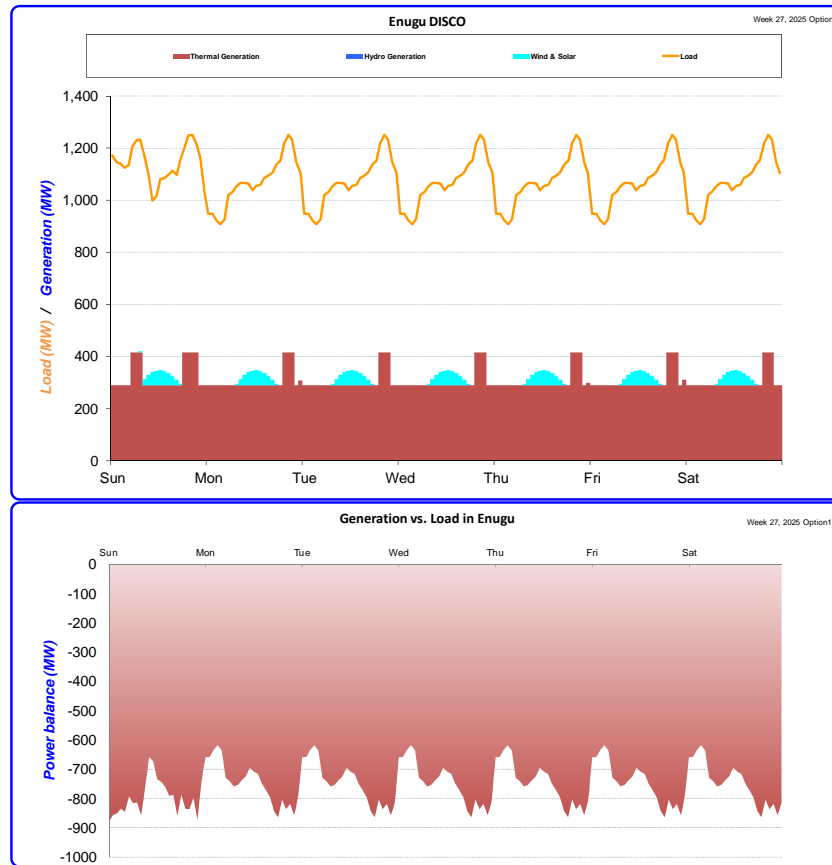
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	13



Annex 8.5.1
Winter 2025
Option 1

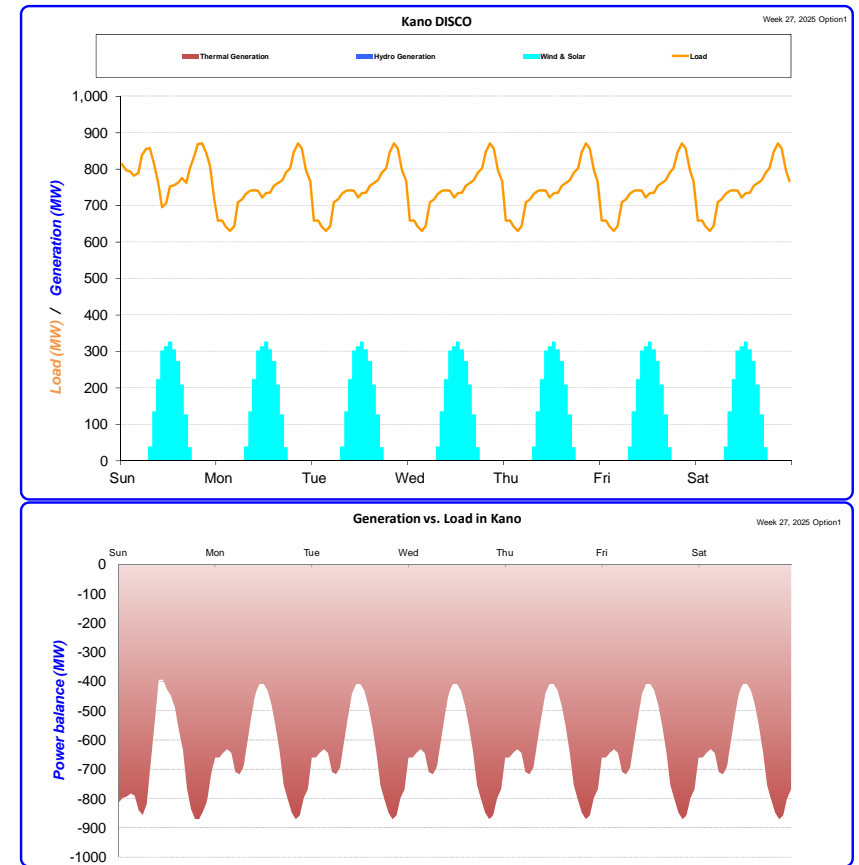
Power flow during Off-peak hours: During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Kaduna to Kano 427 MW in off peak and 883 MW in peak hours.

Annex 8.5.2 - Summer 2025 - Option 1



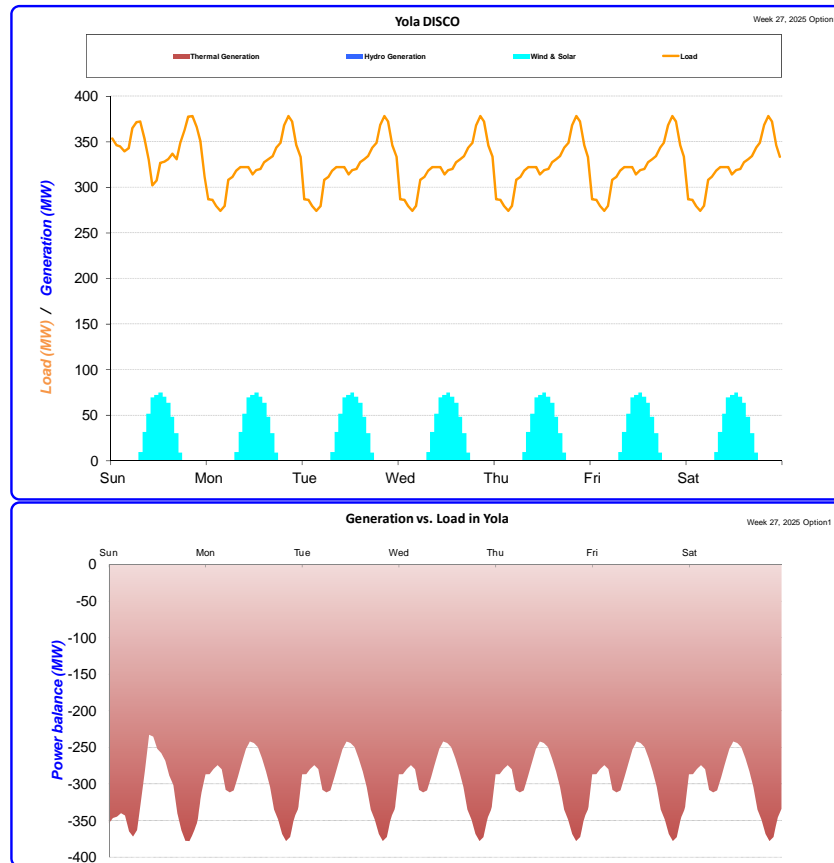
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs. The peaks of peak power indicate a need of new thermal generation e.g higher capacity at Geregu.

Annex 8.5.2 - Summer 2025 - Option 1



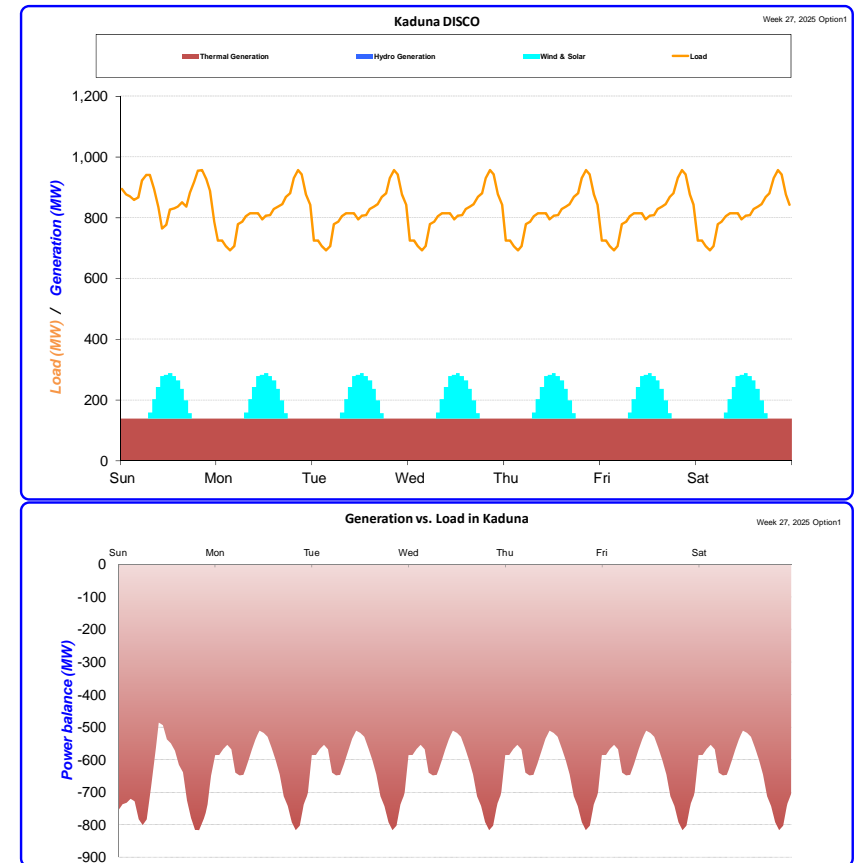
In 2025 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 850 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO.

Annex 8.5.2 - Summer 2025 - Option 1



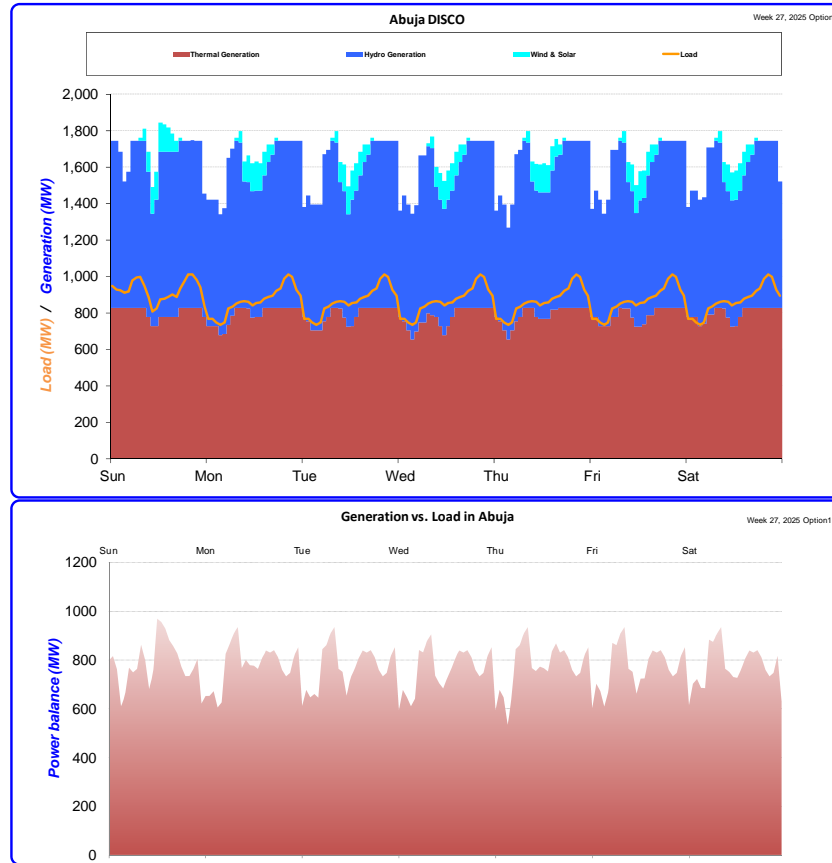
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 3500 MW and is obtained mainly via transfer from Pt Harco DISCO.

Annex 8.5.2 - Summer 2025 - Option 1



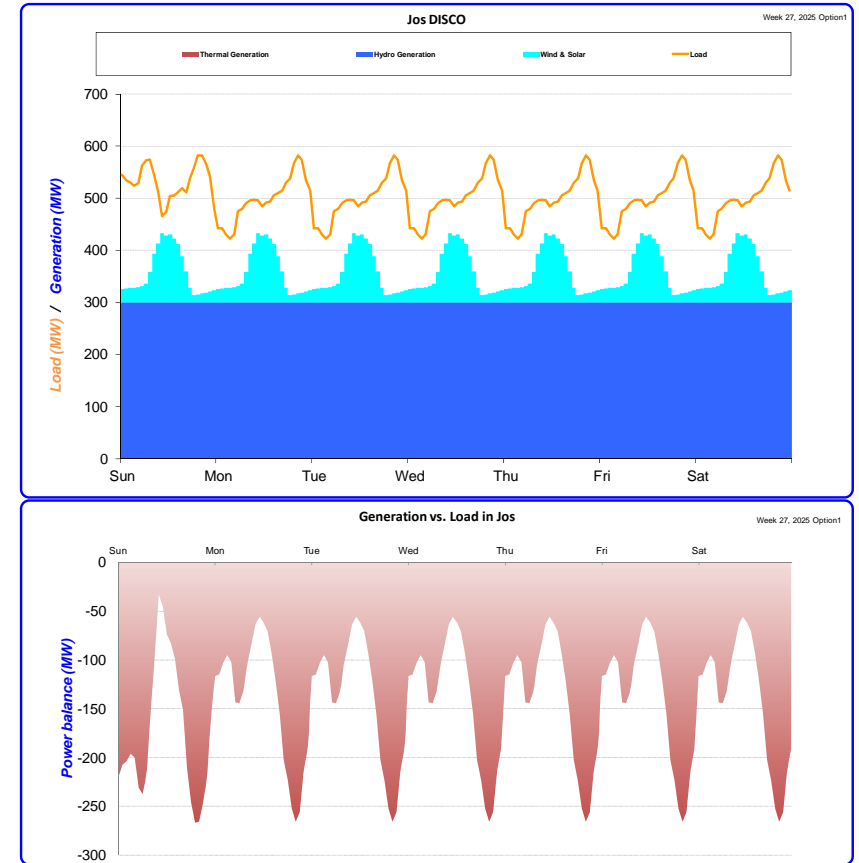
In 2025 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a forth of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 800 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.5.2 - Summer 2025 - Option 1



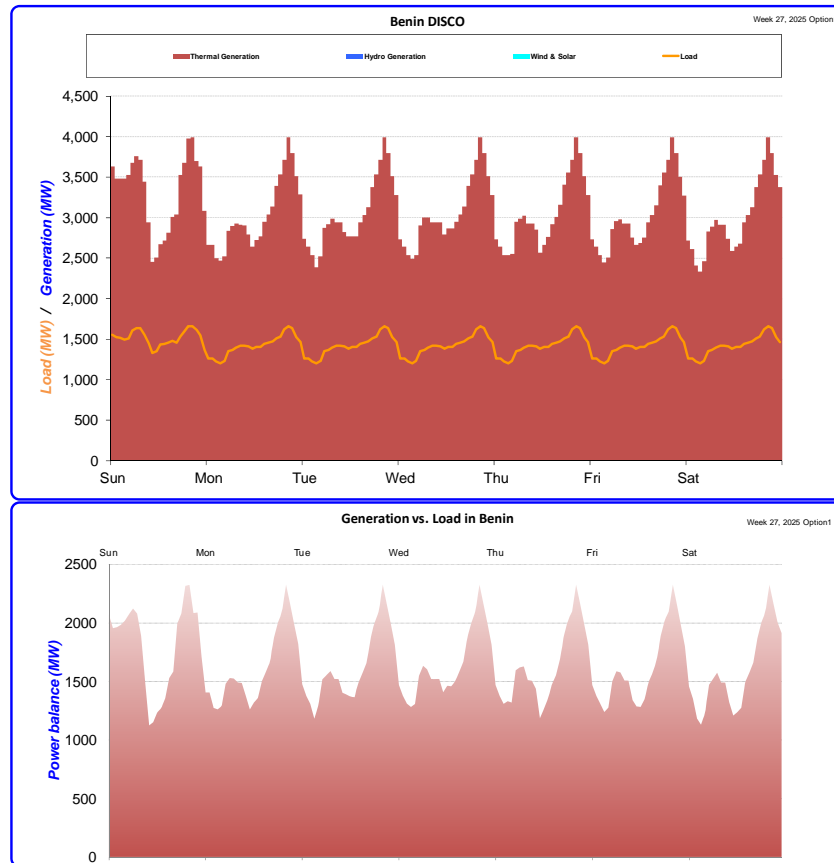
The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria. The availability of hydro power in the summer season is lower than in the winter season.

Annex 8.5.2 - Summer 2025 - Option 1



In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

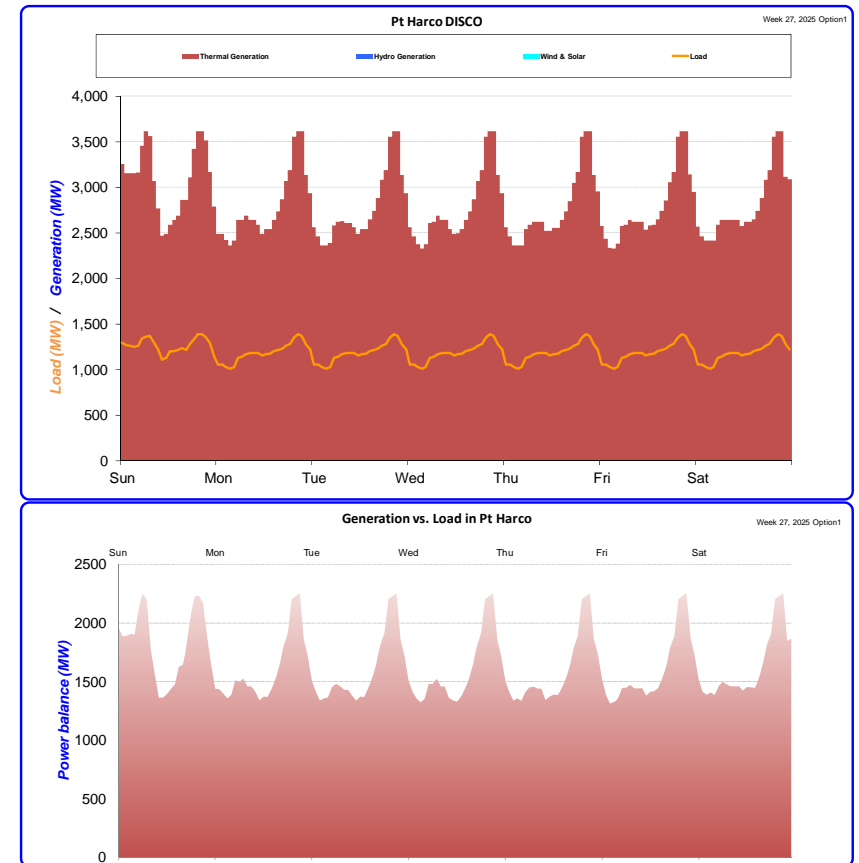
Annex 8.5.2 - Summer 2025 - Option 1



The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 2300 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity.

The exports in the summer season are higher due to a lower availability of hydro power.

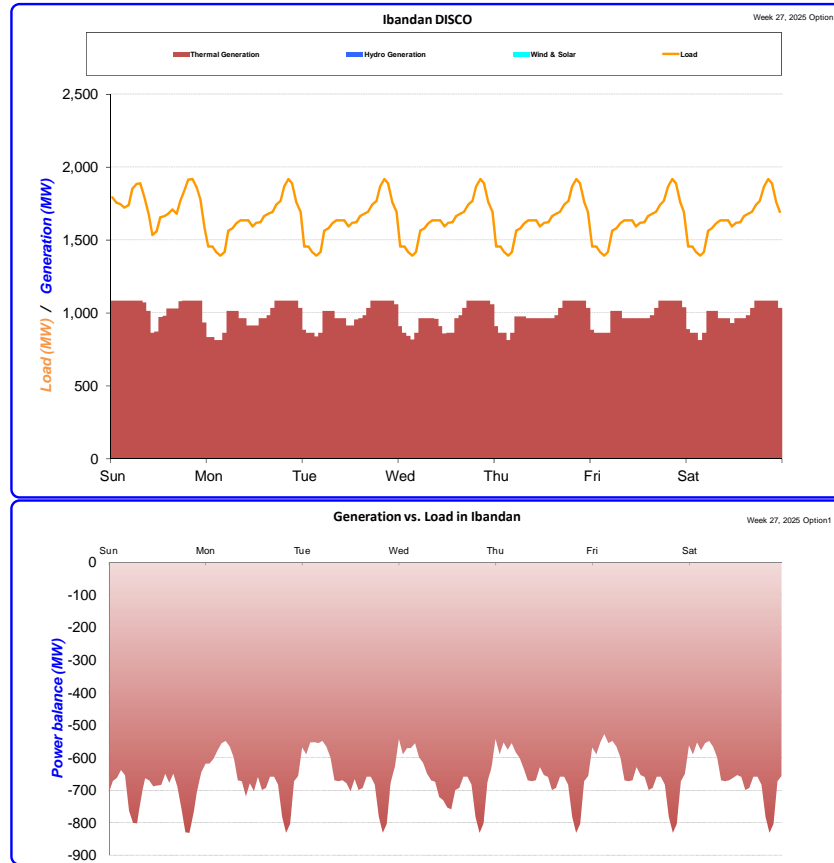
Annex 8.5.2 - Summer 2025 - Option 1



The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 2200MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs.

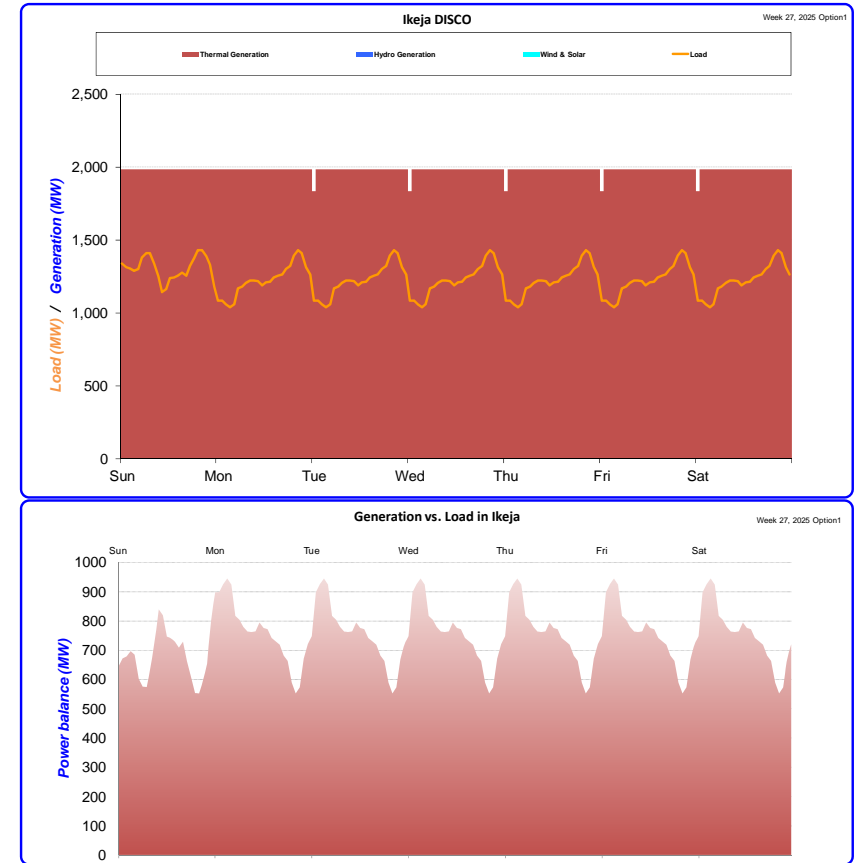
The exports in the summer season are higher due to a lower availability of hydro power.

Annex 8.5.2 - Summer 2025 - Option 1



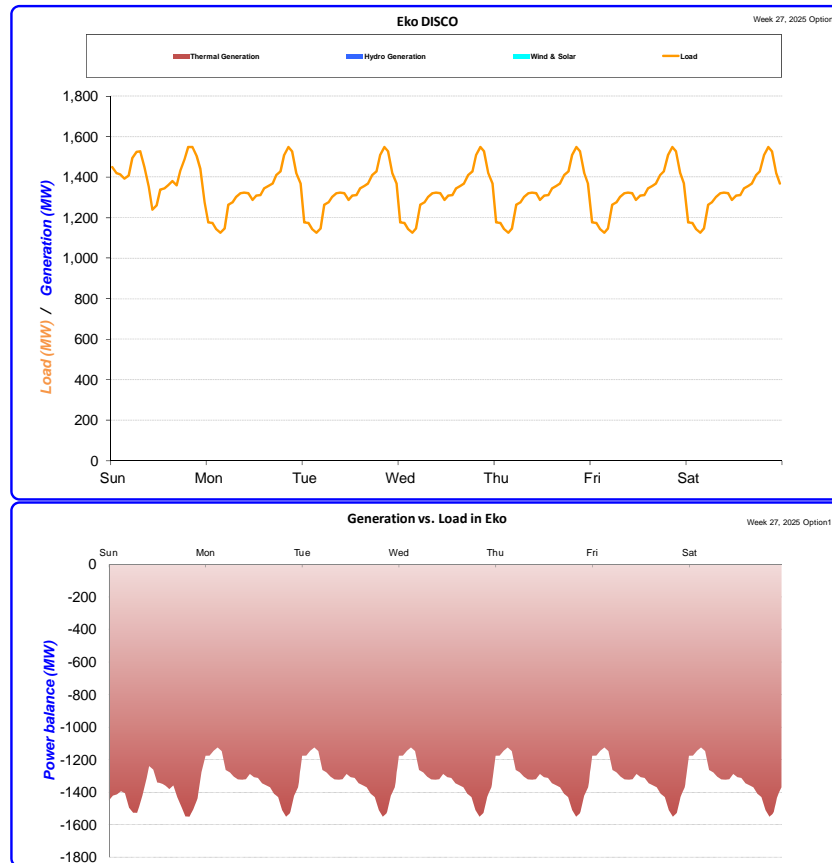
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 800 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.5.2 - Summer 2025 - Option 1



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

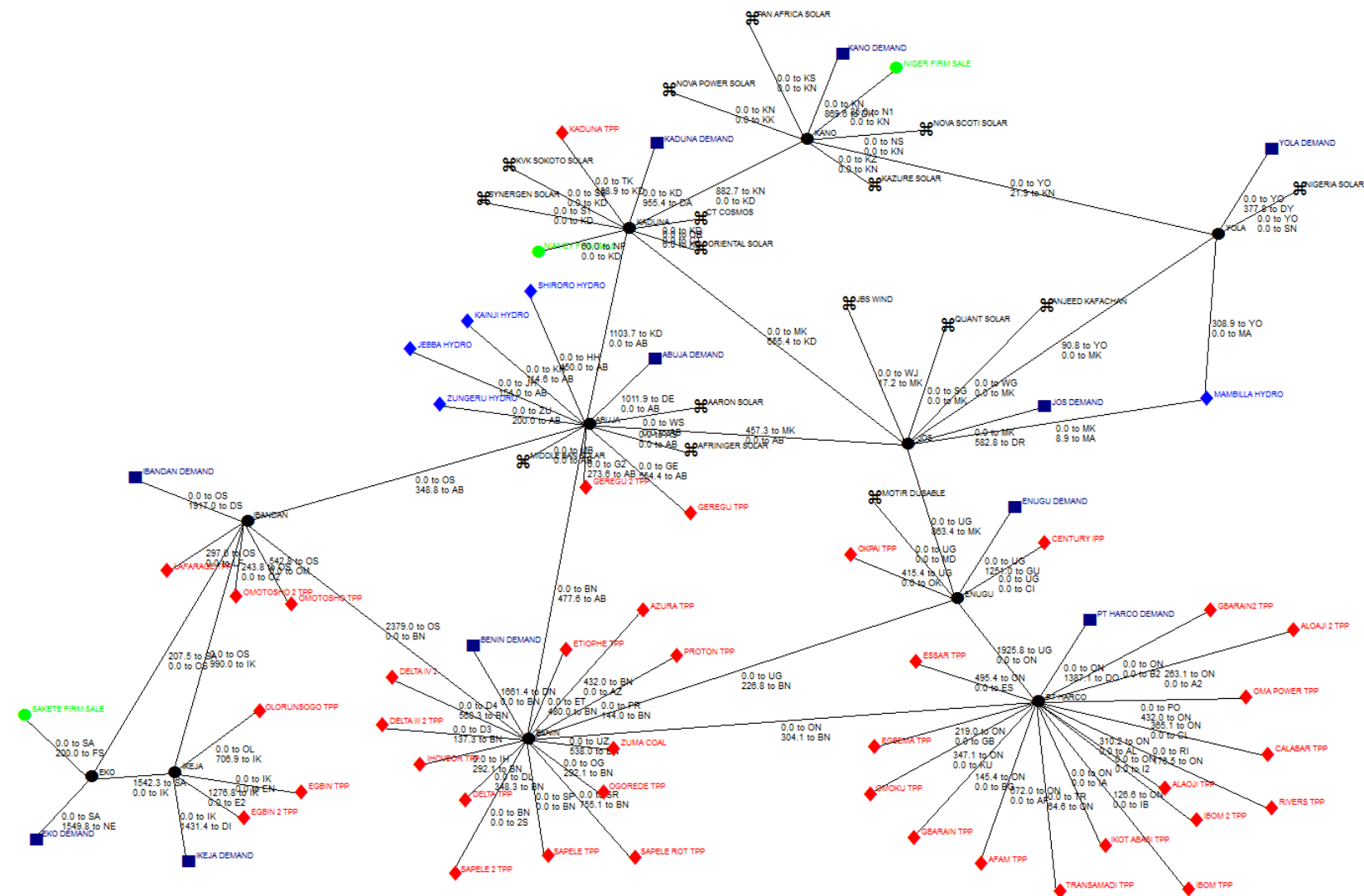
Annex 8.5.2 - Summer 2025 - Option 1



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

Annex 8.5.2 - Summer 2025 - Option 1

Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	27: 27 Jul W1	Sun.	21

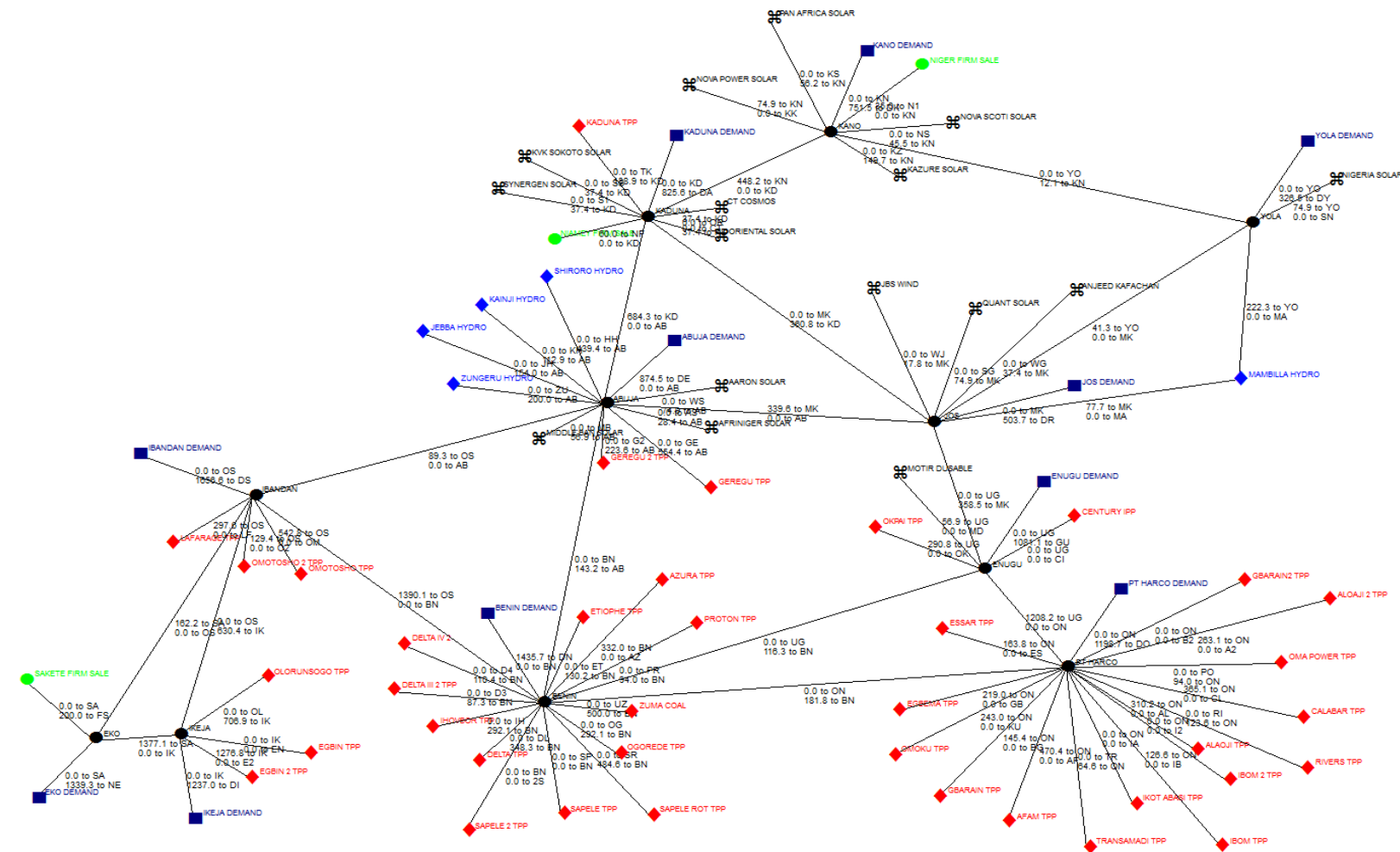


Annex 8.5.2 Summer 2025 Option 1

Power flow during peak hours: The power flows between the DISCOs in Nigeria for the peaking hours in summer in 2025 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco and Ikeja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

Annex 8.5.2 - Summer 2025 - Option 1

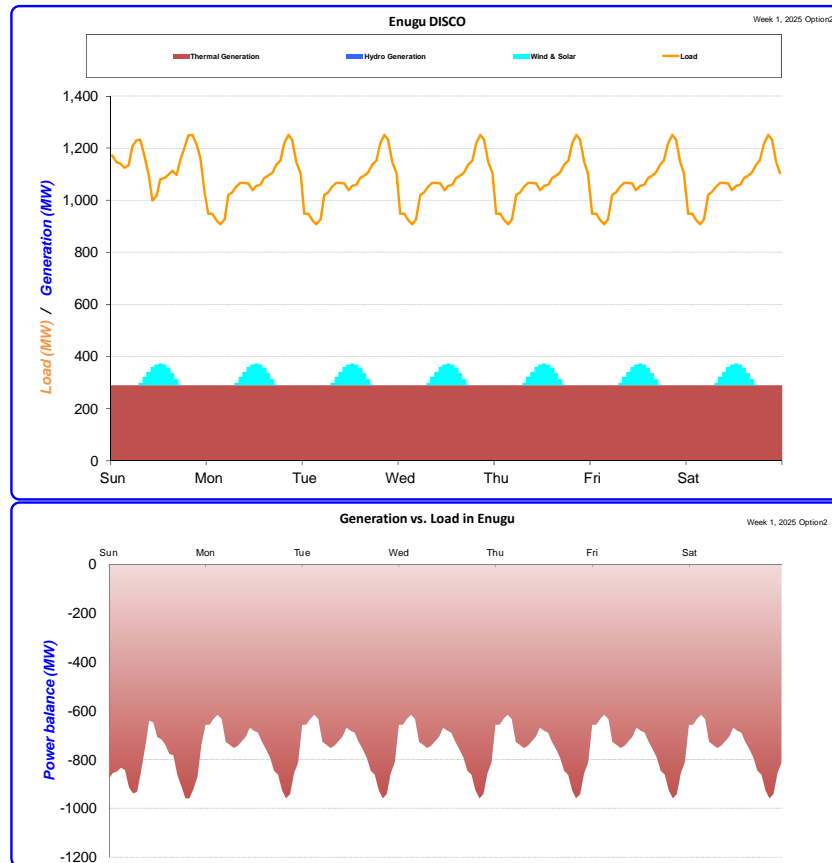
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	27: 27 Jul W1	Sun.	13



Annex 8.5.2
Summer 2025
Option 1

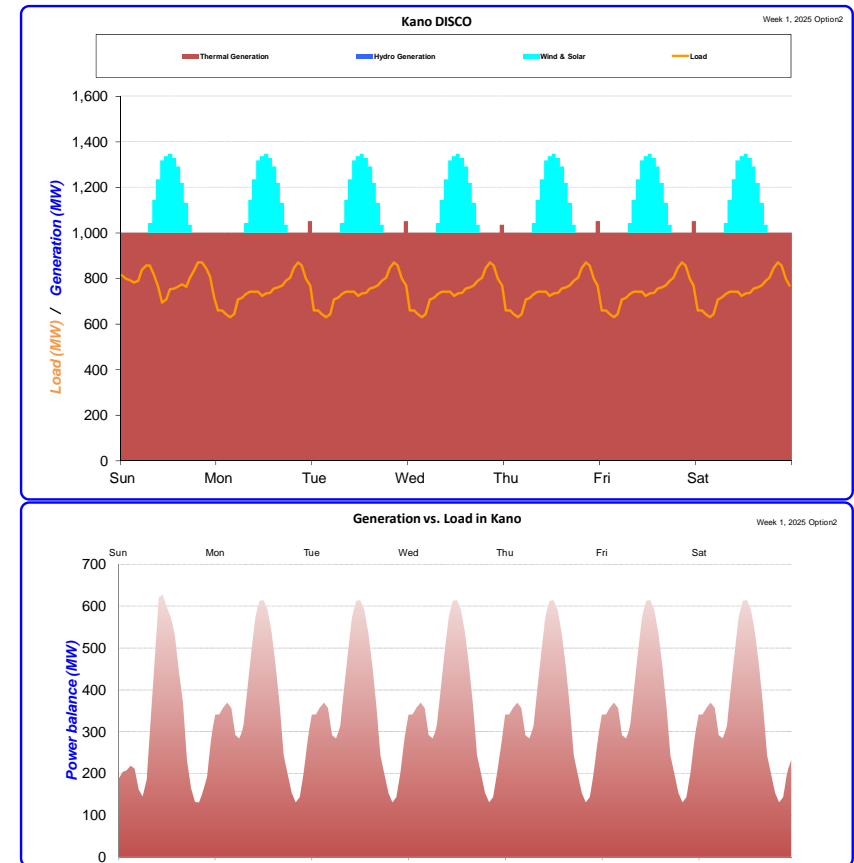
Power flow during Off-peak hours: During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Kaduna to Kano 448 MW in off peak and 882 MW in peaking hours.

Annex 8.5.3 - Winter 2025 - Option 2



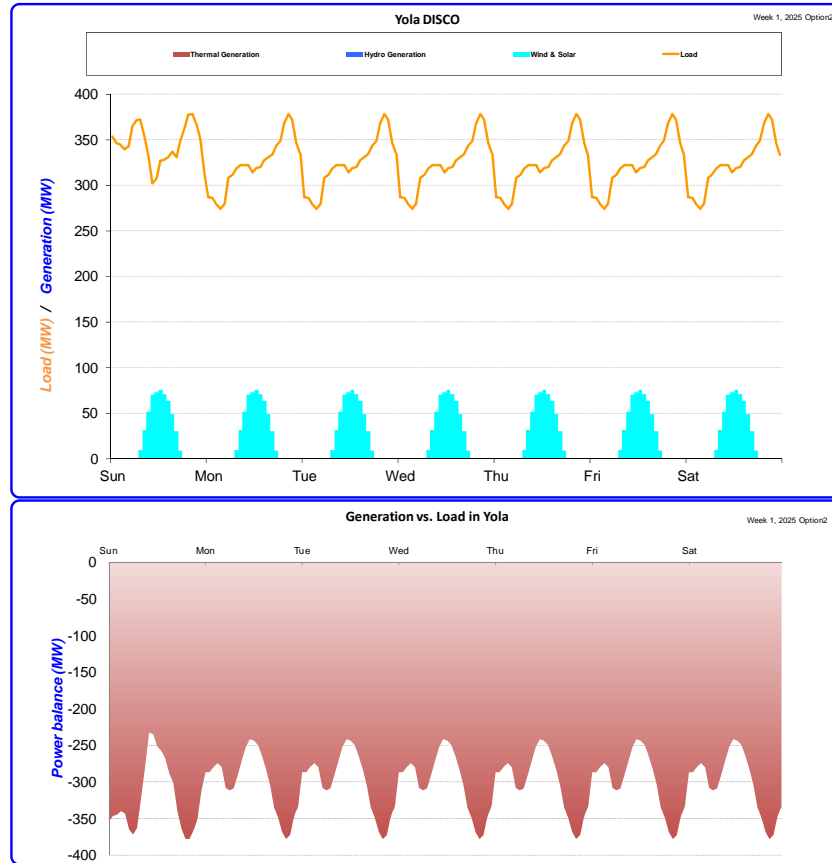
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

Annex 8.5.3 - Winter 2025 - Option 2



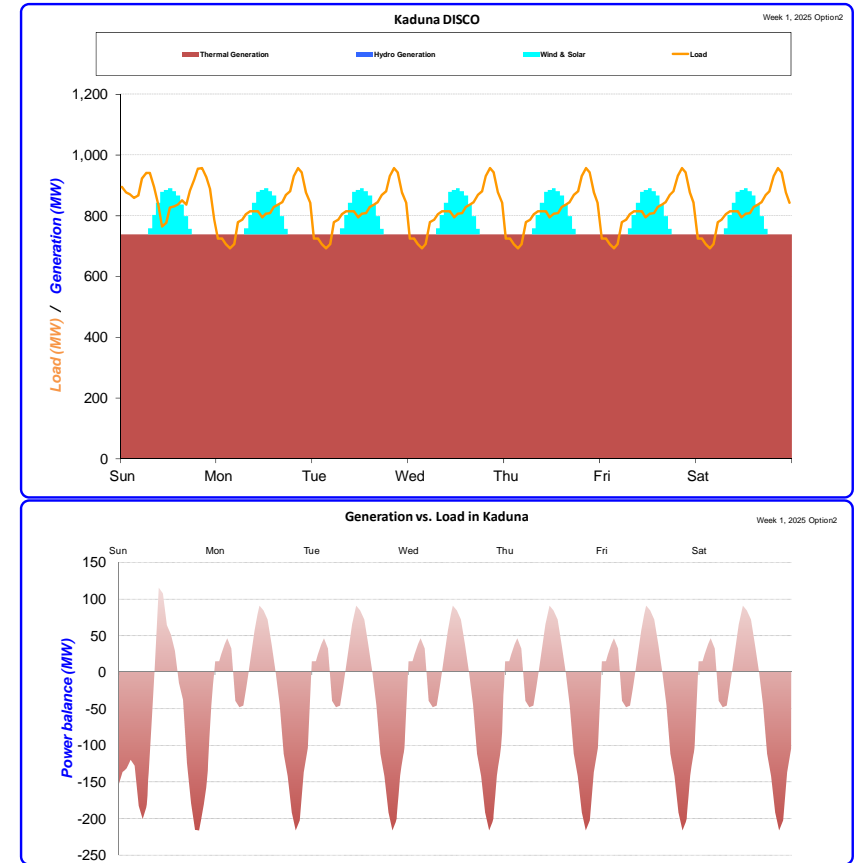
In 2025 Kano DISCO in Option 2 becomes a net exporter of power, due to installed thermal power plants. The installed solar power supplements to the power export which reaches about 600 MW in the peaking hours. The exported power goes to Kaduna and Abuja DISCOs and even further. The available transmission infrastructure is sufficient to enable these power exports.

Annex 8.5.3 - Winter 2025 - Option 2



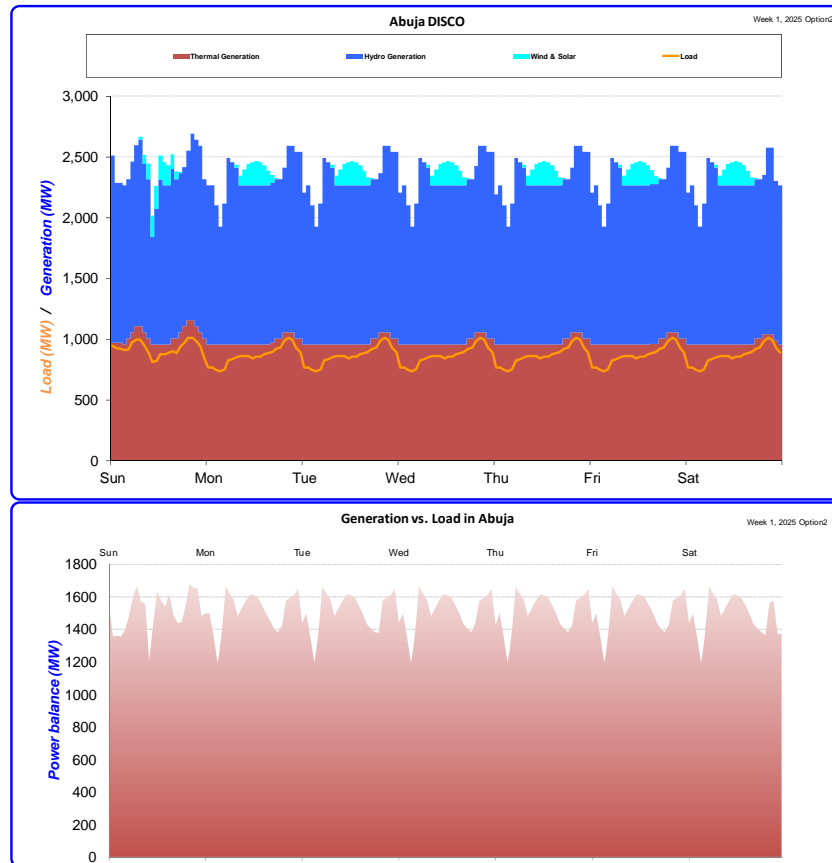
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 350 MW and is obtained mainly via transfer from Pt Harco DISCO.

Annex 8.5.3 - Winter 2025 - Option 2



In 2025 Kaduna DISCO remains partly a net importer of power. The installed additional thermal and solar power can supply only the base load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 200 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The exported power peaks up to 100 MW goes to Abuja and Jos DISCO. The available transmission infrastructure is sufficient to enable these power exports.

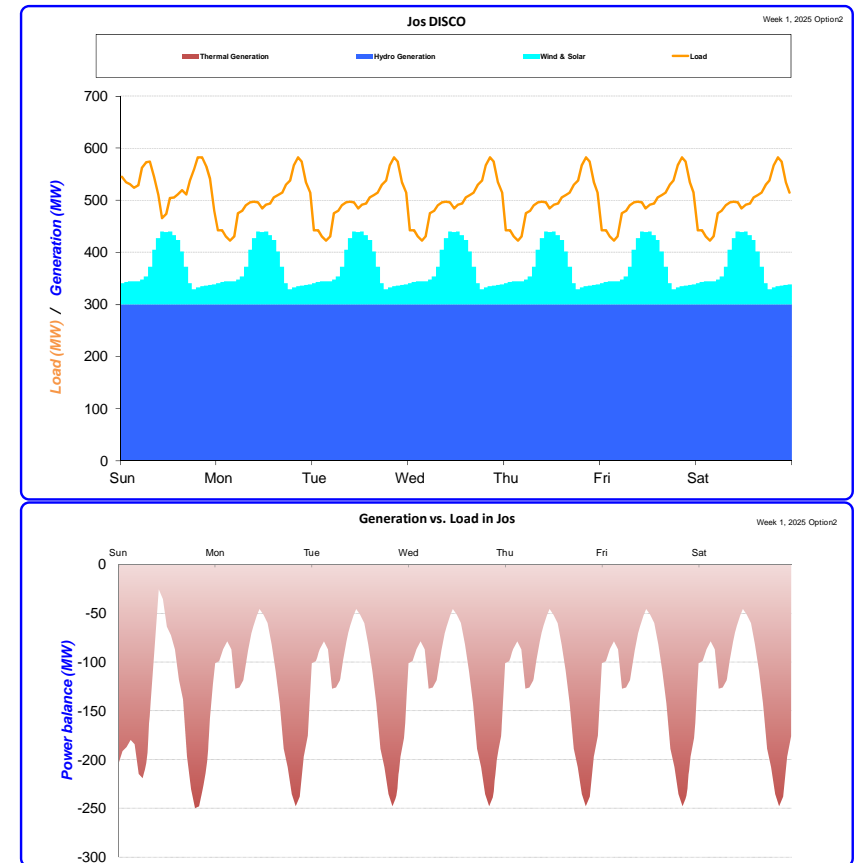
Annex 8.5.3 - Winter 2025 - Option 2



The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 1600 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Benin, Ibandan and Jos.

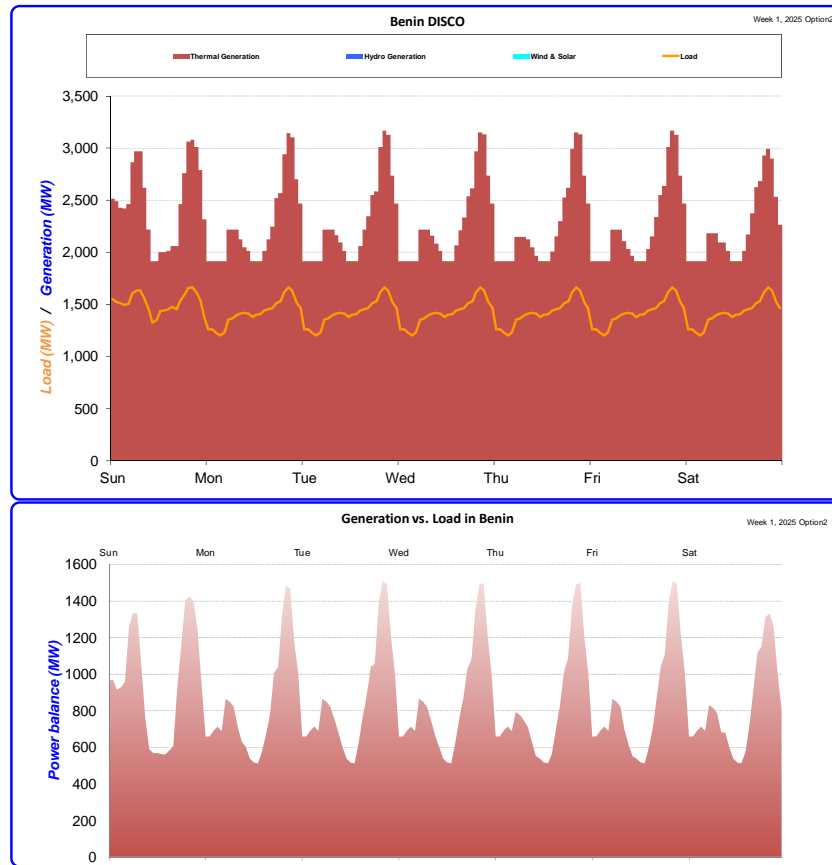
The available transmission infrastructure is sufficient to enable these power exports.

Annex 8.5.3 - Winter 2025 - Option 2



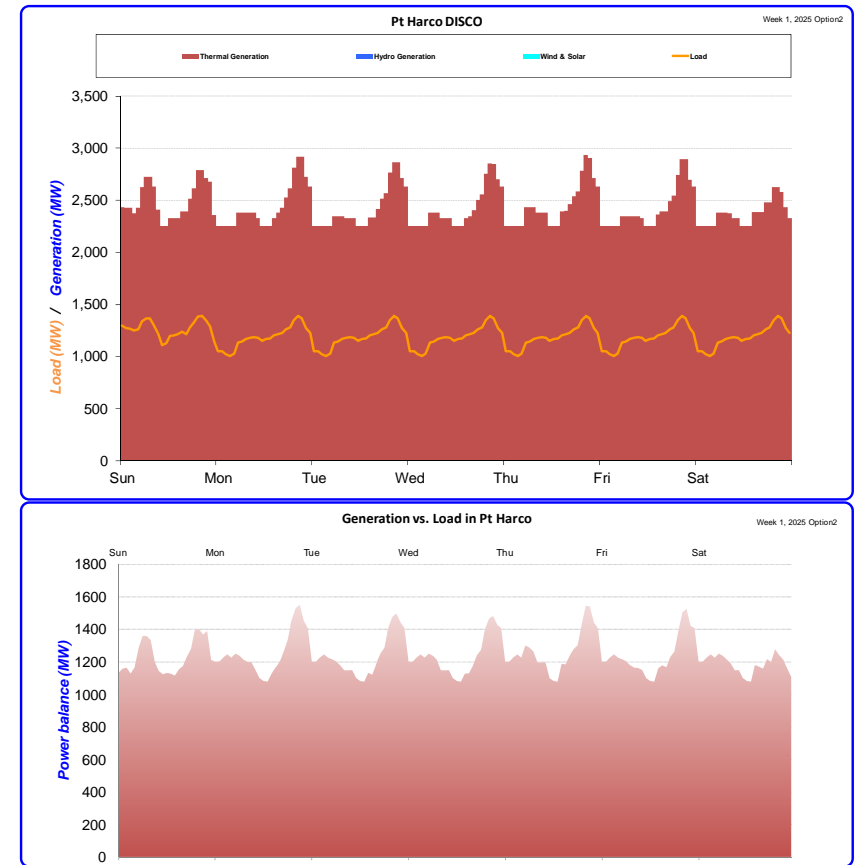
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

Annex 8.5.3 - Winter 2025 - Option 2



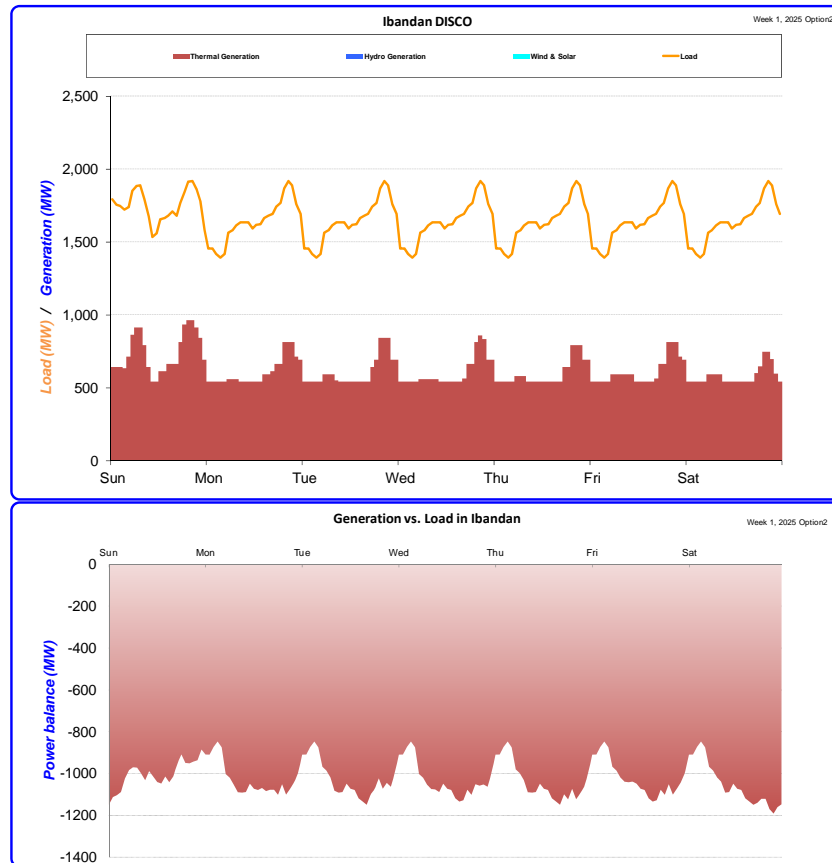
The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 1400 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCO Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 2000 MW).

Annex 8.5.3 - Winter 2025 - Option 2



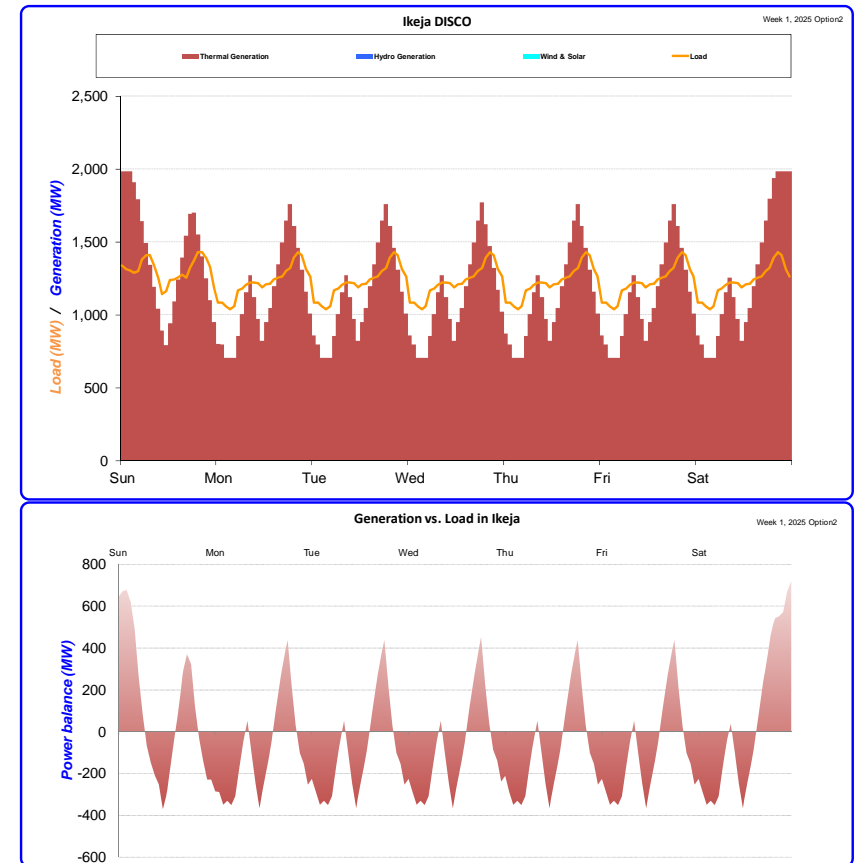
The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 1400MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 1800MW).

Annex 8.5.3 - Winter 2025 - Option 2



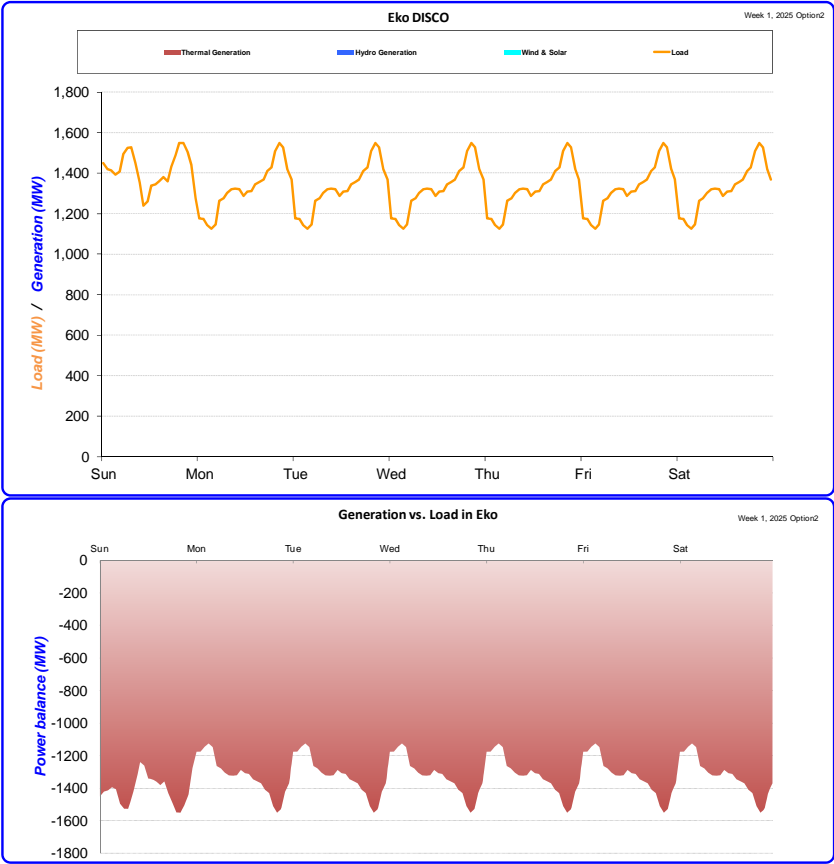
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 1200 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.5.3 - Winter 2025 - Option 2



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 600 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

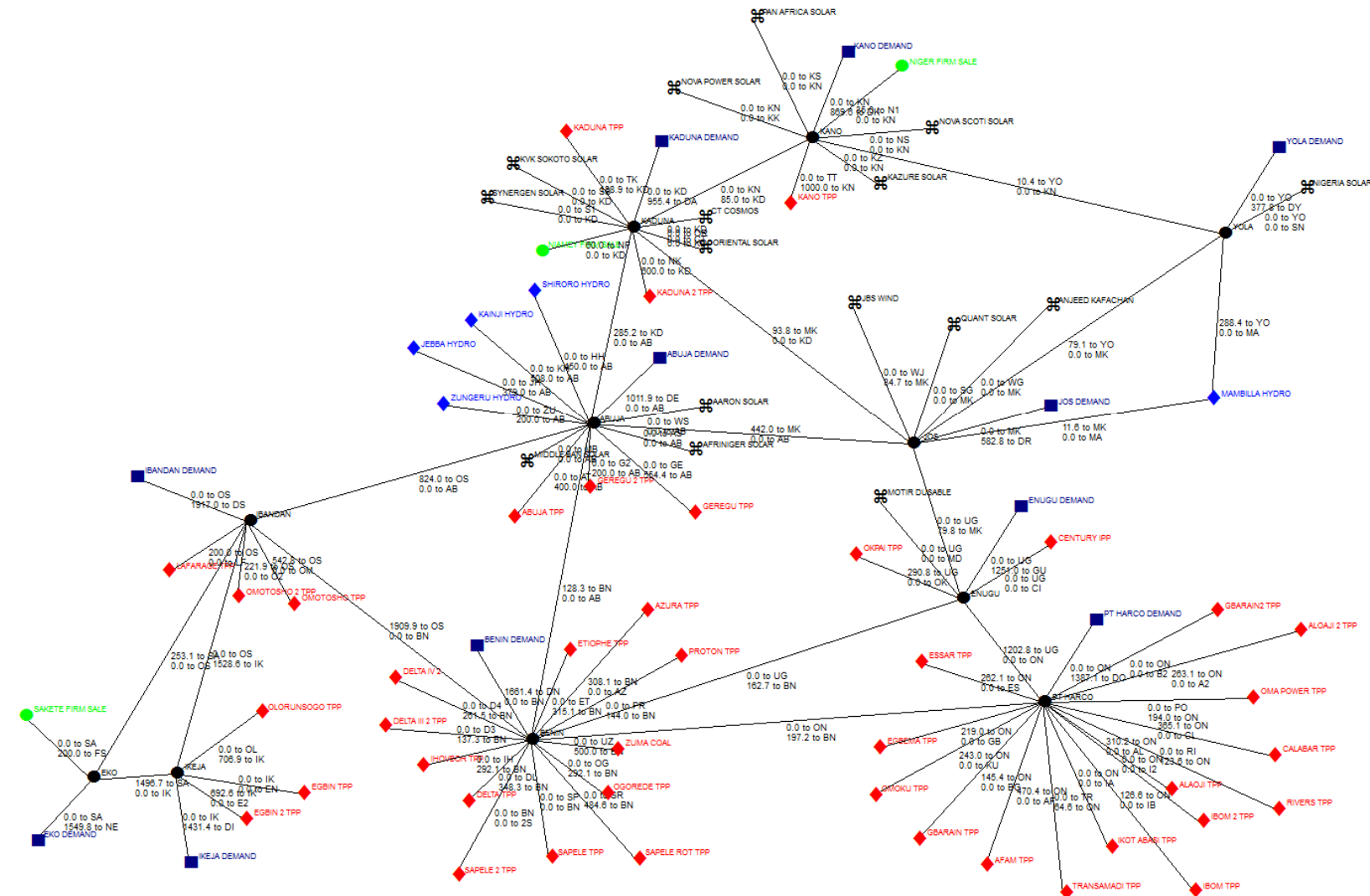
Annex 8.5.3 - Winter 2025 - Option 2



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

Annex 8.5.3 - Winter 2025 - Option 2

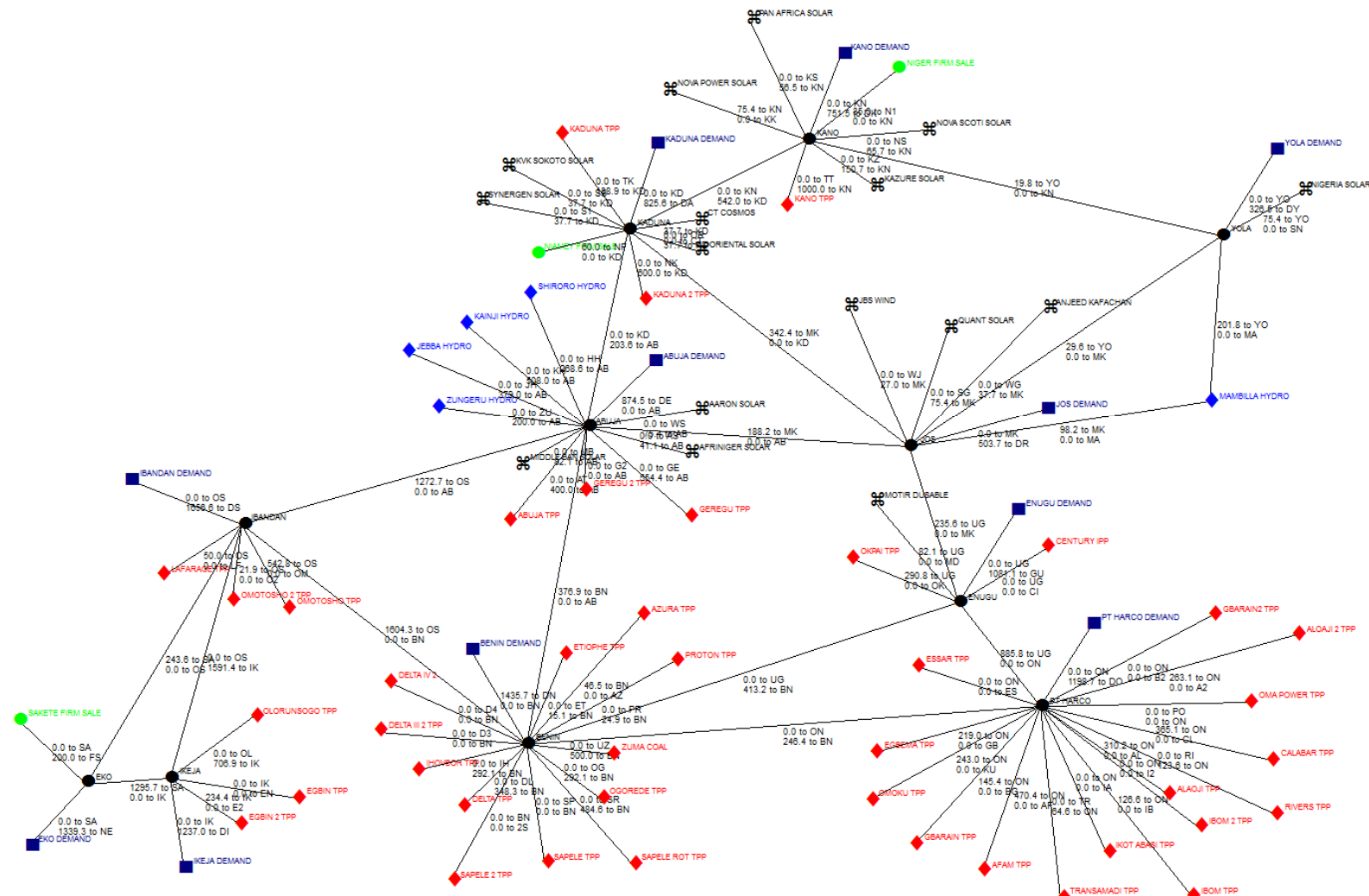
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	21



Power flow during peak hours: The power flows between the DISCOs in Nigeria for the peaking hours in winter in 2025 for the Option 2 are different than the ones for Option 1. The power flows are still from the south to the north, but also from Abuja to Benin, and unchangeably from the east to the west. Main power exporters are remaining Benin, Pt Harco, Abuja and Ikeja, but also Kano. Due to new generation installed in Ibandan DISCO, also Ibandan can export to Eko. Due to new generation installed in Kano DISCO, also Kano can export to Kaduna and further from Abuja to Benin. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

Annex 8.5.3 - Winter 2025 - Option 2

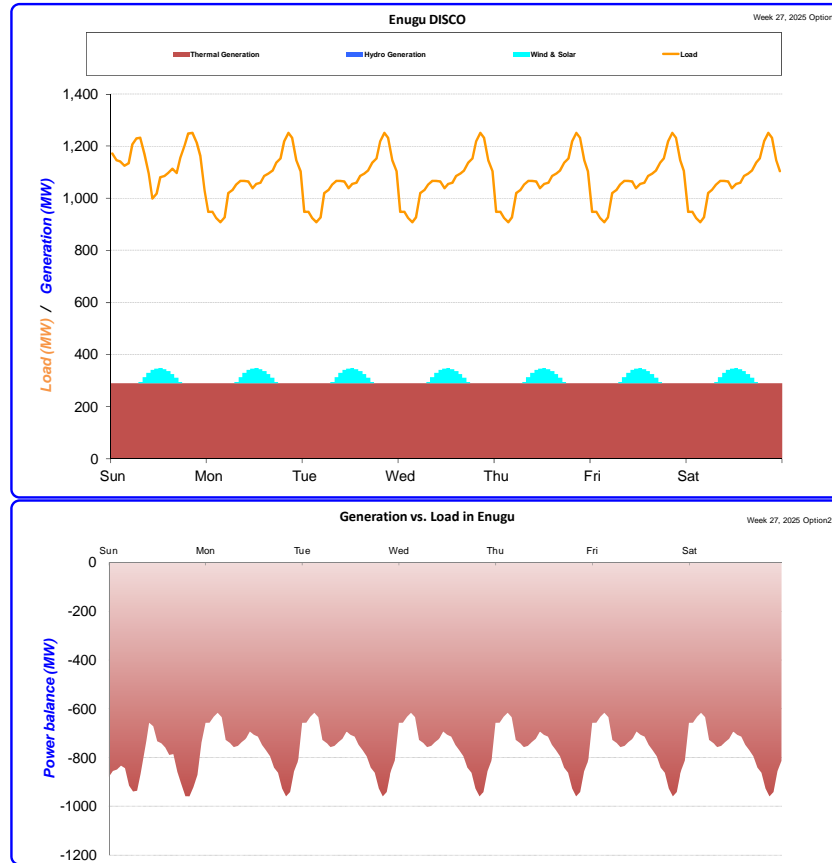
Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	1: 1 Jan W1	Sun.	13



Annex 8.5.3
Winter 2025
Option 2

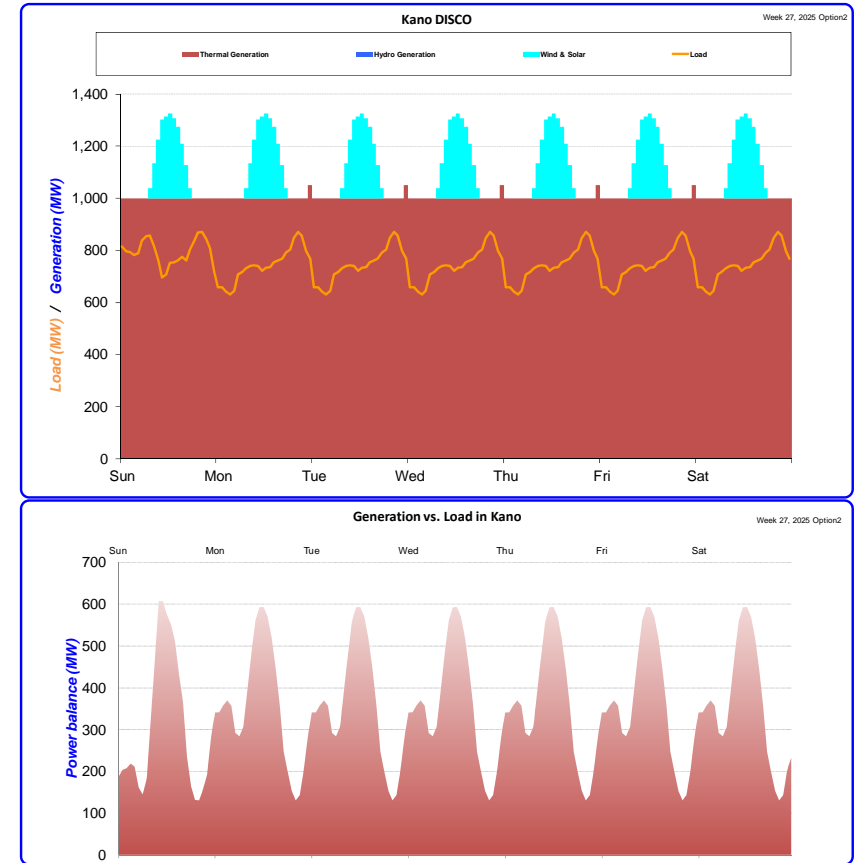
Power flow during Off-peak hours: During off - peaking hours the solar power is available, so the power flows from the north/mid of the country to the south west are increased, e.g. from Abuja to Benin 376 MW in off peak and 128 MW in peak hours.

Annex 8.5.4 - Summer 2025 - Option 2



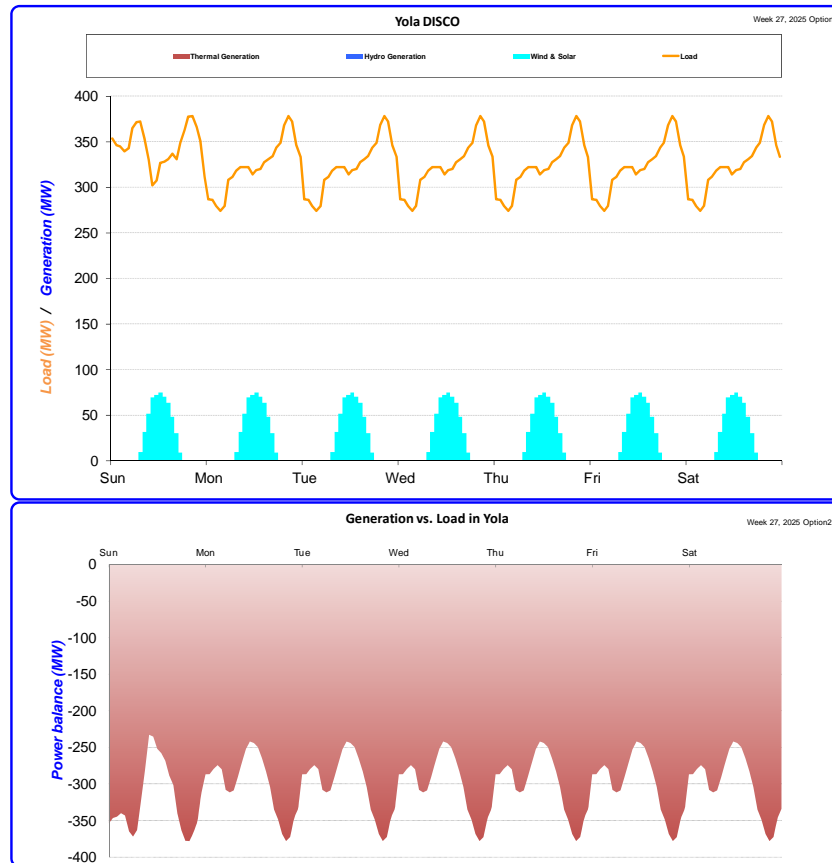
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

Annex 8.5.4 - Summer 2025 - Option 2



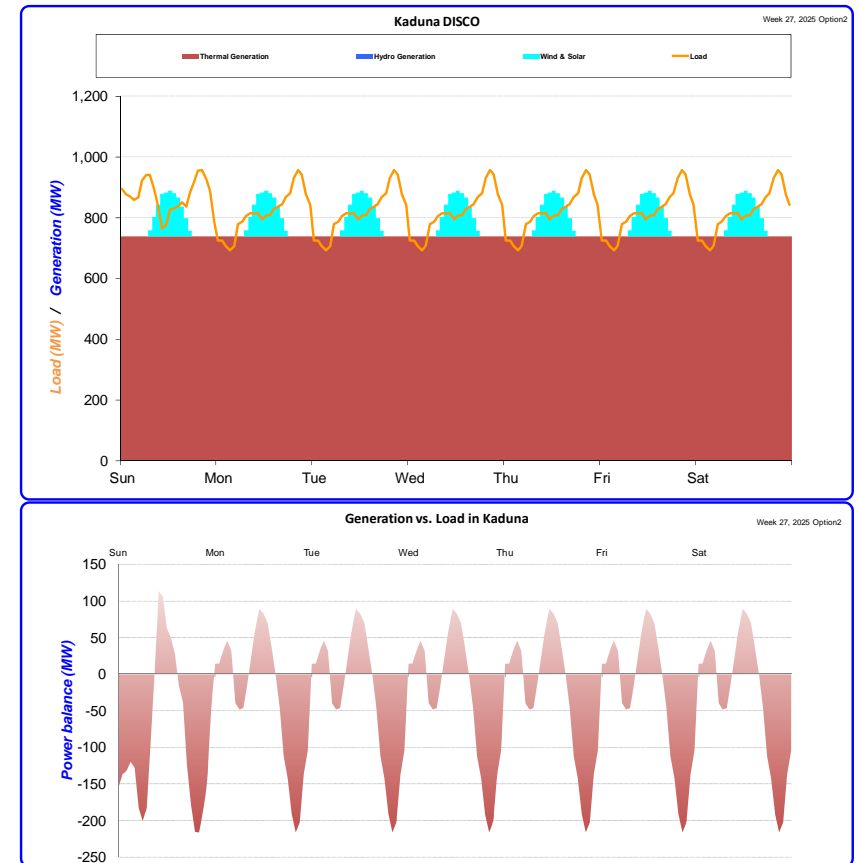
In 2025 Kano DISCO in Option 2 becomes a net exporter of power, due to installed thermal power plants. The installed solar power supplements to the power export which reaches about 600 MW in the peaking hours. The exported power goes to Kaduna and Abuja DISCOs and even further. The available transmission infrastructure is sufficient to enable these power exports.

Annex 8.5.4 - Summer 2025 - Option 2



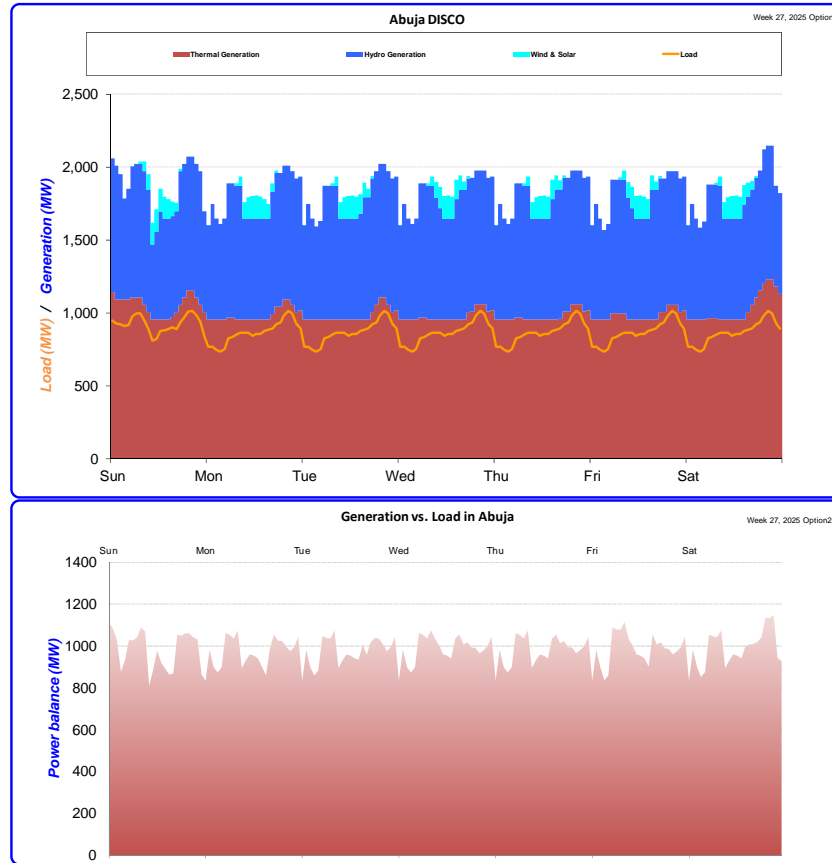
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 350 MW and is obtained mainly via transfer from Pt Harco DISCO.

Annex 8.5.4 - Summer 2025 - Option 2



In 2025 Kaduna DISCO remains partly a net importer of power. The installed additional thermal and solar power can supply only the base load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 200 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The exported power peaks up to 100 MW goes to Abuja and Jos DISCO. The available transmission infrastructure is sufficient to enable these power exports.

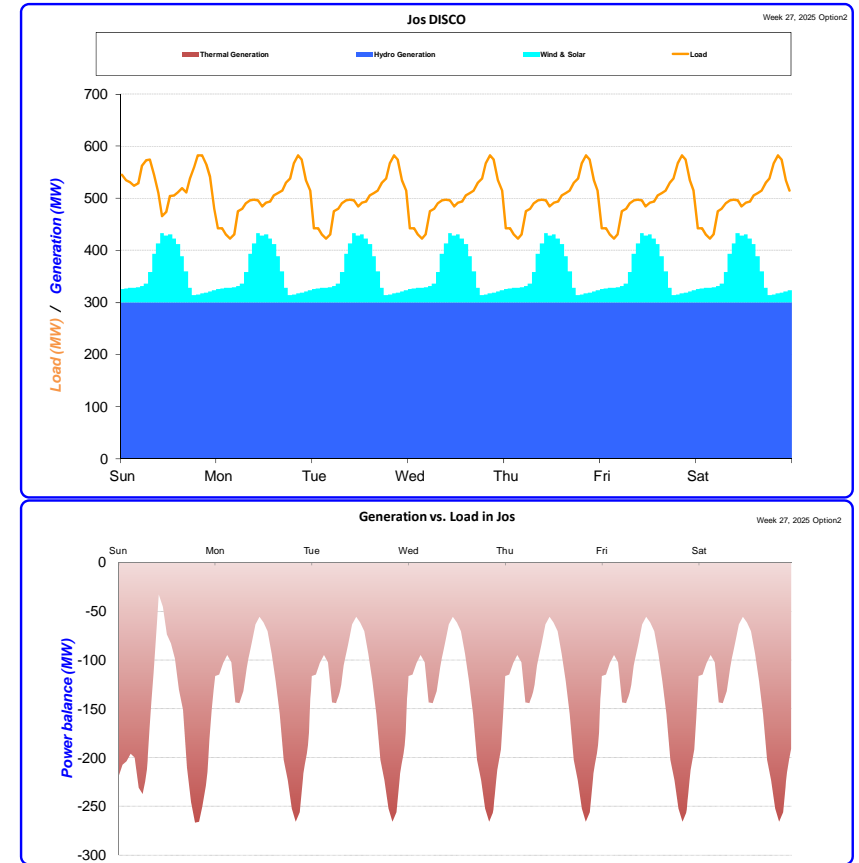
Annex 8.5.4 - Summer 2025 - Option 2



The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 1100 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Benin, Ibandan and Jos.

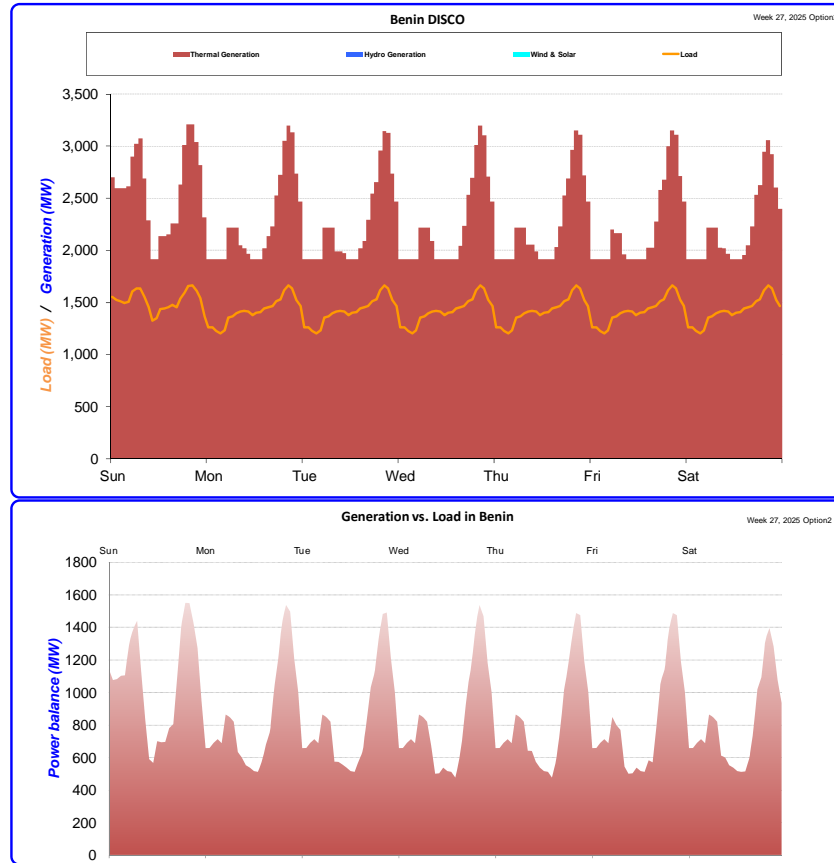
The available transmission infrastructure is sufficient to enable these power exports. The power export is lower than in the winter season due to less hydro power availability.

Annex 8.5.4 - Summer 2025 - Option 2



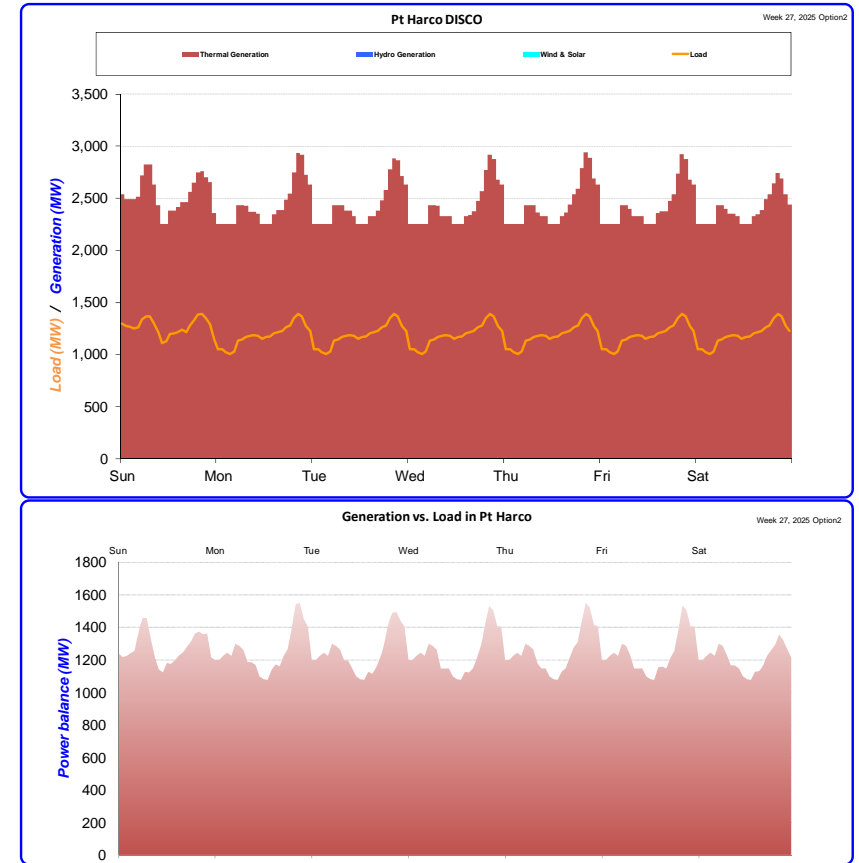
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

Annex 8.5.4 - Summer 2025 - Option 2



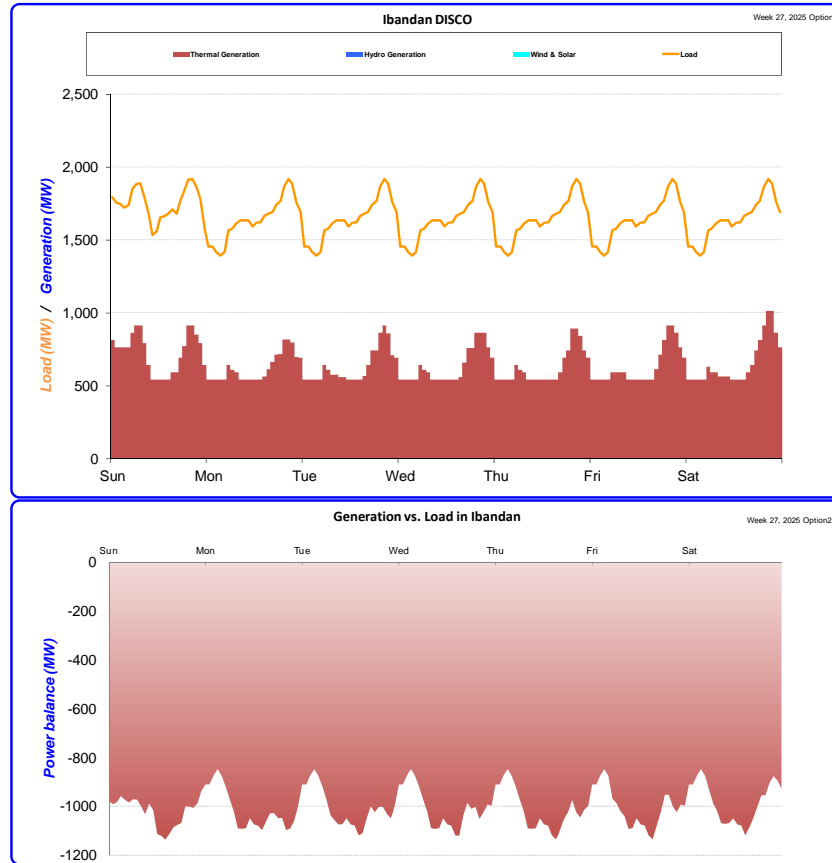
The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 1500 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCO Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 2000 MW).

Annex 8.5.4 - Summer 2025 - Option 2



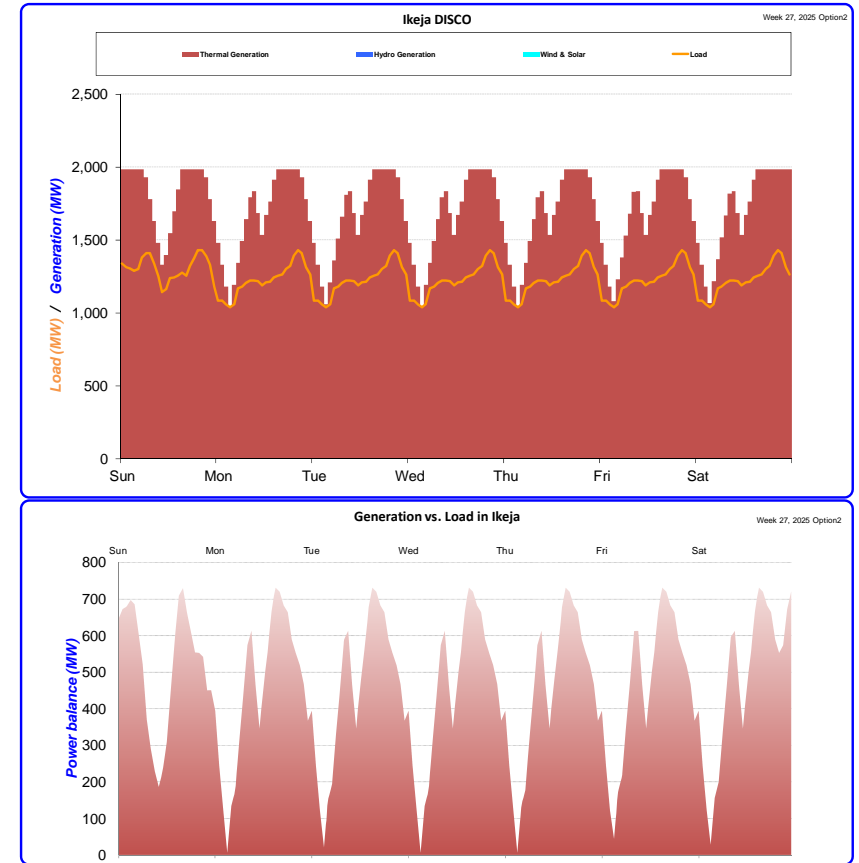
The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 1400MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 1800MW).

Annex 8.5.4 - Summer 2025 - Option 2



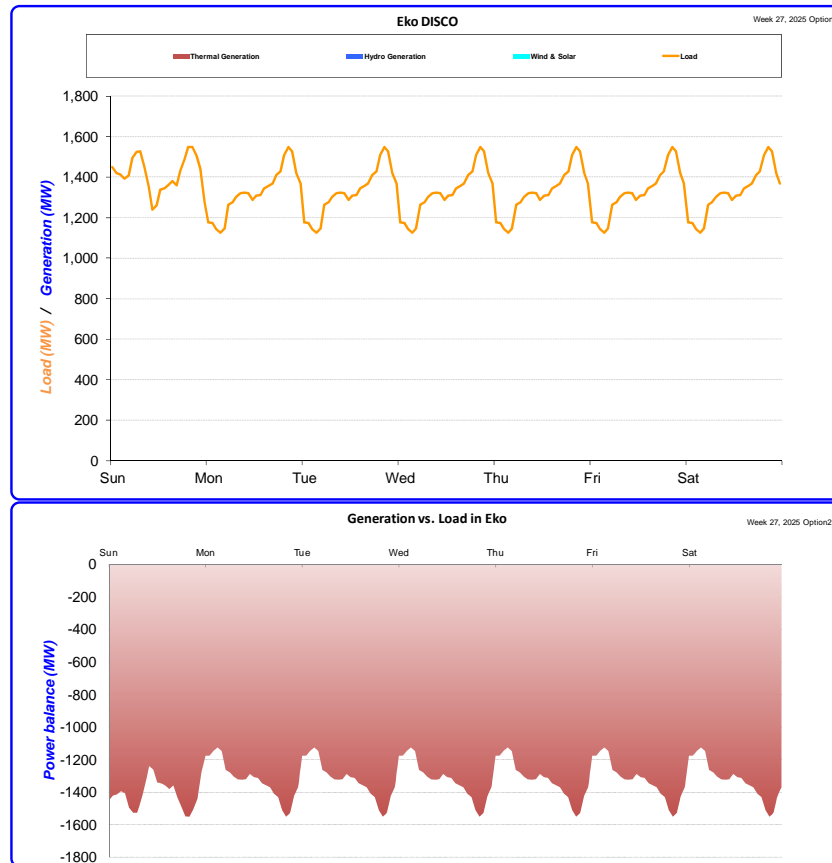
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 1100 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

Annex 8.5.4 - Summer 2025 - Option 2



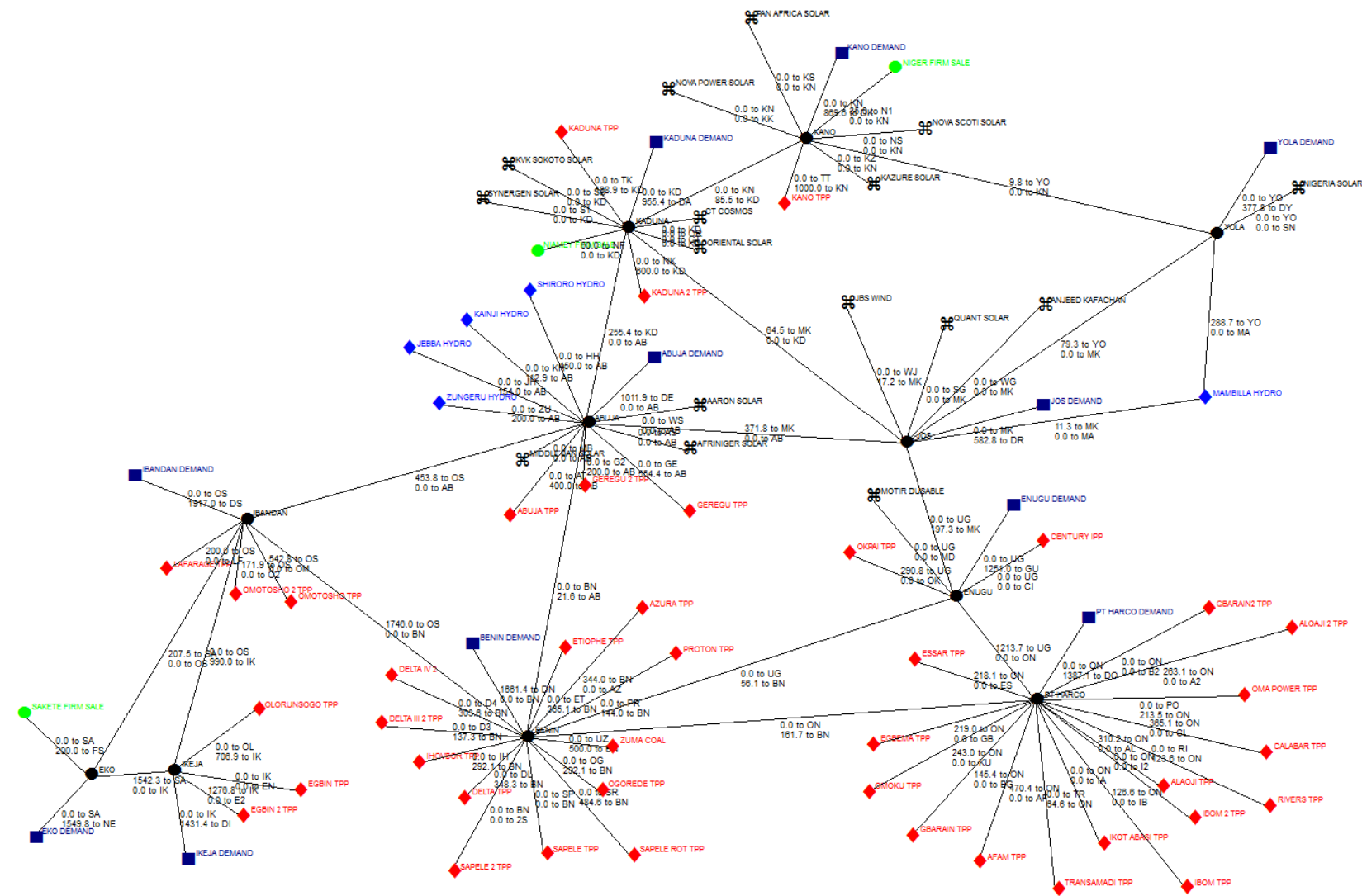
The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 700 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

Annex 8.5.4 - Summer 2025 - Option 2



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

Annex 8.5.4 - Summer 2025 - Option 2

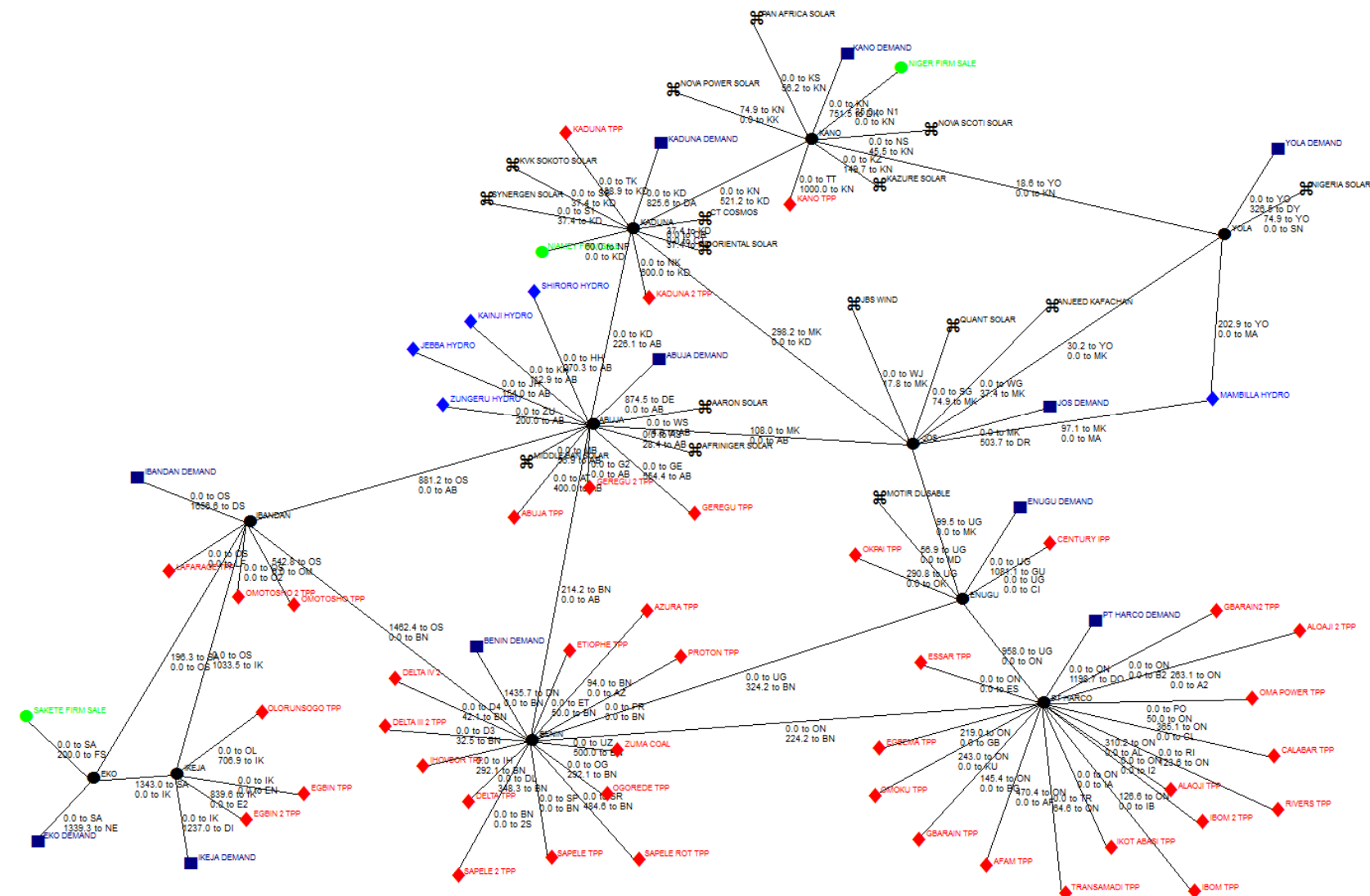


Annex 8.5.4 Summer 2025 Option 2

Power flow during peak hours: The power flows between the DISCOs in Nigeria for the peaking hours in summer in 2025 for the Option 2 are different than the ones for Option 1. The power flows are still from the south to the north, but also from Abuja to Benin, and unchangeably from the east to the west. Main power exporters are remaining Benin, Pt Harco, Abuja and Ikeja, but also Kano. Due to new generation installed in Ibandan DISCO, also Ibandan can export to Eko. Due to new generation installed in Kano DISCO, also Kano can export to Kaduna and further from Abuja to Benin. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

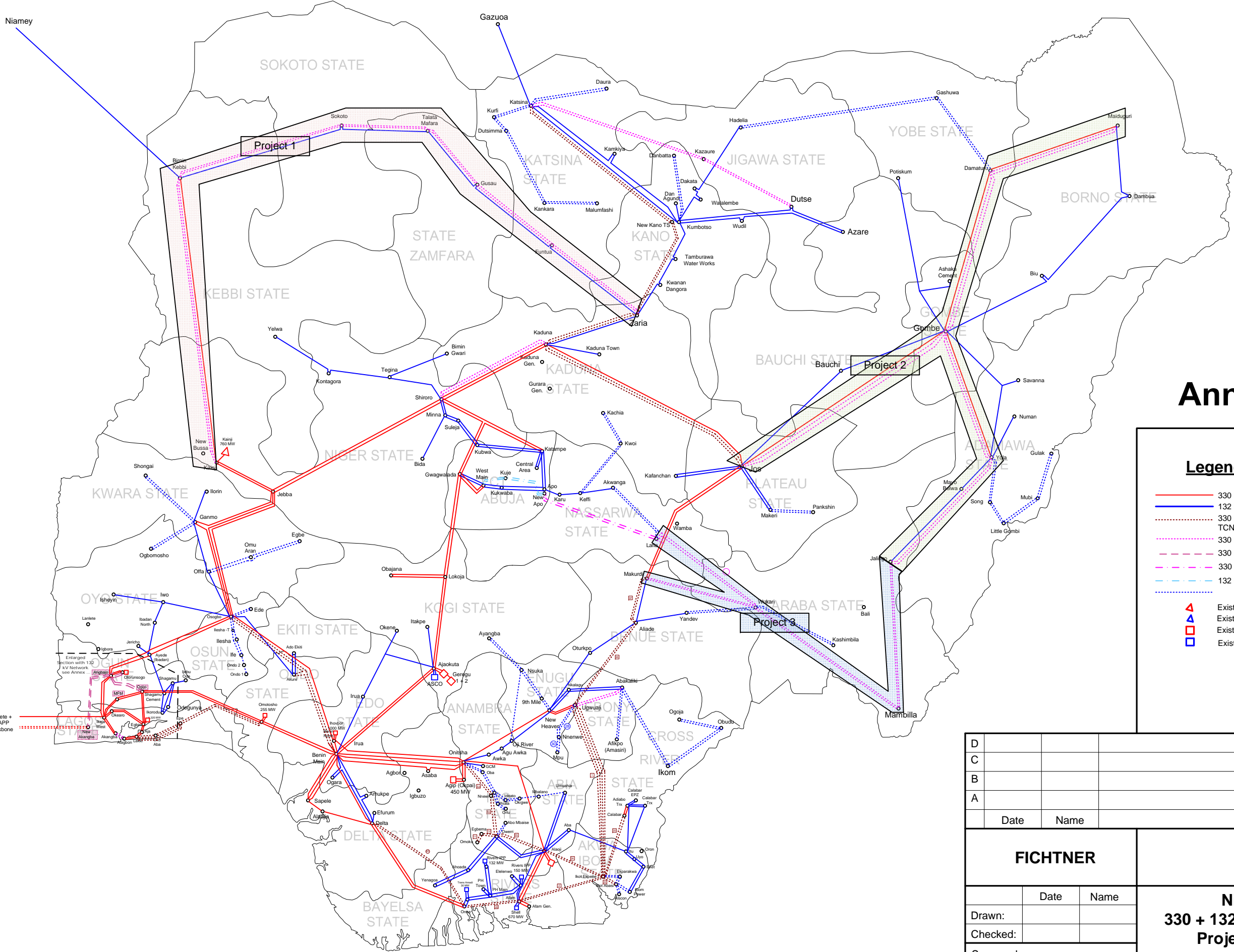
Annex 8.5.4 - Summer 2025 - Option 2

Node	Water Links	Transmission Link	Heat Pipeline	Fuel Transport	Year	Week	Day	Hour
ame	None	Energy Flow	None	None	2000	27: 27 Jul W1	Sun.	13



Annex 8.5.4
Summer 2025
Option 2

Power flow during Off-peak hours: During off - peaking hours the solar power is available, so the power flows from the north/mid of the country to the south west are increased, e.g. from Abuja to Benin 214 MW in off peak and 22 MW in peak hours.



Annex 9.3.1

Legend

330 kV Lines - Existing

132 kV Lines - Existing

330 kV Lines under Construction TCN +NIPP Projects

330 kV Lines proposed by FICHTNER

330 kV Lines Proposed by JICA

330 kV Lines financed by AFD

132 kV Lines financed by AFD

Existing HPP at 330 kV

Existing HPP at 132 kV

Existing TPP at 330 kV

Existing TPP at 132 kV

D			
C			
B			
A			
	Date	Name	Note

FICHTNER			
Drawn:	Date	Name	Nigeria 330 + 132 kV Network Project Areas
Checked:			
Supersedes:			Scale: Sheet: of
Superceded by:			
System:			Size:
			Project No.: 8328P01
			File:
			Drawing No:

Nigeria Electricity and Gas Improvement Project Transmission Expansion Plan							
FICHTNER		Financial Assessment Project 1: 330 kV North West Ring				Annex 10.1	
Year	Cal. Year	Investm. cost US\$m	O&M cost US\$m	Total cost US\$m	Energy transmitted GWh	Revenue US\$m	Net Cash Flow US\$m
-7	2018	110.8		110.8			-110.8
-6	2019	110.8		110.8			-110.8
-5	2020		2.2	2.2	455	3.9	1.7
-4	2021	96.5	2.2	98.7	523	4.5	-94.3
-3	2022	96.5	3.2	99.7	600	5.1	-94.6
-2	2023	96.5	4.1	100.7	690	5.9	-94.8
-1	2024	96.5	5.1	101.6	792	6.7	-94.9
1	2025		6.1	6.1	2,510	21.4	15.3
2	2026		6.1	6.1	2,885	24.6	18.5
3	2027		6.1	6.1	3,316	28.2	22.2
4	2028		6.1	6.1	3,811	32.5	26.4
5	2029		6.1	6.1	4,381	37.3	31.2
6	2030		6.1	6.1	5,036	42.9	36.8
7	2031		6.1	6.1	5,789	49.3	43.2
8	2032		6.1	6.1	6,655	56.7	50.6
9	2033		6.1	6.1	7,650	65.2	59.1
10	2034		6.1	6.1	8,795	74.9	68.8
11	2035		6.1	6.1	10,110	86.1	80.1
12	2036		6.1	6.1	10,115	86.2	80.1
13	2037		6.1	6.1	10,120	86.2	80.1
14	2038		6.1	6.1	10,120	86.2	80.1
15	2039		6.1	6.1	10,120	86.2	80.1
16	2040		6.1	6.1	10,120	86.2	80.1
17	2041		6.1	6.1	10,120	86.2	80.1
18	2042		6.1	6.1	10,120	86.2	80.1
19	2043		6.1	6.1	10,120	86.2	80.1
20	2044		6.1	6.1	10,120	86.2	80.1
21	2045		6.1	6.1	10,120	86.2	80.1
22	2046		6.1	6.1	10,120	86.2	80.1
23	2047		6.1	6.1	10,120	86.2	80.1
24	2048		6.1	6.1	10,120	86.2	80.1
25	2049		6.1	6.1	10,120	86.2	80.1
26	2050		6.1	6.1	10,120	86.2	80.1
27	2051		6.1	6.1	10,120	86.2	80.1
28	2052		6.1	6.1	10,120	86.2	80.1
29	2053		6.1	6.1	10,120	86.2	80.1
30	2054		6.1	6.1	10,120	86.2	80.1
31	2055		6.1	6.1	10,120	86.2	80.1
32	2056		6.1	6.1	10,120	86.2	80.1
33	2057		6.1	6.1	10,120	86.2	80.1
34	2058		6.1	6.1	10,120	86.2	80.1
35	2059		6.1	6.1	10,120	86.2	80.1
NPV	1.15%	584.7	176.9	757.4	226,724.5	1,931.5	1174.1
	2%	568.4	147.4	708.9	182,724	1556.6	847.8
	4%	532.9	99.8	620.3	113,621.1	968.0	347.7
FIRR	6.79%						
B/C ratio	2.55						
Payback	19.8 years						

Nigeria Electricity and Gas Improvement Project Transmission Expansion Plan

FICHTNER

Financial Assessment
Project 2: 330 kV North East Ring

Annex 10.2

Year	Cal. Year	Investm. cost US\$m	O&M cost US\$m	Total cost US\$m	Energy transmitted GWh	Revenue US\$m	Net Cash Flow US\$m
-7	2018	165.6		165.6			-165.6
-6	2019	165.6		165.6			-165.6
-5	2020		3.3	3.3	45	0.4	-2.9
-4	2021	107.0	3.3	110.3	49	0.4	-109.9
-3	2022	107.0	4.4	111.4	53	0.5	-111.0
-2	2023	107.0	5.5	112.5	57	0.5	-112.0
-1	2024	107.0	6.5	113.5	62	0.5	-113.0
1	2025		7.6	7.6	67	0.6	-7.0
2	2026		7.6	7.6	75	0.6	-7.0
3	2027		7.6	7.6	97	0.8	-6.8
4	2028		7.6	7.6	499	4.3	-3.3
5	2029		7.6	7.6	937	8.0	0.4
6	2030		7.6	7.6	1,415	12.1	4.5
7	2031		7.6	7.6	1,930	16.4	8.8
8	2032		7.6	7.6	2,544	21.7	14.1
9	2033		7.6	7.6	3,221	27.4	19.8
10	2034		7.6	7.6	3,958	33.7	26.1
11	2035		7.6	7.6	4,760	40.5	33.0
12	2036		7.6	7.6	4,861	41.4	33.8
13	2037		7.6	7.6	4,963	42.3	34.7
14	2038		7.6	7.6	4,963	42.3	34.7
15	2039		7.6	7.6	4,963	42.3	34.7
16	2040		7.6	7.6	4,963	42.3	34.7
17	2041		7.6	7.6	4,963	42.3	34.7
18	2042		7.6	7.6	4,963	42.3	34.7
19	2043		7.6	7.6	4,963	42.3	34.7
20	2044		7.6	7.6	4,963	42.3	34.7
21	2045		7.6	7.6	4,963	42.3	34.7
22	2046		7.6	7.6	4,963	42.3	34.7
23	2047		7.6	7.6	4,963	42.3	34.7
24	2048		7.6	7.6	4,963	42.3	34.7
25	2049		7.6	7.6	4,963	42.3	34.7
26	2050		7.6	7.6	4,963	42.3	34.7
27	2051		7.6	7.6	4,963	42.3	34.7
28	2052		7.6	7.6	4,963	42.3	34.7
29	2053		7.6	7.6	4,963	42.3	34.7
30	2054		7.6	7.6	4,963	42.3	34.7
31	2055		7.6	7.6	4,963	42.3	34.7
32	2056		7.6	7.6	4,963	42.3	34.7
33	2057		7.6	7.6	4,963	42.3	34.7
34	2058		7.6	7.6	4,963	42.3	34.7
35	2059		7.6	7.6	4,963	42.3	34.7
NPV	1.15%	732.3	222.8	950.5	100,865.3	859.3	-91.2
	2%	713.2	185.9	891.5	80,191	683.2	-208.3
	4%	671.5	126.3	784.1	48,080.2	409.6	-374.5
FIRR	0.63%						
B/C ratio	0.90						
Payback	38.1 years						

Nigeria Electricity and Gas Improvement Project Transmission Expansion Plan							
FICHTNER		Financial Assessment Project 3: 330 kV Lines for Mambilla HPP				Annex 10.3	
Year	Cal. Year	Investm. cost US\$m	O&M cost US\$m	Total cost US\$m	Energy transmitted GWh	Revenue US\$m	Net Cash Flow US\$m
-7							
-6							
-5							
-4							
-3	2022	113.3		113.3			-113.3
-2	2023	113.3		113.3			-113.3
-1	2024	113.3		113.3			-113.3
1	2025		3.4	3.4	501	4.3	0.9
2	2026		3.4	3.4	1,503	12.8	9.4
3	2027		3.4	3.4	2,004	17.1	13.7
4	2028		3.4	3.4	2,505	21.3	17.9
5	2029		3.4	3.4	3,006	25.6	22.2
6	2030		3.4	3.4	3,507	29.9	26.5
7	2031		3.4	3.4	4,008	34.1	30.7
8	2032		3.4	3.4	4,509	38.4	35.0
9	2033		3.4	3.4	5,010	42.7	39.3
10	2034		3.4	3.4	5,010	42.7	39.3
11	2035		3.4	3.4	5,010	42.7	39.3
12	2036		3.4	3.4	5,010	42.7	39.3
13	2037		3.4	3.4	5,010	42.7	39.3
14	2038		3.4	3.4	5,010	42.7	39.3
15	2039		3.4	3.4	5,010	42.7	39.3
16	2040		3.4	3.4	5,010	42.7	39.3
17	2041		3.4	3.4	5,010	42.7	39.3
18	2042		3.4	3.4	5,010	42.7	39.3
19	2043		3.4	3.4	5,010	42.7	39.3
20	2044		3.4	3.4	5,010	42.7	39.3
21	2045		3.4	3.4	5,010	42.7	39.3
22	2046		3.4	3.4	5,010	42.7	39.3
23	2047		3.4	3.4	5,010	42.7	39.3
24	2048		3.4	3.4	5,010	42.7	39.3
25	2049		3.4	3.4	5,010	42.7	39.3
26	2050		3.4	3.4	5,010	42.7	39.3
27	2051		3.4	3.4	5,010	42.7	39.3
28	2052		3.4	3.4	5,010	42.7	39.3
29	2053		3.4	3.4	5,010	42.7	39.3
30	2054		3.4	3.4	5,010	42.7	39.3
31	2055		3.4	3.4	5,010	42.7	39.3
32	2056		3.4	3.4	5,010	42.7	39.3
33	2057		3.4	3.4	5,010	42.7	39.3
34	2058		3.4	3.4	5,010	42.7	39.3
35	2059		3.4	3.4	5,010	42.7	39.3
NPV	1.15%	332.2	97.5	426.5	121,666.1	1,036.5	610.0
	2%	326.7	85.0	406.8	101,634	865.8	459.1
	4%	314.4	63.4	370.8	68,591.1	584.3	213.6
FIRR	7.31%						
B/C ratio	2.43						
Payback	15.7 years						