

Ministry of Energy and Natural Resource

Bhutan Power System Operator

Thimphu: Bhutan



Transmission System Performance Report

Fourth Quarterly Report 2024



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1. Introduction

The electricity transmission network in Bhutan is solely owned by Bhutan Power Corporation limited (BPC) and electricity generation is solely owned by Druk Green Power Corporation Limited (DGPC). Bhutan Power System Operator (BPSO) under Ministry of Energy and Natural Resource is responsible for safe, secure and efficient operation of Bhutan transmission network and generation.

This quarterly report is prepared in compliance to the Grid Code Regulation (GCR) 2024, clause 155, and "System Operator has to submit a quarterly report covering the performance of the Transmission System to all Licensees, Authority and Ministry". This transmission performance report contains summary of growth of peak demand, performance of generating stations (power and energy generation), energy availability and requirement for the country, export and import of electricity to/ from India, frequency profile of selected substation and voltage profile of few important substations.

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

2. Total installed Capacity

1. Major Plants: 3464 MW
2. Mini & Micro: 8.1 MW
3. DG: 8.9 MW
4. Wind: 0.6 MW

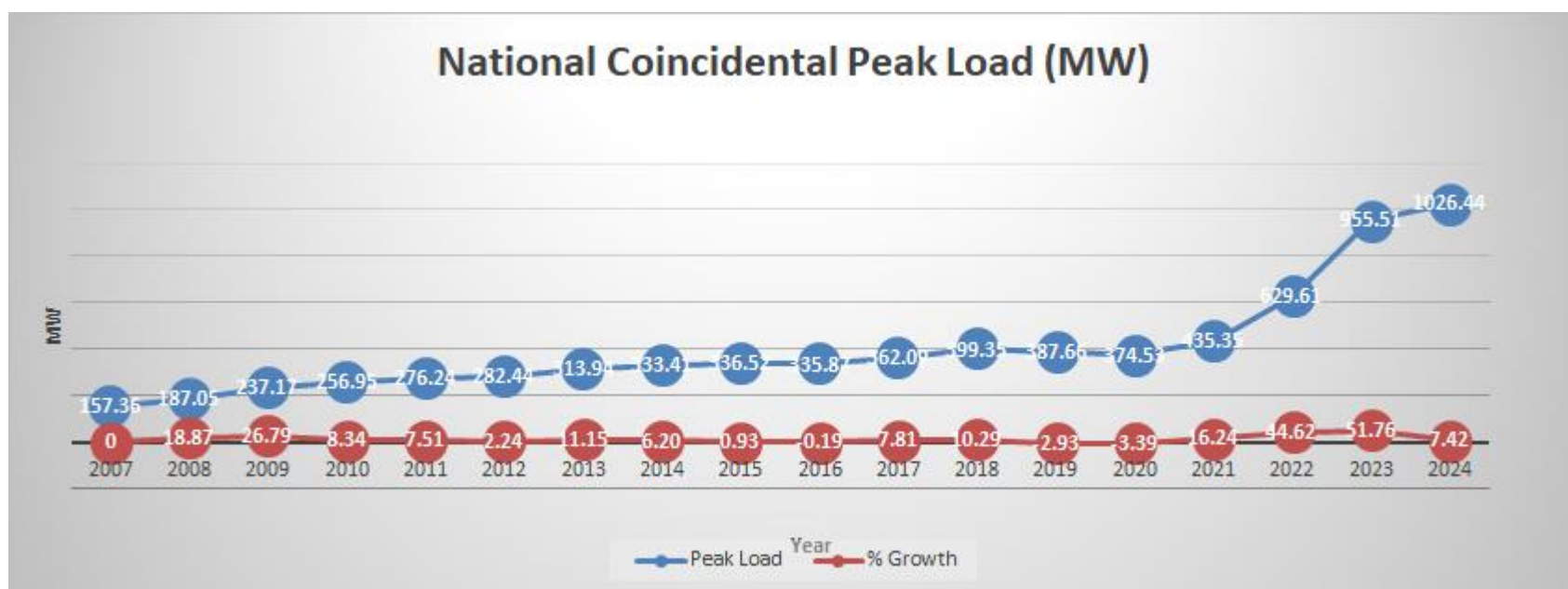
3. National Peak Demand

The national peak demand for Fourth Quarterly report for the year 2024 is recorded at **1026.44 MW** which was occurred on December 25th, 2024 at 18:38:16 hours. This is calculated by summation of Generation minus Export/Import.

Table 3.1. The National Peak Demand since 2007

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Peak Load (MW)	157.36	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
% 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

Graph 3.1. The growth in National Peak Demand since 2007



4. Power (MW) consumed by country

Following methods are used to calculate peak demand for the Eastern Grid, Western Grid and National demand.

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

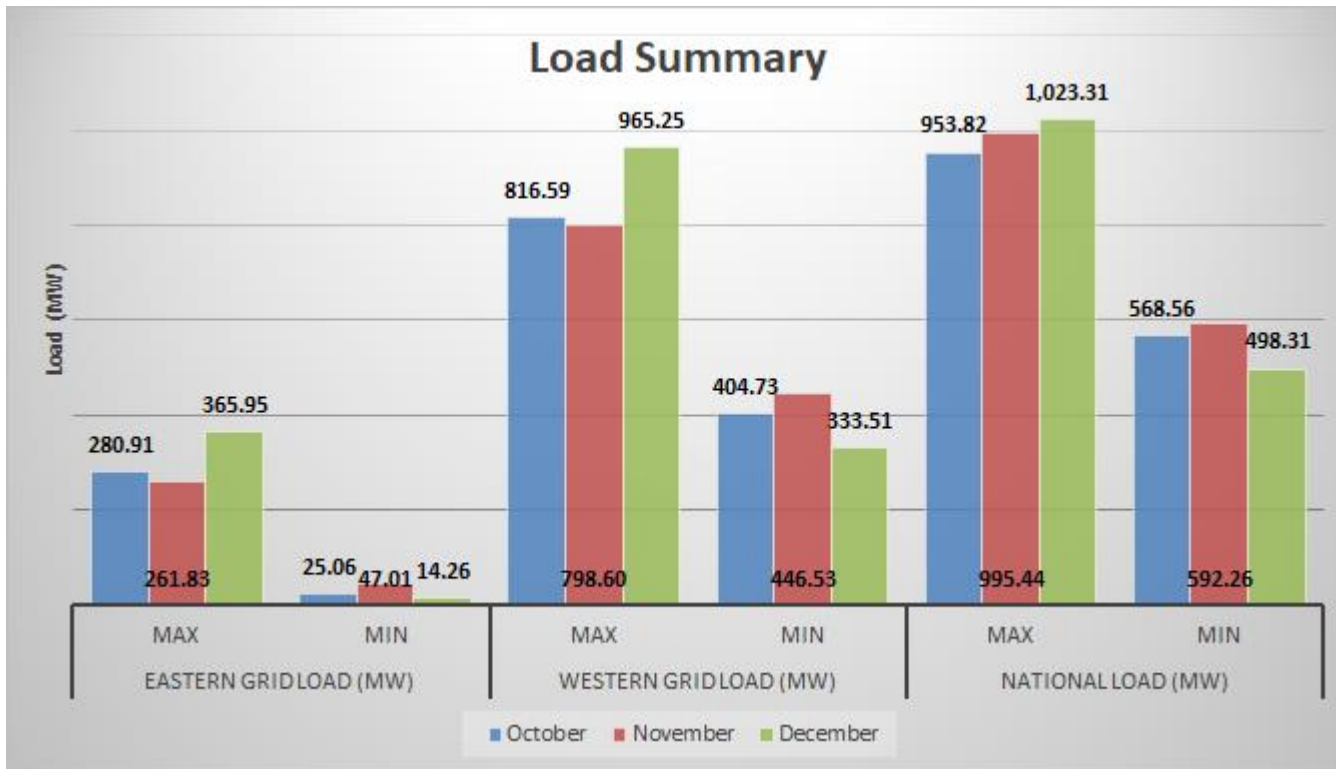
For this report, the National Demand was calculated using method-1.



Table 4.1 Domestic demand for Eastern Grid, Western Grid and National using method- 1

Grid	Eastern Grid Load (MW)		Western Grid Load (MW)		National Load (MW)	
Month	Max	Min	Max	Min	Max	Min
October	280.91	25.06	816.59	404.73	953.82	568.56
November	261.83	47.01	798.60	446.53	995.44	592.26
December	365.95	14.26	965.25	333.51	1,023.31	498.31

Graph 4.1 Domestic demand for Eastern Grid, Western Grid and National using method- 1



5. Energy Availability and Requirement for the country

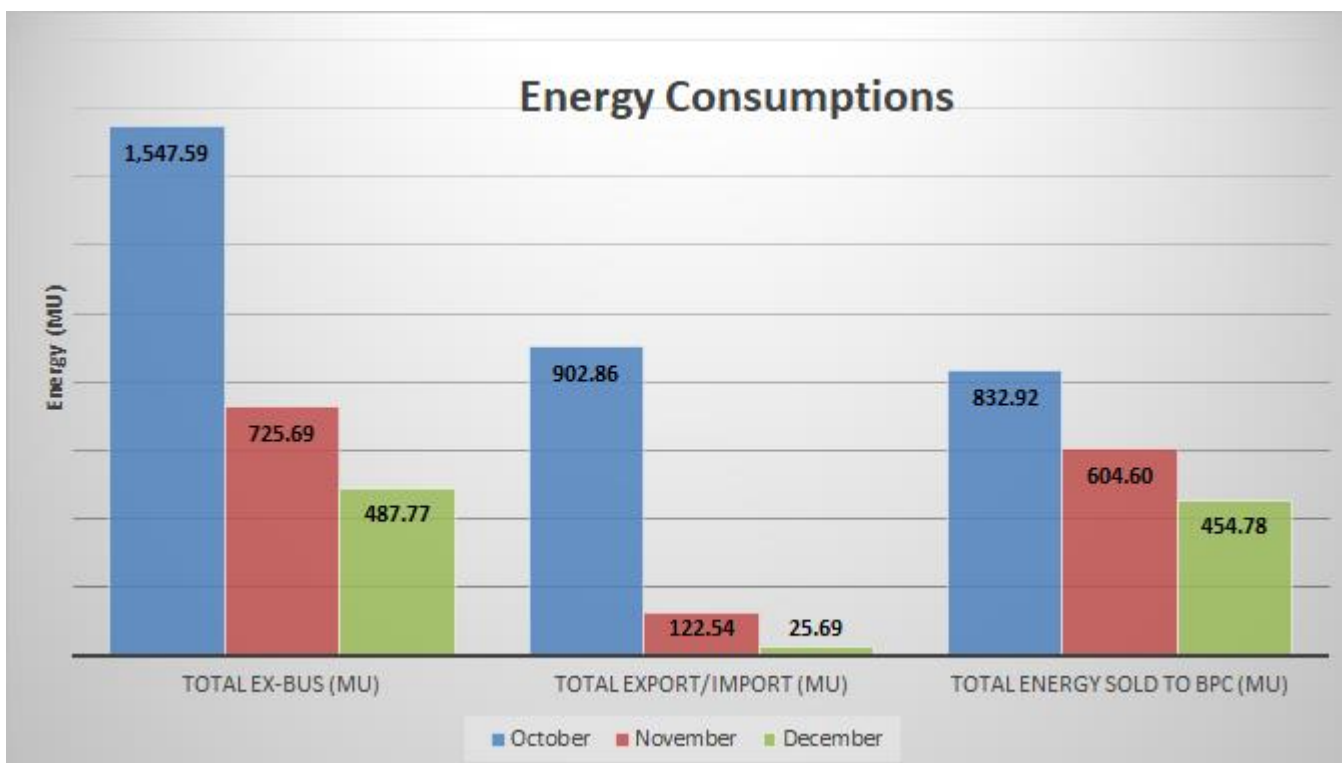
5.1. Energy (MU) consumed by Country

The total energy consumed within Bhutan is computed from the total energy DGPC had sold to BPC including the royalty energy.

Table 5.1 Total Energy (MU) consumed

Month	Total Ex-bus (MU)	Total Export/Import (MU)	Total energy sold to BPC (MU)
October	1,547.59	902.86	832.92
November	725.69	122.54	604.60
December	487.77	25.69	454.78

Graph 5.1 Total Energy (MU) consumed





6. Performance of generating plants

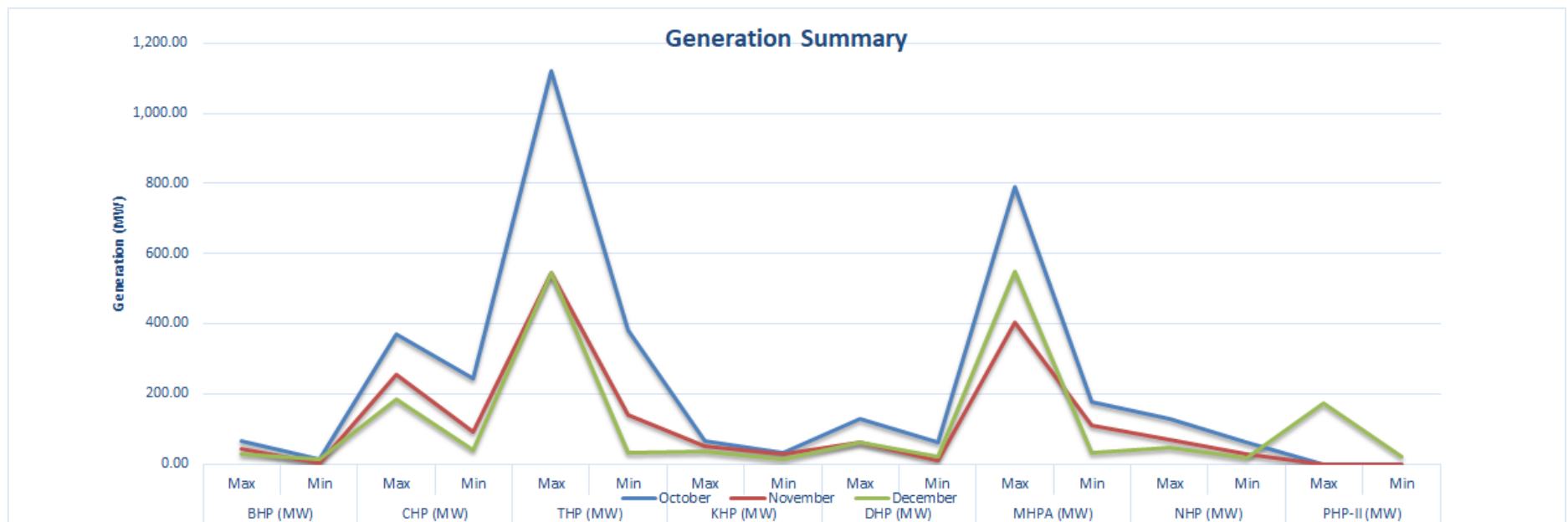
6.1 Power and Energy Generation

The maximum total generation for the fourth quarter of year 2024 was 2,668.34 MW in month of October and minimum generation was 182.36 MW in the month of December.

Table: 6.1 Summary of maximum and minimum generation by various hydropower plant

Generation By	BHP (MW)		CHP (MW)		THP (MW)		KHP (MW)		DHP (MW)		MHPA (MW)		NHP (MW)		PHP-II (MW)		TOTAL (MW)	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
October	66.50	12.90	369.82	244.09	1,122.00	380.00	66.00	33.00	127.24	59.99	789.64	175.00	127.14	59.99	0.00	0.00	2,668.34	964.97
November	42.80	3.50	256.34	91.14	545.00	140.00	50.83	26.29	60.03	7.69	402.13	111.43	70.15	28.00	0.00	0.00	1,427.28	408.05
December	28.00	12.90	184.12	40.49	544.00	32.00	36.48	11.77	60.53	19.95	548.04	31.47	45.06	15.00	173.92	18.78	1,620.15	182.36

Graph: 6.1 Summary of maximum and minimum generation by various hydropower plant



6.2 Plant Capacity Factor

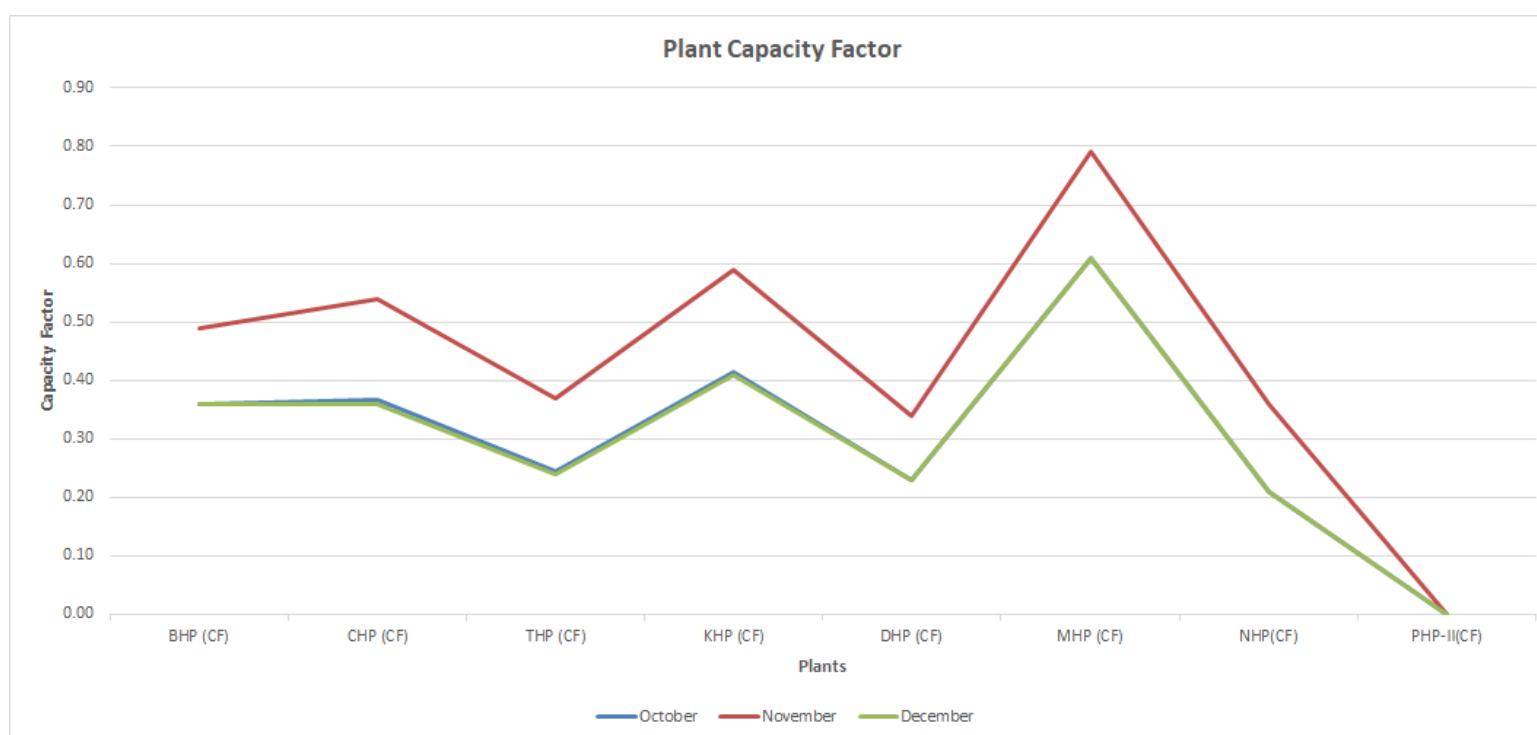
The capacity factor of each generating plant was calculated as below:

$$\text{Capacity factor} = \frac{\text{Total energy plant has produce over a period}}{\text{Total energy plant would produce when operated at full capacity}}$$

Table 6.2 Total generation and capacity factor of various hydropower plants

Month	Plant Capacity Factor															
	BHP (MU)	BHP (CF)	CHP (MU)	CHP (CF)	THP (MU)	THP (CF)	KHP (MU)	KHP (CF)	DHP (MU)	DHP (CF)	MHP (MU)	MHP (CF)	NHP (MU)	NHP (CF)	PHP-II (MU)	PHP-II (CF)
October	40.15	0.36	246.81	0.37	623.20	0.25	46.04	0.42	71.39	0.23	442.23	0.61	77.78	0.21	0.00	0.00
November	22.99	0.49	134.54	0.54	278.23	0.37	26.03	0.59	31.97	0.34	197.37	0.79	34.57	0.36	0.00	0.00
December	16.97	0.36	90.63	0.36	183.92	0.24	18.23	0.41	21.41	0.23	128.08	0.61	20.12	0.21	8.39	0.00

Graph 6.2. Capacity factor of various hydropower plants





7. Export and Import of Electricity

Maximum export for the fourth quarter of year 2024 was 1,040.12 MW in the month of October to Binaguria substation in India. The minimum export recorded was 0.00 MW to Bripara substation in India during the month of November and December.

Table 7.1. Export of electricity to India

Export To	Binaguri (MW)		Birpara (MW)		Salakoti and Rangia (MW)		Alipurduar (MW)		Total Export (MW)
Month	Max	Min	Max	Min	Max	Min	Max	Min	
October	1,040.12	121.32	124.94	0.44	103.82	14.00	844.49	201.77	2,113.37
November	451.49	0.47	0.00	0.00	60.00	0.02	323.06	1.94	834.55
December	619.82	5.91	0.00	0.00	14.76	0.01	148.65	1.14	783.23

Graph 7.1. Export of electricity to India

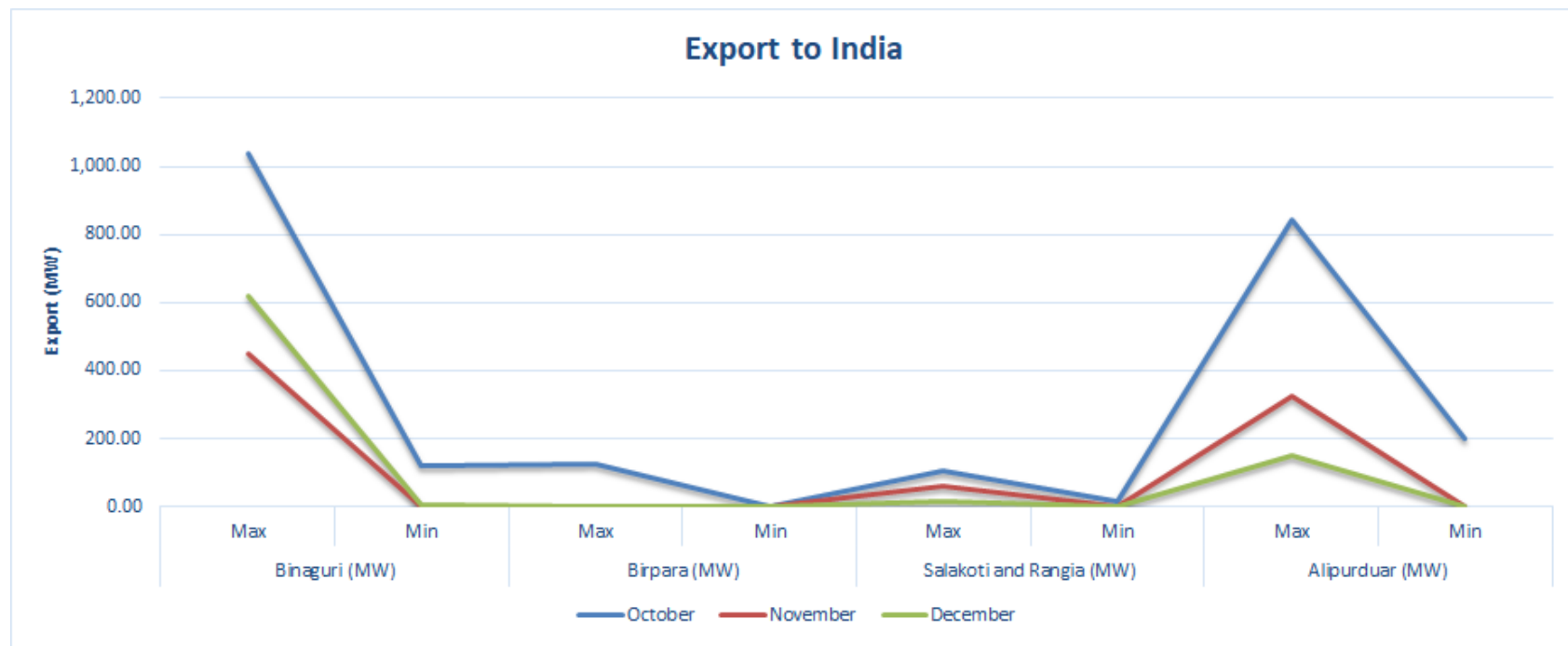
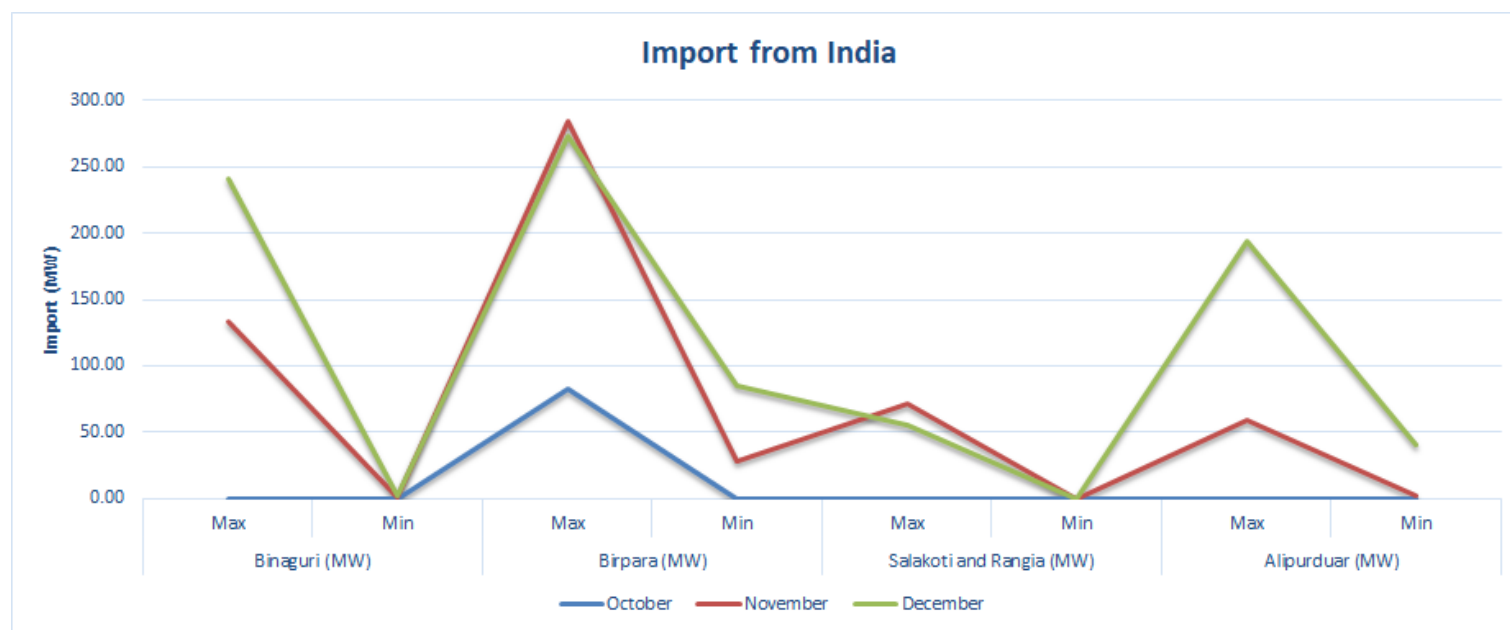


Table 7.2. Import of electricity from India.

Import From	Binaguri (MW)		Birpara (MW)		Salakoti and Rangia (MW)		Alipurduar (MW)		Total Import (MW)
Month	Max	Min	Max	Min	Max	Min	Max	Min	
October	0.00	0.00	82.37	0.27	0.00	0.00	0.00	0.00	82.37
November	133.92	1.57	284.08	27.80	71.27	0.02	58.60	2.28	547.87
December	241.02	2.41	273.60	85.70	55.12	0.09	194.46	40.96	764.20

Graph 7.2. Import of electricity from India





8. Frequency profile

The nominal allowed frequency range shall be 50Hz ± 1% in Bhutan. The system is normally managed such that frequency is maintained within operational limit of 49.5 Hz to 50.5 Hz. However, frequency may move outside these limits under faulty condition.

As per the Grid Code 2008, clause 6.4.1 the frequency is classified into three different bands as follows:

- a. Normal state
The transmission System frequency is within the limit of 49.5Hz to 50.5Hz.
- b. Alert state
The Transmission System frequency is beyond the normal operating limit but within 49.0Hz to 50.0Hz.
- c. Emergency state
There is generation deficiency and frequency is below 49.0Hz.

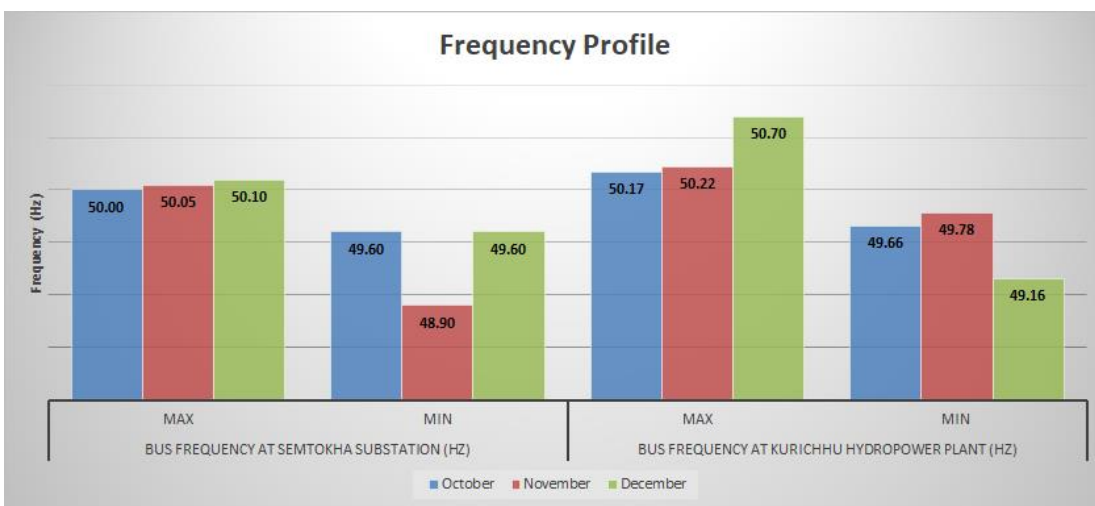
The frequency at 220kV Bus at 220/66/11kV Semtokha substation in the western grid and 132kV Bus at 60MW Kurichhu Hydropower Plant in the eastern grid is considered.

8.1 Frequency Summary for the month of October to December, 2024

Table 8.1 Frequency summary for the month of October to December, 2024.

Substation/Plant	Bus Frequency at Semtokha Substation (Hz)		Bus Frequency at Kurichhu Hydropower Plant (Hz)	
	Max	Min	Max	Min
October	50.00	49.60	50.17	49.66
November	50.05	48.90	50.22	49.78
December	50.10	49.60	50.70	49.16

Graph 8.2 Frequency summary for the month of October to December, 2024



9. Voltage Profile of selected substation

As per the Grid Code 2024, clause 155, the voltage at all connection point is classified into three different bands as follows:

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

Due to the location of 400/22/66/11kV Malbase substation in western grid and 132/33/11kV Nangkhor substation in the eastern grid, the voltage profile of these substations is considered.

9.1 Voltage Summary for the Month of October to December, 2024

Table 9.1 Voltage Summary for the month of October to December, 2024

Substation	Malbase Substation				Nangkhor Substation			
	400kV Bus Voltage (kV)		220kV Bus Voltage (kV)		66kV Bus Voltage (kV)		132kV Bus Voltage (kV)	
	Max	Min	Max	Min	Max	Min	Max	Min
October	412.00	396.50	224.50	210.50	66.73	64.00	136.76	130.08
November	409.50	339.00	226.50	209.50	68.00	62.00	136.94	127.28
December	409.50	394.00	227.00	212.50	67.00	64.00	136.94	127.17

Graph 9.1 Voltage Summary for the month of October to December, 2024

