

**“Opportunity and challenges for developing regional planning approach to meet the clean energy transitions plans through Coordinated, Complementary Electricity Generation and Transmission Planning and integrated system operation in South Asian Countries and suggestions and way forward”**

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# Overview

- Diverse Energy Resources in South Asian Countries
- Focus on the Complementary Energy Generation and Transmission Planning
  - Cross Border Trade of Electricity
  - Resource Optimisation and promote clean energy sources
  - Energy Security
- Bhutan's context
  - Hydropower potential
  - Commitment to carbon neutrality

*Key player in clean energy transition plans in South Asian region*

# MAXIMUM POWER AND ENERGY SCENARIO IN 2040

- Power

- Installed capacity of plants as of December 2022 is 2335 MW and the plants have firm power generation of 415 MW. The peak load in 2022 is 629 MW.
- By 2040, the generation and demand scenario would be:

Installed Capacity (MW)	Firm Power (MW)	Peak Demand (MW)	Deficit in lean season (MW)
11,586	1,885	4,402	2,517

- Energy

- The present annual energy generation is 10,270.70 GWh considering the firm power and the demand is 3,662.96 GWh. The difference is 6,607.74 GWh.
- By 2040, the generation and demand scenario would be:

Energy (GWh)	Generation	Energy Demand (GWh)	Difference (GWh)
	42,915	28,922	13,993

The above peak and energy deficit in lean season occurs during low demand season of India/ Bangladesh and surplus hydro electricity occurs in peak demand season of India and Bangladesh. Hence complementary supply and demand would benefit both Bhutan and neighbouring countries to meet energy/ shortage.



# Overview- Transmission Planning & Systems of Bhutan

## Transmission Planning in Bhutan

- Involvements of several key entities
- Closely linked to Generation Expansion Plans (as Associated Transmission System)
- **Interconnection with India for export**
- Expansion and Reinforcements based on load growth

## National Transmission Grid Master Plan

- A comprehensive, integrated and holistic road map for the construction of common power evacuation networks and pooling substations including system strengthening.

## Transmission Systems

- Voltage level up to 400 kV
- Mostly developed as part of Associated Transmission System

# Transmission Network of Bhutan and connection point to India

BHUTAN POWER SYSTEM MAP

SOURCE: BPSO

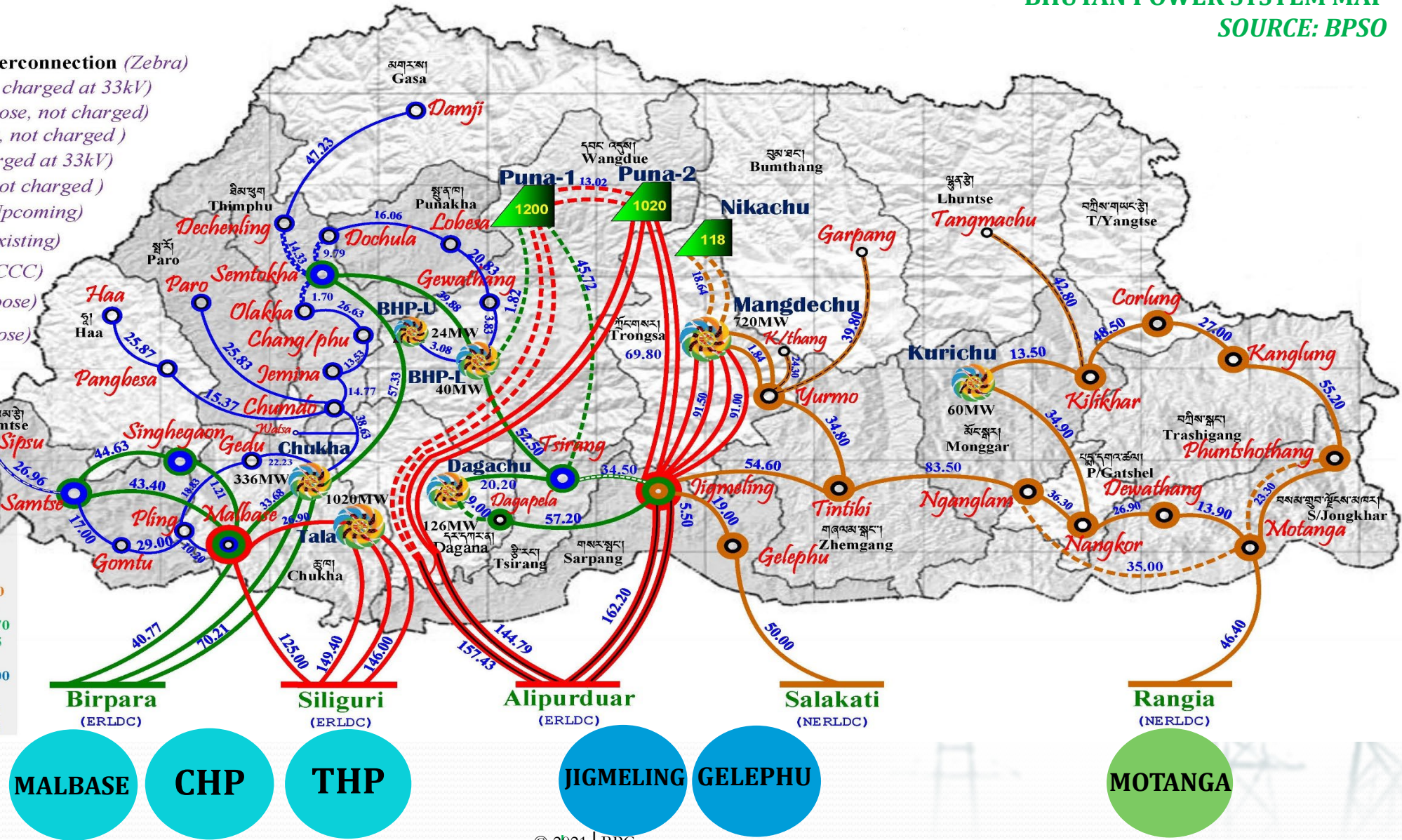


## Legends

- 220kV E-W Interconnection (Zebra)
- 132kV (Panther, charged at 33kV)
- - - 400kV (Twin Moose, not charged)
- - - 132kV (Panther, not charged)
- 66kV (Dog, charged at 33kV)
- - - 220kV (Zebra, not charged)
- Hydro Plants (Upcoming)
- Hydro Plant (Existing)
- 66kV (HTLS, ACCC)
- 400kV (Quad Moose)
- 400kV (Twin Moose)
- 132kV (Panther)
- 220kV (Zebra)
- 66kV (Dog)

**Distance (km) till Border**

400kV Tala I & II: -----	26.730
400kV Tala IV: -----	50.170
400kV Puna_1 I & II: ---	93.500
400kV Puna_2 I & II: --	80.865
400kV Jigmeling I & II: ----	5.500
400kV Malbase: -----	28.670
220kV Malbase: -----	4.075
220kV Chukha I & II: -----	36.800
132kV Gelephu: -----	0.100
132kV Motanga: -----	1.894



# Transmission Network of Bhutan and connection point to India

## Existing export line and its capacity

Sl No.	Transmission Lines from Bhutan to India	Circuit	Conductor	Capacity (MVA)	SIL (MW)
1	400kV Tala-Siliguri line-1	DC	Moose (Twin)	1,500.00	515.00
2	400kV Tala-Siliguri line-2				515.00
3	400kV Malbase-Siliguri line	DC	Moose (Twin)	1,500.00	515.00
4	400kV Tala-Siliguri line-4				515.00
5	400kV Jigmeling-Alipurduar line-1	DC	Moose (Quad)	2,000.00	614.00
6	400kV Jigmeling-Alipurduar line-2				614.00
7	400kV Puna-1-Lhamoizingkha-Alipurduar line 1 & 2	DC	Moose (Twin) upto Lhamoizingkha (merging point). Moose (Quad) thereafter.	2,000.00	1,228.00
8	400kV Puna-2-Lhamoizingkha-Alipurduar line 1 & 2	DC			
9	220kV Chhukha-Birpara line-1	DC	Zebra (Single)	400.00	132.00
10	220kV Chhukha-Birpara line-2				132.00
11	220kV Malbase-Birpara line	SC	Zebra (Single)	224.82	132.00
12	132kV Gelephu-Salakati	SC	Panther (Single)	90.31	50.00
13	132kV Motanga-Rangia	SC	Panther (Single)	90.31	50.00
	<b>TOTAL</b>			<b>7,805.44</b>	<b>5,012.00</b>

# Opportunities & Challenges

- Complementary resources
- Economic benefits & clean energy transition
- Regional cooperation promotion
- Peer learning, sharing of knowledge, ideas and technologies
- Diversity in resources, seasonal complementariness in demand and consumption can be leveraged for energy security
- Opportunity for trilateral electricity trade through coordinated transmission planning
- Promotion of clean energy systems in transport, energy efficiency in buildings and industries
- Policy and Regulatory harmonisation requirements
- Coordinated Infrastructure development
- Financing and Investments
- Commercials- levies, fees and charges
- Garnering political will to move towards coordinated implementation of regional electricity grid and market integration

# Suggestions & Way forward

## Policy

- Transparent Regional Power Cooperation Framework
- Transparent Harmonization of Regulatory Frameworks
- Equal opportunity/market access irrespective of the market sizes
- Development of regional energy markets and trading platforms
- Risk Mitigating measures



# Suggestions & Way forward

## Technical

- Cross-Border Transmission Infrastructure and Equal access to the network system
- Harmonization of Technical Standards
- Grid Integration and System Stability
- Capacity Building and Knowledge Exchange

# Suggestions & Way forward

## Financial

- Financing and Investment Promotion
- Implementing appropriate financial measures

# Suggestions & Way forward

Finally

Create or Activate appropriate SA Regional Forums for coordinated Generation and Transmission Planning and implementation.

# “Meeting Bhutan’s Electricity Needs”

