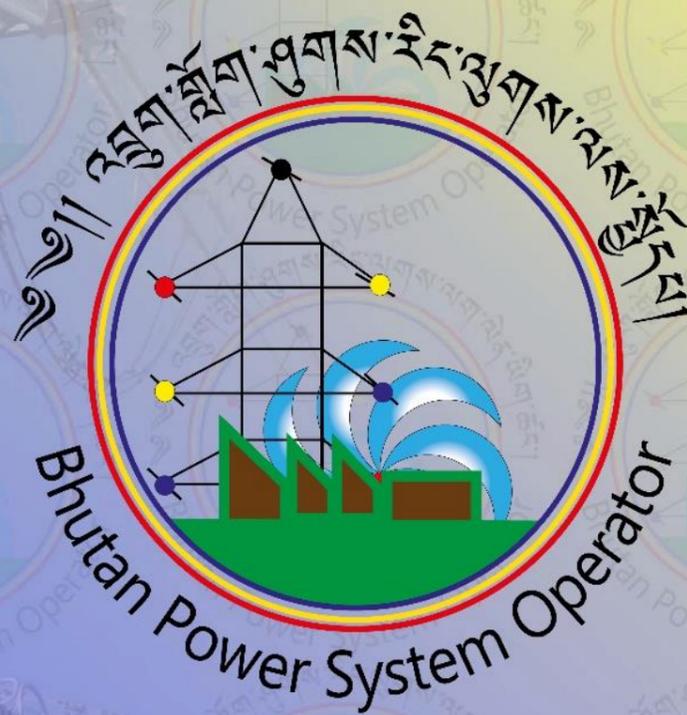


འབྲུག་གློག་ཤུགས་ཟིང་ལྷགས་ལས་ཚུན་དཔ།
Bhutan Power System Operator

རྒྱལ་ཁྲིམས་དང་རང་བཞིན་ཐོན་སྐྱེད་ལྗན་ཁག
Ministry of Energy and Natural Resources

Power System Operation Division



Annual Transmission System Performance Report for the year 2025

January 2026



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INTRODUCTION

In compliance to Grid Code Regulation 2024, Clause No. 153, this office prepared an annual report covering the performance of the Transmission System and details as required by the Ministry and the Authority annually for development of power system master plan and formulation of other policy decisions, thus this report contains the performance of Transmission System for the year 2025.

All the index and other calculations in this report have been executed based on the data received from substations and generating plants.

1.0 PERFORMANCE OF GENERATING STATIONS

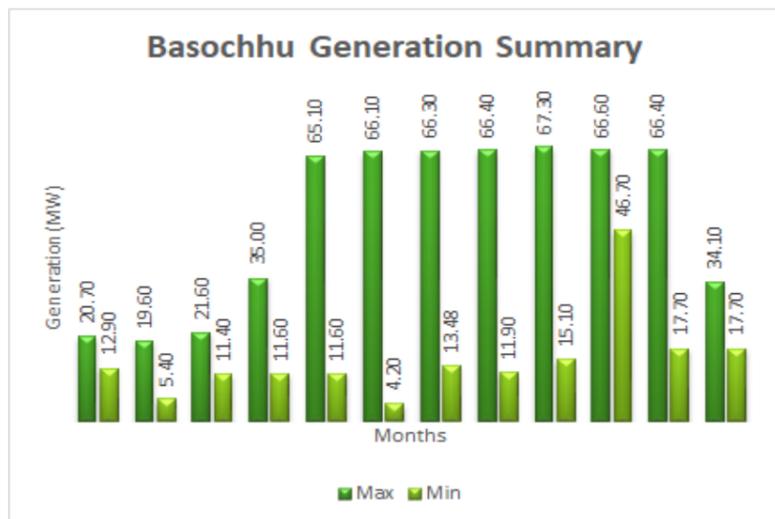
1.1 POWER GENERATION

The maximum individual plant generation was recorded as 1122.00 MW by the Tala Hydropower Plant, followed by 934.60 MW by PHP-II

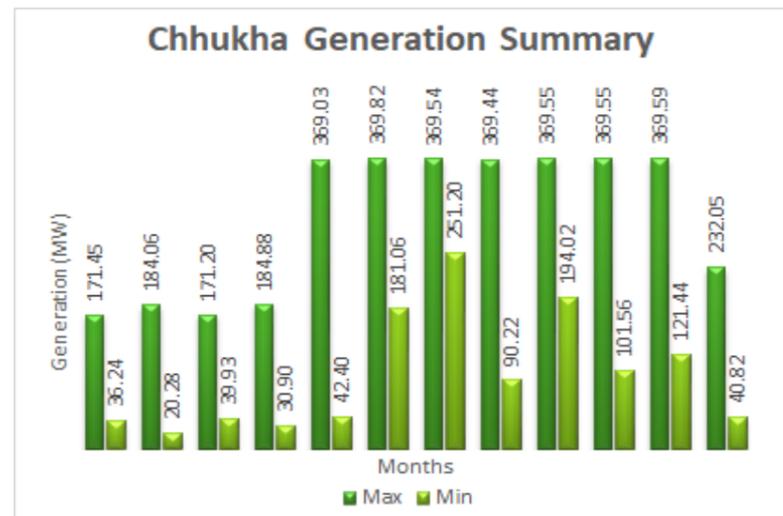
Table: 1.1.1 Monthly maximum and minimum generation summary

SL No	Hydropower Plant	Monthly Maximum and Minimum Generation (MW)												Max/Min of year (MW)	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	BHP	Max	20.70	19.60	21.60	35.00	65.10	66.10	66.30	66.40	67.30	66.60	66.40	34.10	67.30
		Min	12.90	5.40	11.40	11.60	11.60	4.20	13.48	11.90	15.10	46.70	17.70	17.70	4.20
2	CHP	Max	171.45	184.06	171.20	184.88	369.03	369.82	369.54	369.44	369.55	369.55	369.59	232.05	369.82
		Min	36.24	20.28	39.93	30.90	42.40	181.06	251.20	90.22	194.02	101.56	121.44	40.82	20.28
3	THP	Max	509.00	428.00	473.00	559.00	1122.00	1122.00	1122.00	1122.00	1122.00	1122.00	1122.00	649.00	1122.00
		Min	22.00	20.00	22.00	21.00	51.00	187.00	453.00	453.00	935.00	374.00	180.00	41.00	20.00
4	KHP	Max	29.37	30.71	49.50	63.89	66.00	66.00	66.00	66.00	66.00	66.00	66.00	31.37	66.00
		Min	11.38	11.19	15.32	22.36	26.39	30.05	31.09	27.90	15.18	33.00	24.57	15.35	11.19
5	DHP	Max	28.16	21.07	47.75	32.00	127.03	127.28	127.14	113.68	127.34	127.60	0.00	0.00	127.60
		Min	19.55	11.06	15.15	5.35	17.18	24.51	46.35	49.98	63.05	36.75	0.00	0.00	0.00
6	MHP	Max	348.36	350.85	322.65	593.14	782.48	790.59	785.47	785.47	785.53	785.39	784.93	602.11	790.59
		Min	31.22	20.98	17.81	34.71	61.62	321.80	394.44	394.44	329.43	279.70	115.81	40.38	17.81
7	NHP	Max	40.03	40.03	18.07	64.95	129.85	159.84	129.94	129.91	129.95	129.94	129.89	80.61	159.84
		Min	13.04	15.00	12.00	15.00	28.00	45.02	64.90	64.64	64.46	53.01	40.00	28.00	12.00
8	PHP-II	Max	342.50	282.80	372.44	451.10	699.60	748.00	750.90	748.00	934.60	934.60	917.90	369.10	934.60
		Min	7.00	49.70	49.59	40.10	186.40	186.40	373.00	187.00	187.00	186.50	184.50	110.20	7.00
9	SHP	Max							20.00	20.00	10.00	10.00	10.00	8.00	20.00
		Min							2.00	2.00	5.00	0.00	5.00	0.00	0.00

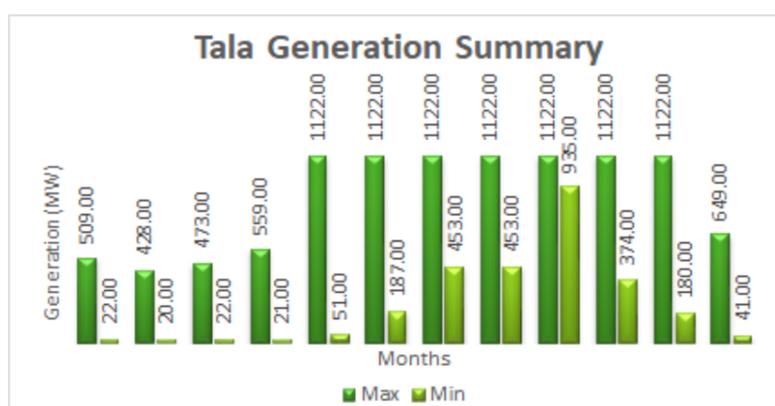
Graph: 1.1.1 Basochhu Generation Summary



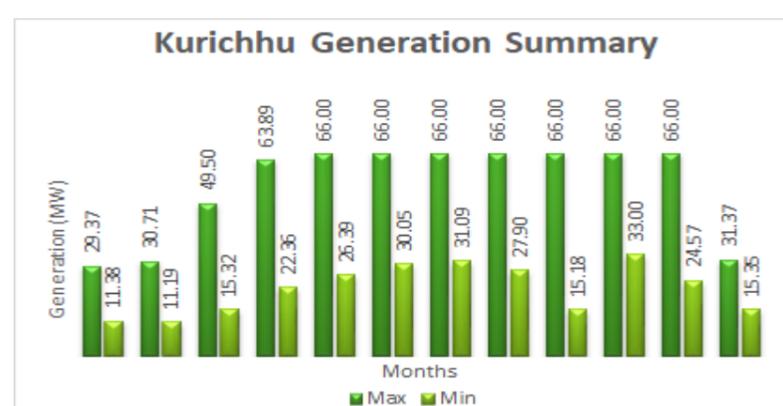
Graph: 1.1.2 Chukha Generation Summary



Graph: 1.1.3 Tala Generation Summary



Graph: 1.1.4 Kurichhu Generation Summary

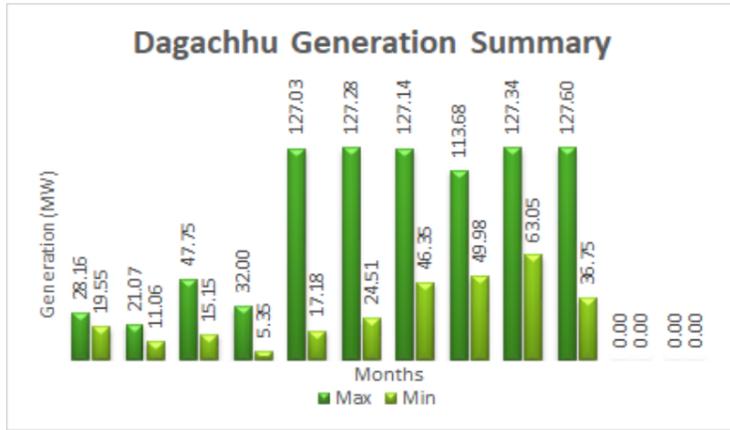




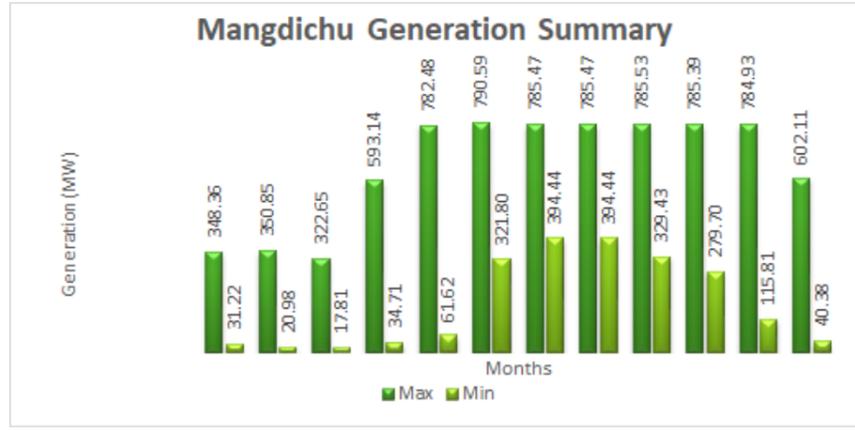
Transmission System Performance Report

Annual report -2025

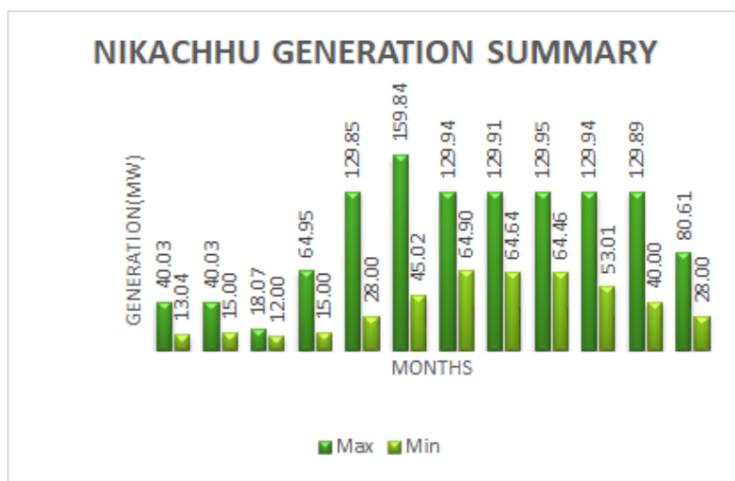
Graph: 1.1.5 Dagachhu generation summary



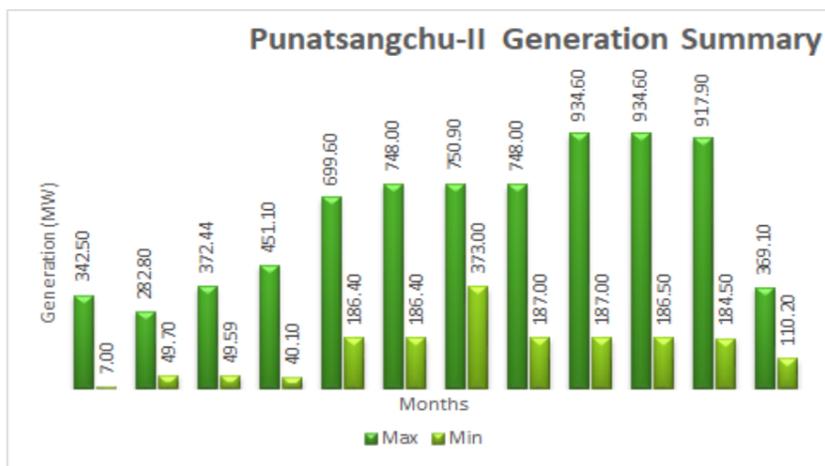
Graph: 1.1.6 Mangdichu generation summary



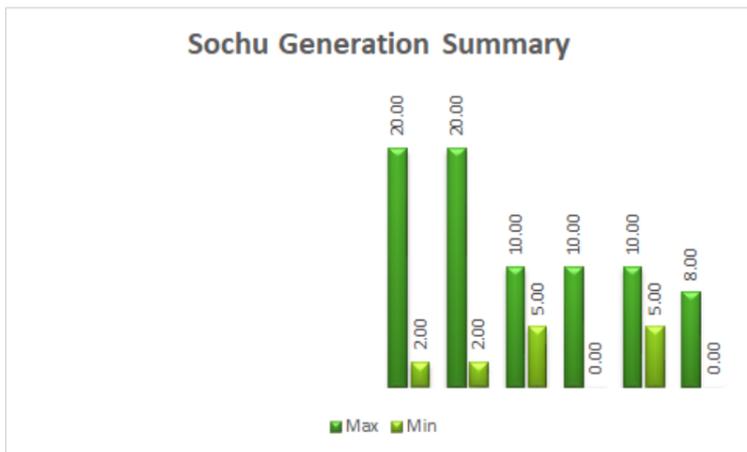
Graph: 1.1.7 Nikachhu generation summary



Graph: 1.1.8 Phunatsangchu-II Generation Summary



Graph: 1.1.9 Sochu Generation summary



1.2 PLANT FACTOR

The plant factor of each generating plant was calculated as below:

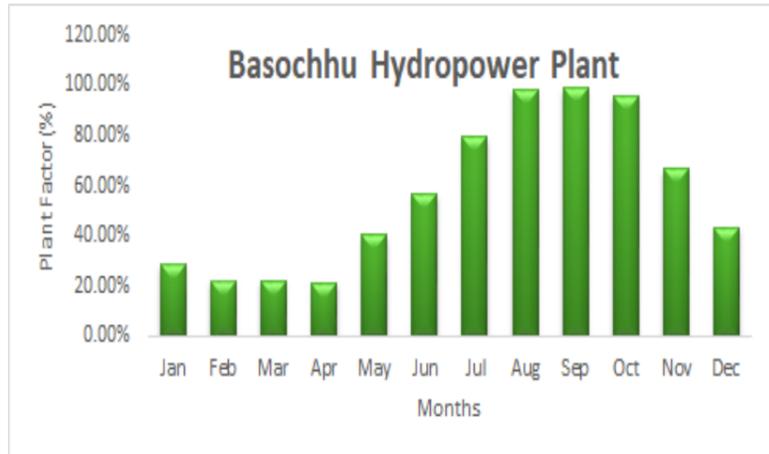
$$\begin{aligned}
 \text{Plant factor} &= (\text{Actual output of a plant over a period of time}) / (\text{Output when operated at name plate rated capacity for entire time}) \\
 &= (\text{Total energy plant has produced over a period}) / (\text{Total energy plant would produce when operated at full rated capacity})
 \end{aligned}$$

Table: 1.2.1 Monthly plant factor of the hydropower plants

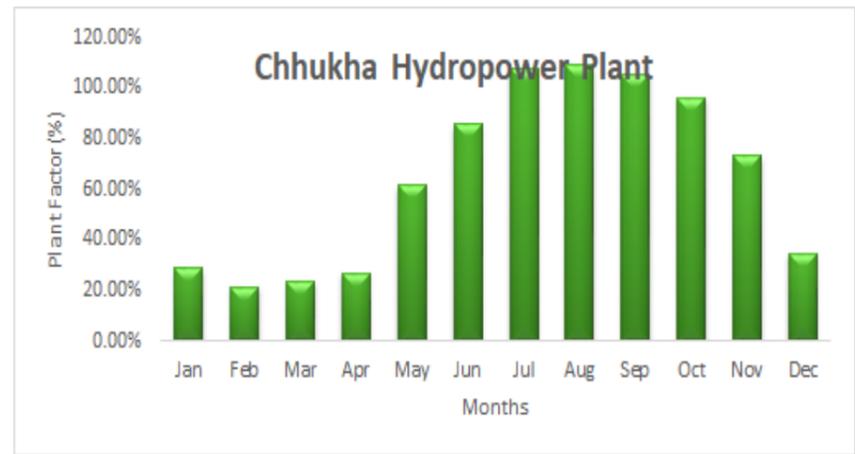
Sl. No	Hydropower Plant	Monthly Plant Factor (%)												Max/Min of year (%)	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Min
1	BHP	28.43%	21.98%	22.14%	21.24%	40.48%	56.64%	79.31%	97.81%	98.88%	95.79%	66.65%	43.18%	98.88%	21.24%
2	CHP	28.62%	21.31%	23.55%	26.97%	61.53%	85.53%	107.83%	108.84%	105.58%	96.21%	73.15%	34.79%	108.84%	21.31%
3	THP	18.76%	14.01%	15.52%	17.33%	44.15%	71.80%	94.73%	108.75%	106.02%	74.27%	59.32%	31.02%	108.75%	14.01%
4	KHP	32.51%	28.73%	28.73%	56.64%	90.72%	100.85%	107.60%	105.87%	103.88%	100.12%	64.91%	41.03%	107.60%	28.73%
5	DHP	17.44%	13.41%	13.83%	13.43%	30.10%	43.88%	61.07%	82.99%	88.56%	21.74%	0.00%	0.04%	88.56%	0.00%
6	MHP	18.17%	14.78%	21.62%	29.45%	53.78%	81.35%	98.97%	98.89%	104.06%	79.82%	13.36%	26.76%	104.06%	13.36%
7	NHP	16.32%	12.22%	13.29%	18.10%	47.35%	76.47%	87.76%	89.13%	78.03%	71.10%	42.46%	24.28%	89.13%	12.22%
8	SHP	-	-	-	-	-	-	59.58%	59.58%	81.72%	0.00%	0.00%	0.00%	81.72%	0.00%
9	PHP-II	50.01%	5.20%	52.79%	68.30%	39.72%	60.41%	63.06%	71.02%	69.33%	48.08%	35.42%	22.70%	71.02%	5.20%



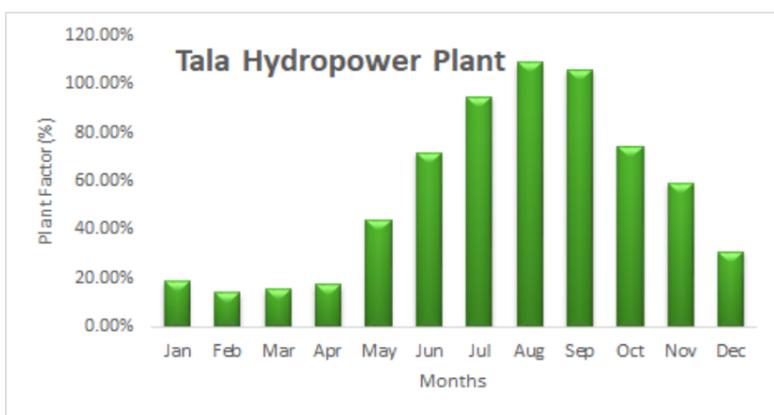
Graph: 1.2.1 Plant factor of Basochhu Hydropower Plant



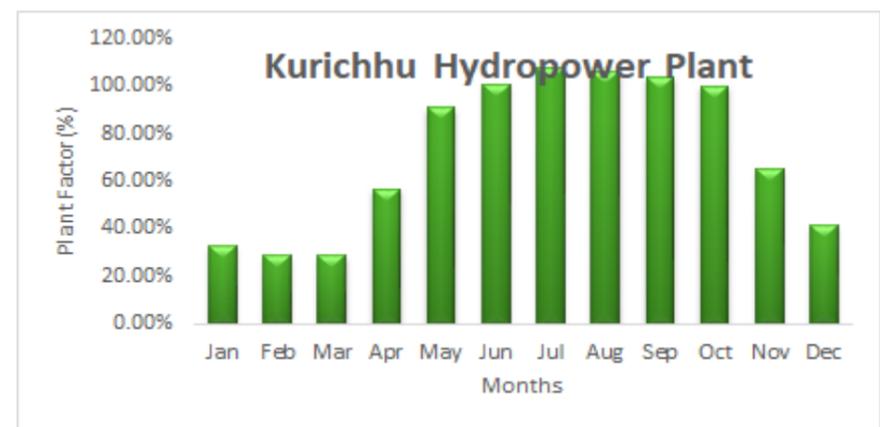
Graph: 1.2.2 Plant factor of Chhukha Hydropower Plant



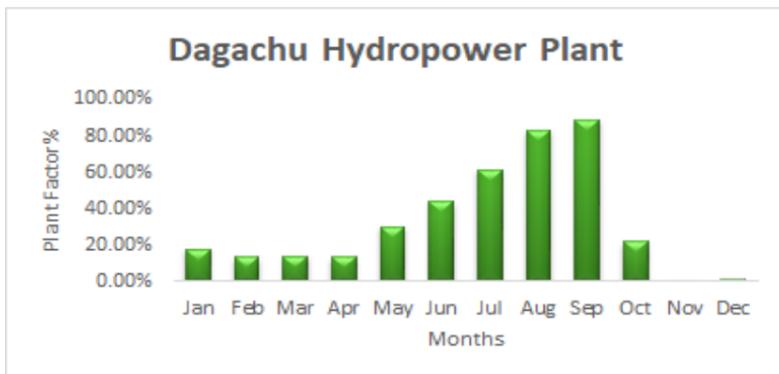
Graph: 1.2.3 Plant factor of Tala Hydropower Plant



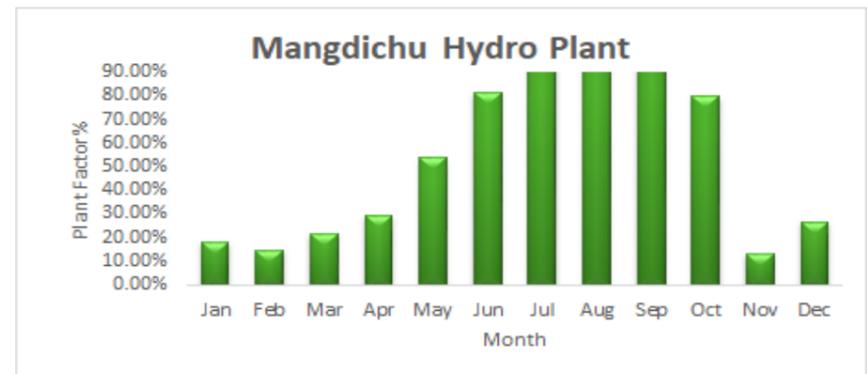
Graph: 1.2.4 Plant factor of Kurichhu Hydropower Plant



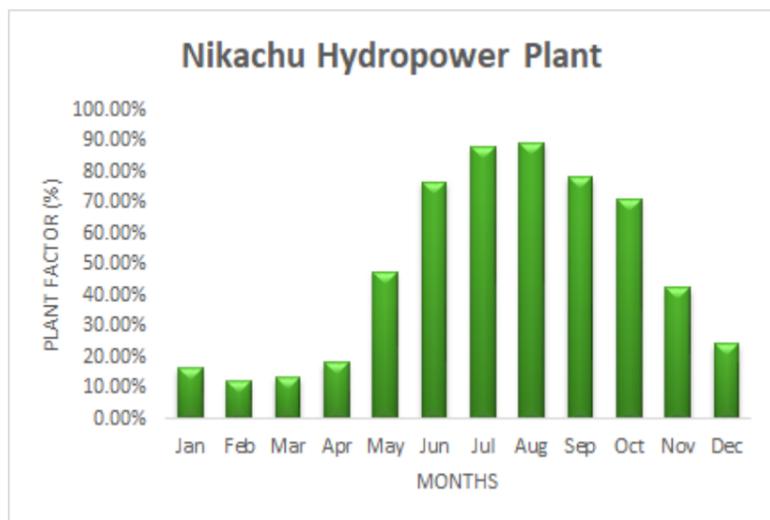
Graph: 1.2.4 Plant factor of Dagachhu Hydropower Plant



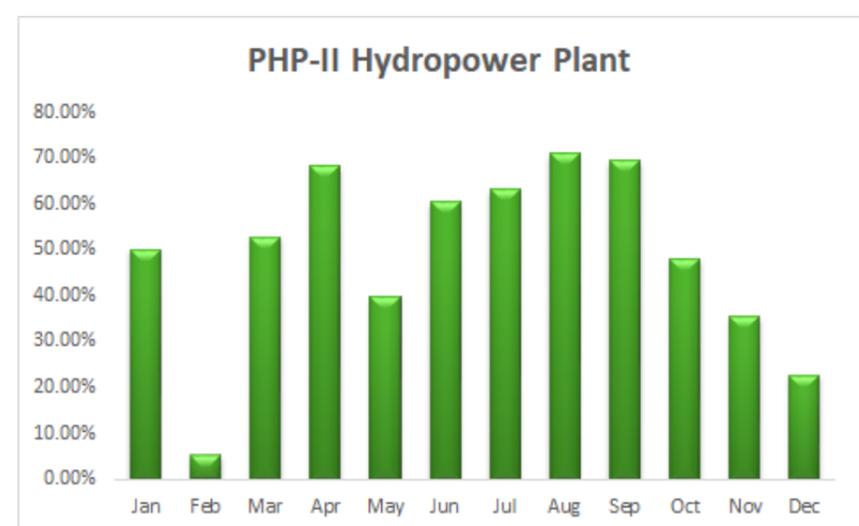
Graph: 1.2.4 Plant factor of Mangdichu Hydropower Plant



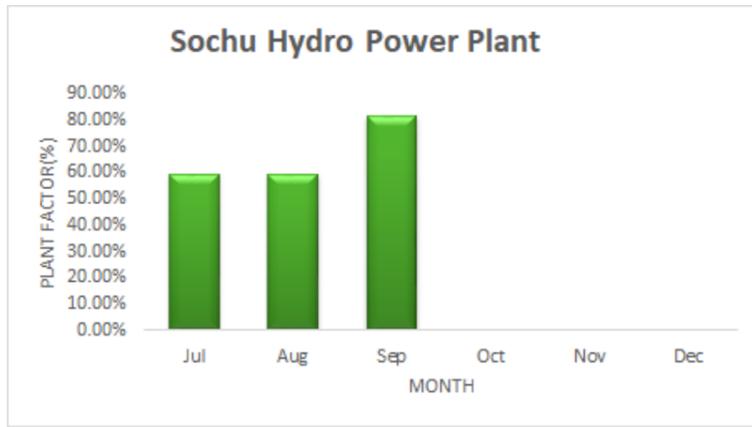
Graph: 1.2.5 Plant factor of Nikachhu Hydropower Plant



Graph: 1.2.6 Plant factor of Punatsangchu-II Hydropower Plant



Graph: 1.2.7 Plant factor of Sochu Hydropower Plant



2.0 PEAK DEMAND, ENERGY AVAILABILITY AND REQUIREMENT FOR THE COUNTRY

Calculation of coincidental peak load for the eastern grid, western grid and national load, we use the following methods:

1. *National Demand = (Sum of all total generation of each plant) – (Sum of all Export/Import)*
2. *National Demand = (Sum of all feeders loading at hydropower plant) – (Sum of all Export/Import)*
3. *National Demand = (Sum of all substation loading)*

The national load calculated using method-1 is considered in the report.

2.1 NATIONAL LOAD

The national coincidental peak load for the year was recorded 1477 MW (Increased by 43.90 % compare to 2024 (1026.44 MW) on November 8, 2025 at 19:00:00 Hrs. using method-1 (sum of all total generation each plant minus sum of export/import). The main factor contributing towards the increase in Bhutan peak load in 2025 could be because of more production by the industries, new number of industries came up along with numerous new generating stations and substations came up in 2025.

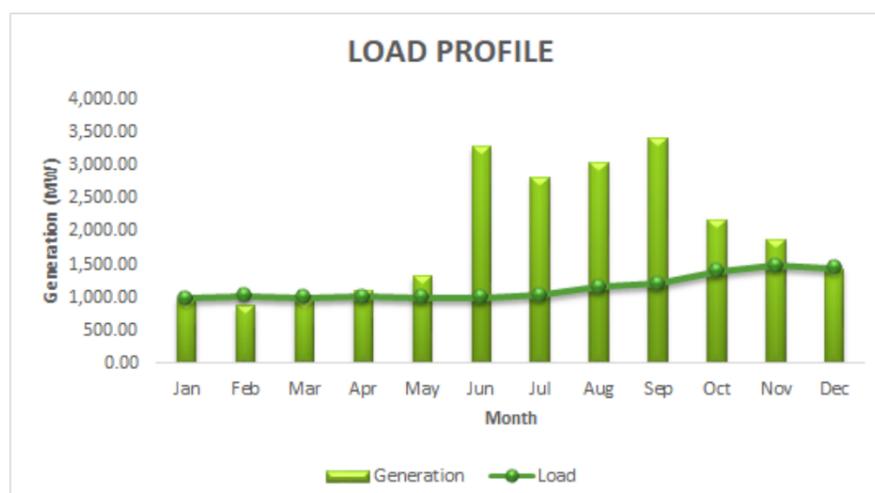
Table 2.1.2 Yearly National peak load

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Peak Load (MW)	187.05	237.17	256.95	276.24	282.44	313.94	333.41	336.52	335.87	362.09	399.35	387.66	374.53	435.35	629.61	955.51	1026.44	1477
% Growth over previous Year	18.87	26.79	8.34	7.51	2.24	11.15	6.20	0.93	-0.19	7.81	10.29	-2.93	-3.39	16.24	44.62	51.76	7.42	43.90

Table: 2.1.3 Monthly national peak load and corresponding generation using method- 1

Sl.No	Months	Date	Time	Total Grid (MW)	
				Load	Generation
1	Jan	1/30/2025	16:00	986.58	964.42
2	Feb	2/10/2025	12:00	1019.58	871.68
3	Mar	3/9/2025	22:00	1,000.76	953.38
4	Apr	4/11/2025	22:00	1011.69	1102.91
5	May	5/11/2025	4:00	999.73	1,318.98
6	Jun	6/30/2025	5:00	999.17	3281.45
7	Jul	7/17/2025	20:00	1,035.63	2,810.28
8	Aug	8/15/2025	17:00	1153.6	3045.93
9	Sep	9/17/2025	19:00	1,202.06	3,416.96
10	Oct	10/30/2025	18:00	1399.46	2181.32
11	Nov	11/8/2025	19:00	1,477.00	1,876.07
12	Dec	12/15/2025	19:00	1442.74	1426.45
National Peak Load of the year (MW)				1,477.00	3,416.96

Graph: 2.1.1 Monthly national peak load and corresponding generation using method-1





3.0 EXPORT AND IMPORT OF ELECTRICITY TO/FROM NEIGHBORING COUNTRIES

3.1 EXPORT OF ELECTRICITY TO NEIGHBORING COUNTRY

Maximum export of electricity for the year was 1,395.44 MW to Alipurduar substation in May & June, 2025, followed by 1106.33 MW to Binaguri substation. The minimum export was 0.01 MW to Binaguri substation.

Table: 3.1.1 Monthly power export summary

Sl. No	Substation in India	Monthly Maximum and Minimum Export (MW)												Max/Min of year (MW)	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	Binaguri	Max	324.44	343.78	237.90	288.98	948.13	932.08	944.94	1036.91	1069.83	1106.33	916.01	377.20	1106.33
		Min	3.84	1.60	0.53	1.16	0.03	0.83	224.10	484.66	689.82	144.63	0.39	0.01	0.01
2	Birpara	Max	40.01	0.00	0.00	0.00	120.91	170.36	180.27	213.68	166.88	125.70	21.16	0.00	213.68
		Min	2.57	0.00	0.00	0.00	0.36	0.60	3.33	8.41	17.00	0.21	0.29	0.00	0.00
3	alakoti & Rang	Max	10.65	16.61	31.34	46.72	89.44	125.64	105.39	96.73	101.38	39.65	20.84	0.00	125.64
		Min	0.84	0.02	0.15	0.05	0.08	9.44	21.88	0.08	0.47	0.29	0.40	0.00	0.00
4	Alipurduar	Max	310.75	424.67	270.51	356.37	1395.44	1395.44	974.77	974.77	728.72	923.87	394.36	130.93	1395.44
		Min	0.97	0.69	0.09	0.00	125.99	125.99	244.91	244.91	3.23	2.46	2.91	130.93	0.00

3.2 IMPORT OF ELECTRICITY FROM NEIGHBORING COUNTRY

Maximum import of power was 475.79 MW from Alipurduar substation which occurred in December, 2025 followed by 406.05 MW and 365.34 MW from Birpara Binaguri respectively.

Table: 3.2.1 Monthly power import summary

Sl. No	Substation in India	Monthly Maximum and Minimum Import (MW)												Max/Min of year (MW)	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	Binaguri	Max	323.11	345.00	365.34	307.68	135.57	48.17	0.00	0.00	0.00	287.19	215.12	259.92	365.34
		Min	0.61	0.61	0.87	0.96	0.33	1.09	0.00	0.00	0.00	111.32	0.51	0.97	0.00
2	Birpara	Max	272.53	406.05	387.28	311.45	226.13	203.74	246.38	91.92	0.00	154.85	324.34	358.65	406.05
		Min	22.28	115.64	27.34	35.81	0.06	0.18	20.07	39.86	0.00	0.42	0.01	112.00	0.00
3	alakoti & Rang	Max	51.54	48.27	40.52	88.12	61.52	56.35	0.00	0.15	16.83	66.57	133.34	92.46	133.34
		Min	0.14	0.06	0.01	0.00	0.11	0.70	0.00	0.11	0.97	0.34	0.13	17.30	0.00
4	Alipurduar	Max	132.00	222.91	206.80	233.08	182.54	103.91	0.00	0.00	0.00	149.82	378.19	475.79	475.79
		Min	0.32	68.48	6.75	16.82	3.78	0.00	0.00	0.00	0.00	0.73	0.64	330.91	0.00

4.0 FREQUENCY PROFILE: MAXIMUM AND MINIMUM FREQUENCY RECORDED AND THE FREQUENCY DURATION IN DIFFERENT FREQUENCY BANDS

As per the Grid Code Regulation 2024, Clause 153, the transmission system frequency was classified into three different bands as follows:

1. Normal state
The transmission system frequency is within the limit of 49.5Hz to 50.5Hz
2. Alert state
The transmission system frequency is beyond the normal operating limit but within 49.0Hz to 51.0Hz
3. Emergency state
There is generation deficiency and frequency is below 49.0Hz.

We base our frequency at 220kV Bus frequency at 220/66/11kV Semtokha substation is considered as the grid frequency

Table: 4.0.1 Grid Frequency profile

Grid Frequency					
Sl. No	Months	Frequency profile of Bhutan			
		Normal	Alert	Emergency	Blackout/Other
1	Jan	99.87	0.13	0.00	0.00
2	Feb	90.32	0.00	0.00	9.68
3	Mar	99.87	0.00	0.00	0.13
4	Apr	99.87	0.00	0.00	0.13
5	May	100.00	0.00	0.00	0.00
6	Jun	96.64	0.00	0.13	3.23
7	Jul	100.00	0.00	0.00	0.00
8	Aug	100.00	0.00	0.00	0.00
9	Sep	96.64	0.13	0.00	3.23
10	Oct	99.87	0.13	0.00	0.00
11	Nov	96.64	0.13	0.00	3.23
12	Dec	99.87	0.13	0.00	0.00
Operation State for the year		98.30%	0.06%	0.01%	1.64%



5.0 VOLTAGE PROFILE OF SELECTED SUBSTATIONS

As the Grid Code Regulation 2025, Clause 153, the voltage at all connection points was classified into three different bands as follows:

1. *Normal state*
The voltages at all connection point are within the limits of 0.95 times and 1.05 times of the normal values
2. *Alert state*
The voltage at all connection points are outside the normal limit but within the limits of 0.9 times and 1.1 times of the normal values
3. *Emergency state*
Transmission system voltages are outside the limits of 0.9 times and 1.1 times of nominal values.

The voltage profile of 400/220/66/11kV Malbase substation in western grid and 132/33/11kV Nangkhor substation in the eastern grid are considered in the report as the grid voltage.

Table: 5.0.1 Grid Voltage profile

400/220/132/66 kV Grid Voltage																	
Sl. No	Months	400kV Bus Voltage Operation State (%)				220kV Bus Voltage Operation State (%)				66kV Bus Voltage Operation State (%)				132kV Bus Voltage Operation State (%)			
		Normal	Alert	Emergency	Blackout/Other	Normal	Alert	Emergency	Blackout/Other	Normal	Alert	Emergency	Blackout/Other	Normal	Alert	Emergency	Blackout/Other
1	Jan	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2	Feb	90.32	0.00	0.00	9.68	90.19	0.13	0.00	9.68	90.32	0.00	0.00	9.68	90.32	0.00	0.00	9.68
3	Mar	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
4	Apr	96.64	0.00	0.13	3.23	96.77	0.00	0.00	3.23	96.77	0.00	0.00	3.23	96.24	0.00	0.00	3.76
5	May	99.87	0.00	0.13	0.00	100.00	0.00	0.00	0.00	99.73	0.13	0.13	0.00	98.66	0.00	0.00	1.34
6	Jun	96.77	0.00	0.00	3.23	96.77	0.00	0.00	3.23	96.77	0.00	0.00	3.23	96.64	0.00	0.00	3.36
7	Jul	99.87	0.13	0.00	0.00	99.73	0.27	0.00	0.00	99.73	0.27	0.00	0.00	99.60	0.00	0.00	0.40
8	Aug	99.87	0.13	0.00	0.00	99.73	0.27	0.00	0.00	99.73	0.27	0.00	0.00	99.60	0.13	0.00	0.00
9	Sep	96.77	0.00	0.00	3.23	96.77	0.00	0.00	3.23	96.77	0.00	0.00	3.23	96.37	0.27	0.00	3.36
10	Oct	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	99.87	0.00	0.00	0.13
11	Nov	96.51	0.00	0.00	3.49	96.51	0.00	0.00	3.49	96.51	0.00	0.00	3.49	96.64	0.00	0.00	3.36
12	Dec	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	99.87	0.00	0.00	0.13
Operation State for year		98.05%	0.02%	0.02%	1.90%	98.04%	0.06%	0.00%	1.90%	98.03%	0.06%	0.01%	1.90%	97.82%	0.03%	0.00%	2.13%