Transmission System Plan

The Three Core Pillars:

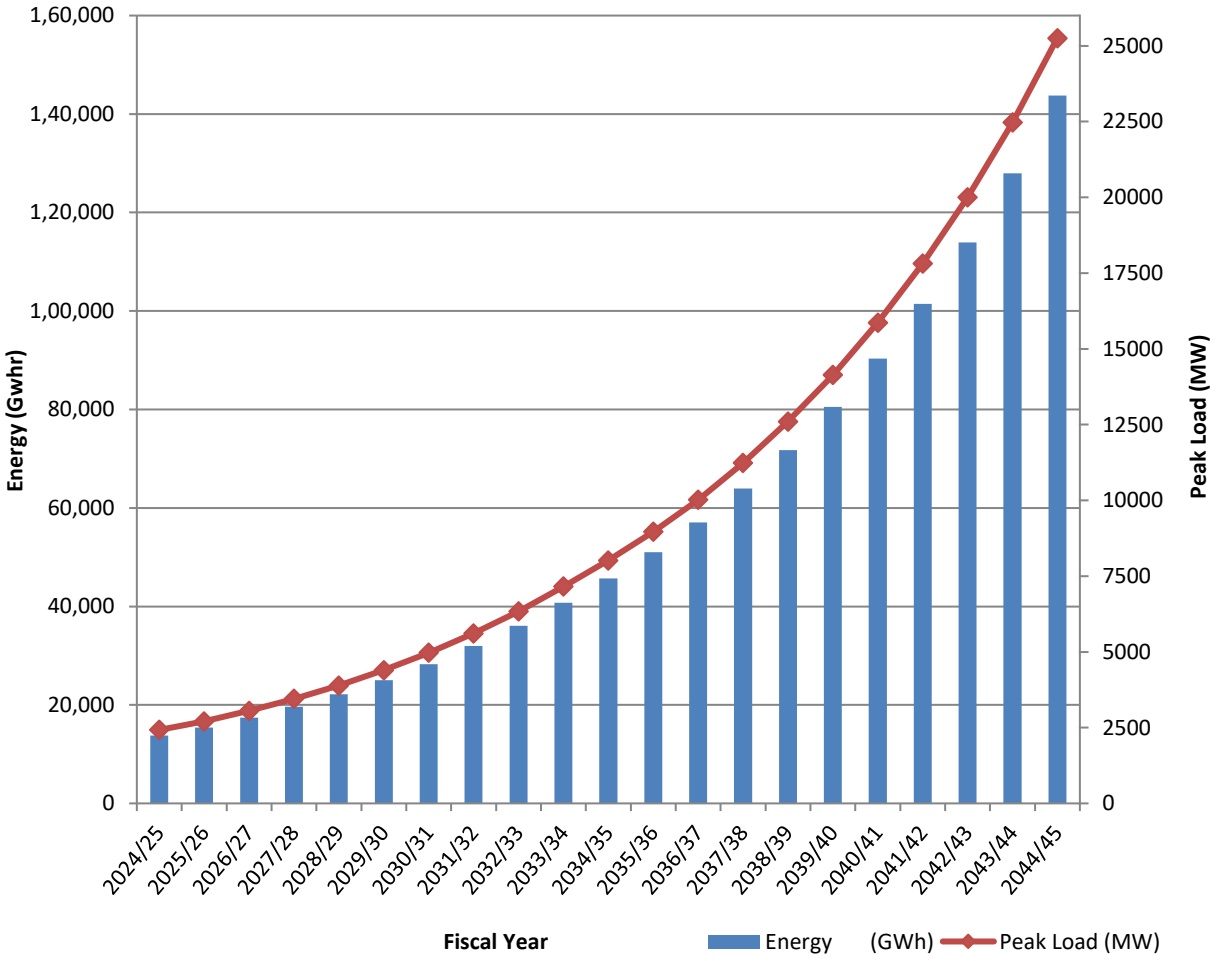
- Demand Forecast
- Generation Expansion Plan
- Transmission System Plan with Regional market integration (Cross Border Interconnections)

Demand Forecast

Objective of Demand Forecast:

- Provide short, medium and long-term evaluations of the potential national power demand that should be supplied under reasonable growth scenarios;
- Study is carried out sector wise - Domestic, Industrial, Irrigation, Commercial and Others
- The formula consists of different economic parameters – GDP growth rates, price elasticity, income elasticity – necessary for the load forecast.

Demand Forecast Result: Base Case



S. No.	Fiscal Years	Energy (GWh)	Peak Load (MW)
1	2024/25	13808.7	2425.1
2	2025/26	15416.3	2707.5
3	2026/27	17398.6	3055.6
4	2027/28	19649.0	3450.8
5	2028/29	22149.1	3889.9
6	2029/30	25044.8	4398.4
7	2030/31	28298.3	4969.9
8	2031/32	31953.7	5611.8
9	2032/33	36076.8	6335.9
10	2033/34	40751.0	7156.8
11	2034/35	45671.9	8021.1
12	2035/36	51035.6	8963.0
13	2036/37	57045.7	10018.6
14	2037/38	63963.0	11233.4
15	2038/39	71740.8	12599.4
16	2039/40	80489.2	14135.8
17	2040/41	90333.1	15864.6
18	2041/42	101413.4	17810.6
19	2042/43	113890.0	20001.8
20	2043/44	127943.7	22469.9
21	2044/45	143779.2	25251.0

Fiscal Years	Domestic Energy (GWh)	Industrial Energy (GWh)	Commercial Energy (GWh)	Irrigation Energy (GWh)	Other Loads (GWh)	Total Nepal Energy Demand (GWh)	**Export Energy (GWh)	Total Sales (GWh)	Sales Growth (%)	Self Consumption (%)	System Losses (%)	Total Generation Requirement (GWh)	Total Requirement (GWh) Growth Rate (%)	System Load Factor (%)	System Peak Load (MW)	Peak Load (MW) Growth Rate (%)
2024-25	4,962.9	4,570.3	888.7	504.2	866.4	11,792.6	0.0	11,792.6	11.3	0.3	14.30	13,808.7	11.09	65.0	1,320.4	9.6
2025-26	5,531.4	5,162.7	966.1	616.6	935.0	13,211.8	0.0	13,211.8	12.0	0.3	14.00	15,416.3	11.64	65.0	1,395.5	11.6
2026-27	6,230.5	5,887.5	1,066.6	749.2	1,020.3	14,954.1	0.0	14,954.1	13.2	0.3	13.75	17,398.6	12.86	65.0	1,547.9	12.9
2027-28	7,030.4	6,700.0	1,184.5	905.6	1,117.0	16,937.5	0.0	16,937.5	13.3	0.3	13.50	19,649.0	12.93	65.0	1,724.0	12.9
2028-29	7,850.5	7,696.9	1,295.3	1,090.3	1,214.9	19,147.9	0.0	19,147.9	13.1	0.3	13.25	22,149.1	12.72	65.0	1,928.9	12.7
2029-30	**8,769.2**	**8,889.3**	**1,421.5**	**1,308.1**	**1,325.6**	**21,713.8**	**0.0**	**21,713.8**	**13.4**	**0.3**	**13.00**	**25,044.8**	**13.07**	**65.0**	2,164.9	**13.1**
2030-31	9,767.2	10,266.4	1,560.1	1,565.2	1,446.5	24,605.4	0.0	24,605.4	13.3	0.3	12.75	28,298.3	12.99	65.0	2,435.7	13.0
2031-32	10,847.8	11,856.8	1,712.1	1,868.5	1,578.5	27,863.6	0.0	27,863.6	13.2	0.3	12.50	31,953.7	12.92	65.0	2,688.9	12.9
2032-33	12,027.8	13,693.6	1,878.9	2,226.4	1,722.4	31,549.1	0.0	31,549.1	13.2	0.3	12.25	36,076.8	12.90	65.0	2,972.8	12.9
2033-34	13,333.3	15,814.9	2,062.0	2,648.8	1,879.5	35,738.6	0.0	35,738.6	13.3	0.3	12.00	40,751.0	12.96	65.0	3,284.9	13.0
2034-35	**14,676.4**	**18,060.8**	**2,247.5**	**3,147.2**	**2,036.6**	**40,168.4**	**0.0**	**40,168.4**	**12.4**	**0.3**	**11.75**	**45,671.9**	**12.08**	**65.0**	3,628.3	**12.1**
2035-36	16,152.1	20,625.5	2,449.7	3,579.2	2,206.9	45,013.4	0.0	45,013.4	12.1	0.3	11.50	51,035.6	11.74	65.0	3,979.1	11.7
2036-37	17,773.6	23,554.4	2,670.0	4,067.4	2,391.4	50,456.9	0.0	50,456.9	12.1	0.3	11.25	57,045.7	11.78	65.0	4,362.9	11.8
2037-38	19,555.4	26,899.3	2,910.2	4,619.1	2,591.3	56,575.3	0.0	56,575.3	12.1	0.3	11.25	63,963.0	12.13	65.0	4,783.0	12.1
2038-39	21,513.1	30,719.1	3,172.0	5,242.5	2,808.0	63,454.7	0.0	63,454.7	12.2	0.3	11.25	71,740.8	12.16	65.0	5,242.8	12.2
2039-40	**23,664.4**	**35,081.4**	**3,457.3**	**5,947.0**	**3,042.7**	**71,192.7**	**0.0**	**71,192.7**	**12.2**	**0.3**	**11.25**	**80,489.2**	**12.19**	**65.0**	5,746.1	**12.2**
2040-41	26,028.1	40,063.1	3,768.3	6,743.0	3,297.1	79,899.6	0.0	79,899.6	12.2	0.3	11.25	90,333.1	12.23	65.0	6,297.1	12.2
2041-42	28,625.4	45,752.3	4,107.2	7,642.5	3,572.7	89,700.2	0.0	89,700.2	12.3	0.3	11.25	101,413.4	12.27	65.0	6,900.2	12.3
2042-43	31,479.3	52,249.4	4,476.7	8,659.0	3,871.4	100,735.7	0.0	100,735.7	12.3	0.3	11.25	113,890.0	12.30	65.0	7,560.6	12.3
2043-44	34,615.2	59,669.1	4,879.3	9,807.5	4,195.0	113,166.2	0.0	113,166.2	12.3	0.3	11.25	127,943.7	12.34	65.0	8,283.6	12.3
2044-45	**38,060.8**	**68,142.5**	**5,318.2**	**11,105.4**	**4,545.7**	**127,172.7**	**0.0**	**127,172.7**	**12.4**	**0.3**	**11.25**	**143,779.2**	**12.38**	**65.0**	9,075.2	**12.4**
A (%)	11.5	14.5	9.6	20.7	8.8	12.9		12.9				12.6			12.5	
B (%)	10.7	14.4	9.3	17.1	8.6	12.6		12.6				12.4			12.3	

A : Average Annual Growth of First Ten Years; B : Average Annual Growth over Forecast Period; # 2023-24 data is based on Annual Report.; Domestic energy also includes the community bulk supply

Generation Expansion Plan

Objective

- To meet the future demand reliably at minimum cost over the Planning Period.
- Both Capacity and Energy demand need to be met.
- Generation plan currently uses Power Purchase Agreement (PPA) concluded projects, PPA in process projects and long term government generation targets.

For long term government generation targets the main sources are :

- Ministry of Energy, Water Resources and Irrigation (MoEWRI):
- Department of Electricity Development (DoED).
- Nepal Investment Board (IBN):
- Nepal Electricity Authority (NEA):

Transmission System Plan

- The cost of constructing a transmission network is high. So, an up-to-date national Transmission System Plan that optimizes domestic demand, export and import.
- load flows is critical priority for deciding the design and timing of individual transmission line network.

Why Transmission System Expansion ?

- To provide greater reliability and capacity
- To increase the ability to distribute available power to meet existing and future demands
- To meet contractual obligation for transmission with various power producers
- To increase utility's ability to import/export power (Cross Border Transmission Links)

Transmission System Plan

Core components study

Study Type	**Core Objective**	**Decision Impact**
Load Flow	Assess thermal limits and voltage profiles	Finalizes equipment ratings and conductor sizing
Short Circuit	Determine fault current levels	Specifies circuit breaker interrupting capacity
Transient Stability	Analyze system response to faults	Optimizes relay settings and bus configurations
Over Voltage Study	Identify switching/lightning surges	Determines insulation coordination levels

Transmission System Plan

- Two approach:
  i. Deterministic Approach
  ii. Probabilistic Approach
- Deterministic approaches are straightforward and provide clear guidelines under specific scenarios, making them useful for baseline and regulatory compliance studies.
- Probabilistic approaches, on the other hand, offer a more comprehensive understanding of risks and uncertainties, allowing for more informed and potentially cost-effective decision-making in complex and uncertain environments.
- Deterministic approach used in Nepal.

Criteria for transmission planning
(As per Grid Code 2080)

- Criteria for supply reliability
  - (N-1) condition should be established for radial lines that supply more than 50 MW load.

- Voltage and Frequency criteria
  - Voltage variation in normal operation : +/-5% of nominal voltage.
  - Voltage variation during emergencies : +/-10% of nominal voltage.
  - Frequency variation in normal operation: +/-2.5% of nominal frequency.
  - Frequency variation during emergencies : +/-5% of nominal frequency.

Criteria for transmission planning
(As per Grid Code 2080)

Permissible loading on transmission lines and substations shall follow N-1 Contingency criteria

For Normal Conditions:

- Transmission line loading :<100% of thermal capacity of line @85 C
- Transformer loading :<100% of rated transformer capacity.

For Single Outage Conditions:

- Transmission line loading :<120% of thermal capacity of line @85 C
- Transformer loading :<120% of rated transformer capacity.

For Severe Conditions:

- Transmission line loading :<120% of thermal capacity of line @85 C
- Transformer loading :<120% of rated transformer capacity.

Criteria for transmission planning
(As per Grid Code 2080)

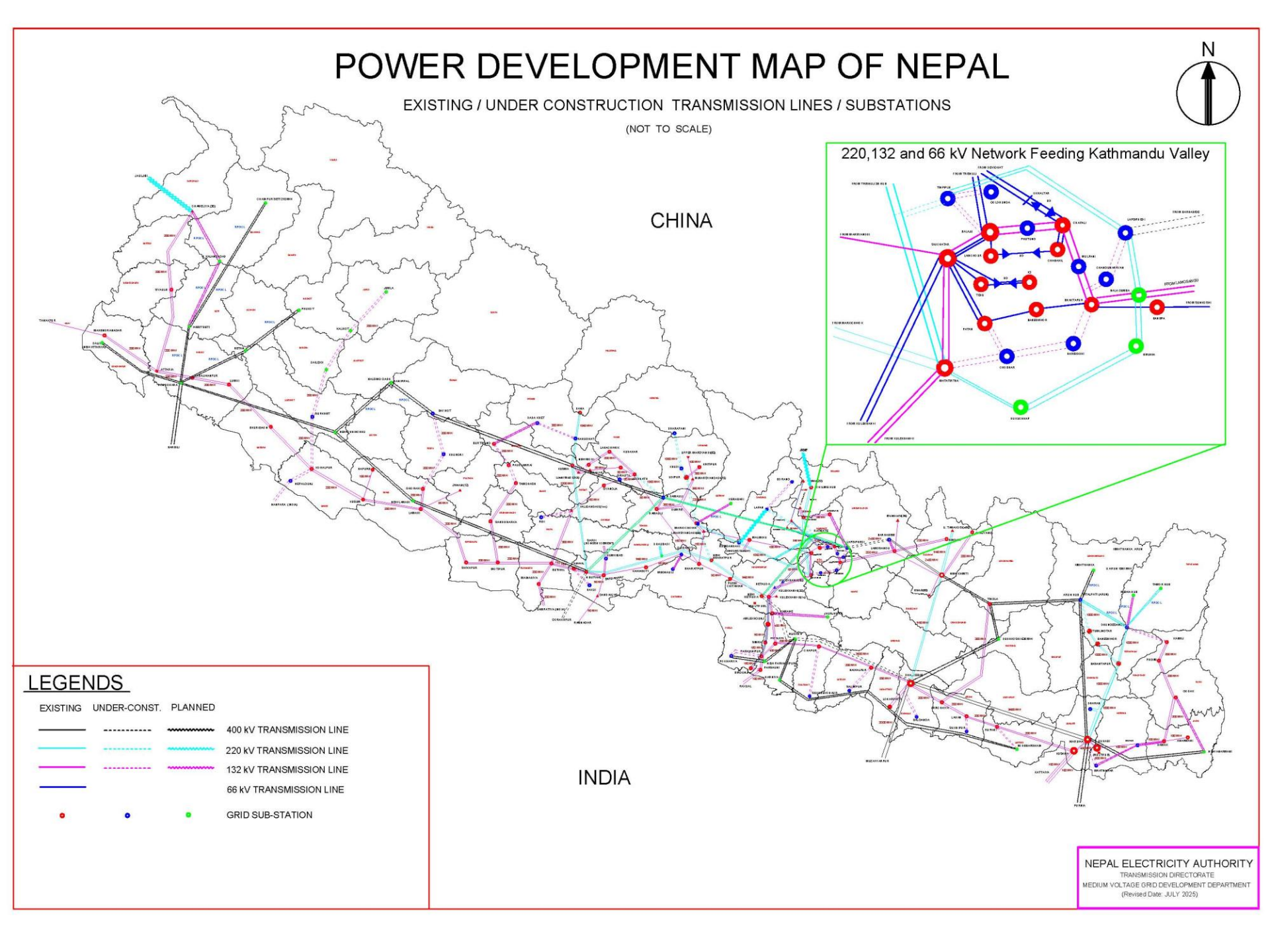
Fault Level for all equipments and switchgears

Nominal Voltage (V)	Fault Level (kA)
765 kV	TBD
400 kV	60 kA
220 kV	50 kA
132 kV	40 kA
66 kV	40 kA
33 kV	31.5 kA
11 kV	25 kA

POWER DEVELOPMENT MAP OF NEPAL

EXISTING / UNDER CONSTRUCTION TRANSMISSION LINES / SUBSTATIONS

(NOT TO SCALE)



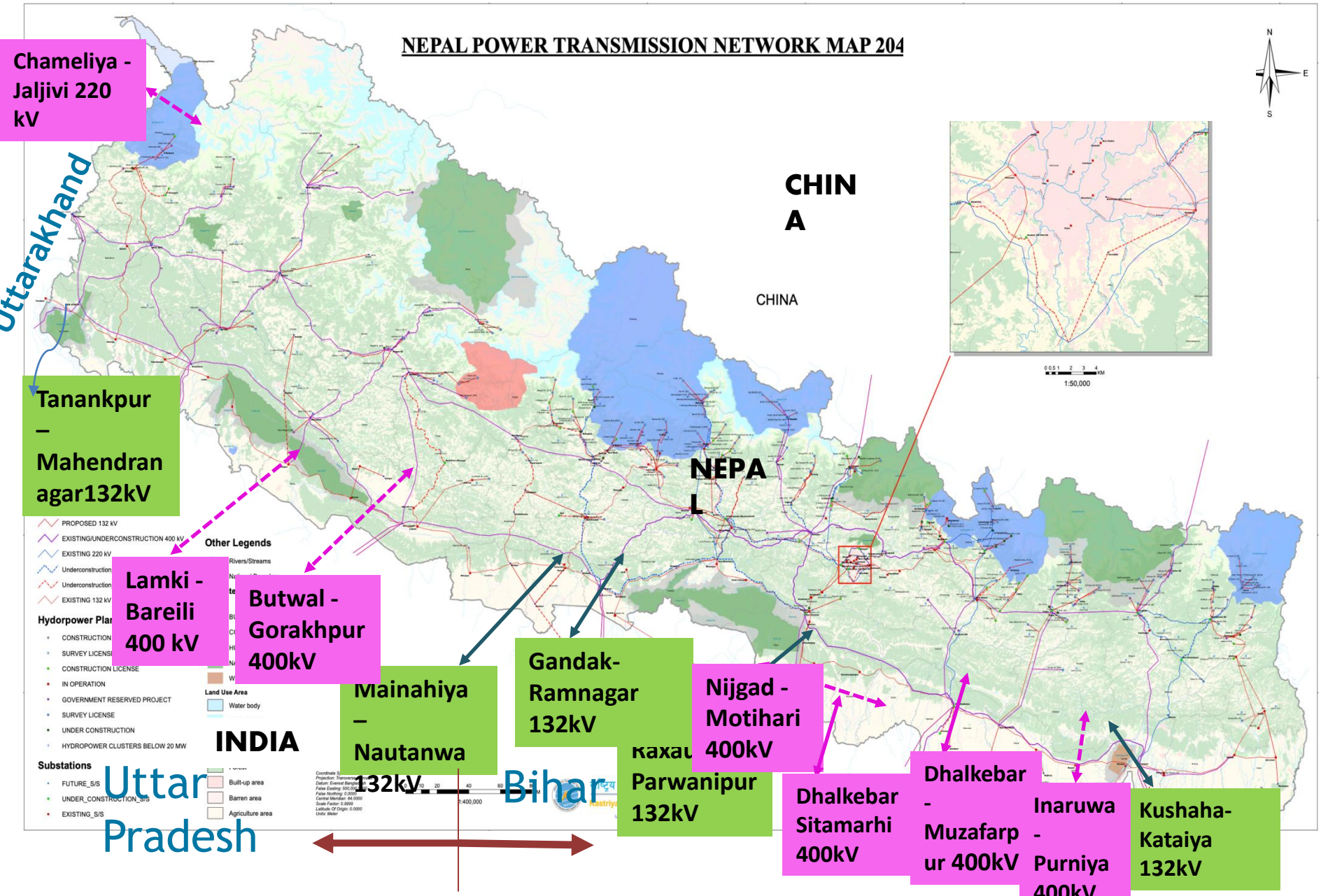
LEGENDS

EXISTING	UNDER-CONST.	PLANNED	
———	- - - - -	~~~~~	400 kV TRANSMISSION LINE
———	- - - - -	~~~~~	220 kV TRANSMISSION LINE
———	- - - - -	~~~~~	132 kV TRANSMISSION LINE
———			66 kV TRANSMISSION LINE
●	●	●	GRID SUB-STATION

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
MEDIUM VOLTAGE GRID DEVELOPMENT DEPARTMENT
(Revised Date: JULY 2025)

Proposed Cross-Border Transmission Lines between India and Nepal		
S. No.	**Pooling point**	**Transmission Lines**
1	Dododhara	Bareilly – Dododahra 400kV D/c (Quad) – 1st
		Bareilly – Dododhara 400kV D/c (Quad) – 2nd
2	Lucknow	Lamahi/Kohalpur – Lucknow 400kV D/c (Quad)
3	New Butwal	Gorakhpur – New Butwal 400kV D/c (Quad) – 1st **(UC)**
		Gorakhpur – New Butwal 400kV D/c (Quad) – 2nd
4	Dhalkebar	Muzaffarpur – Dhalkebar 400kV D/c (Twin HTLS) – **Existing**
		Sitamarhi – Dhalkebar 400kV D/c (Quad)
5	Inaruwa	New Purnea – Inaruwa 400kV D/c (Quad) – 1st
		New Purnea – Inaruwa 400kV D/c (Quad) – 2nd
6	Nijgadh/Hernaiya	Nijgadh/Hernaiya – Motihari 400kV D/c (Quad) **(Study Phase)**

Power Export-Import with India



Thank you