Department of Energy
Ministry of Energy & Natural Resources
Royal Government of Bhutan

Best Practices in Planning of New Transmission Systems in Bhutan

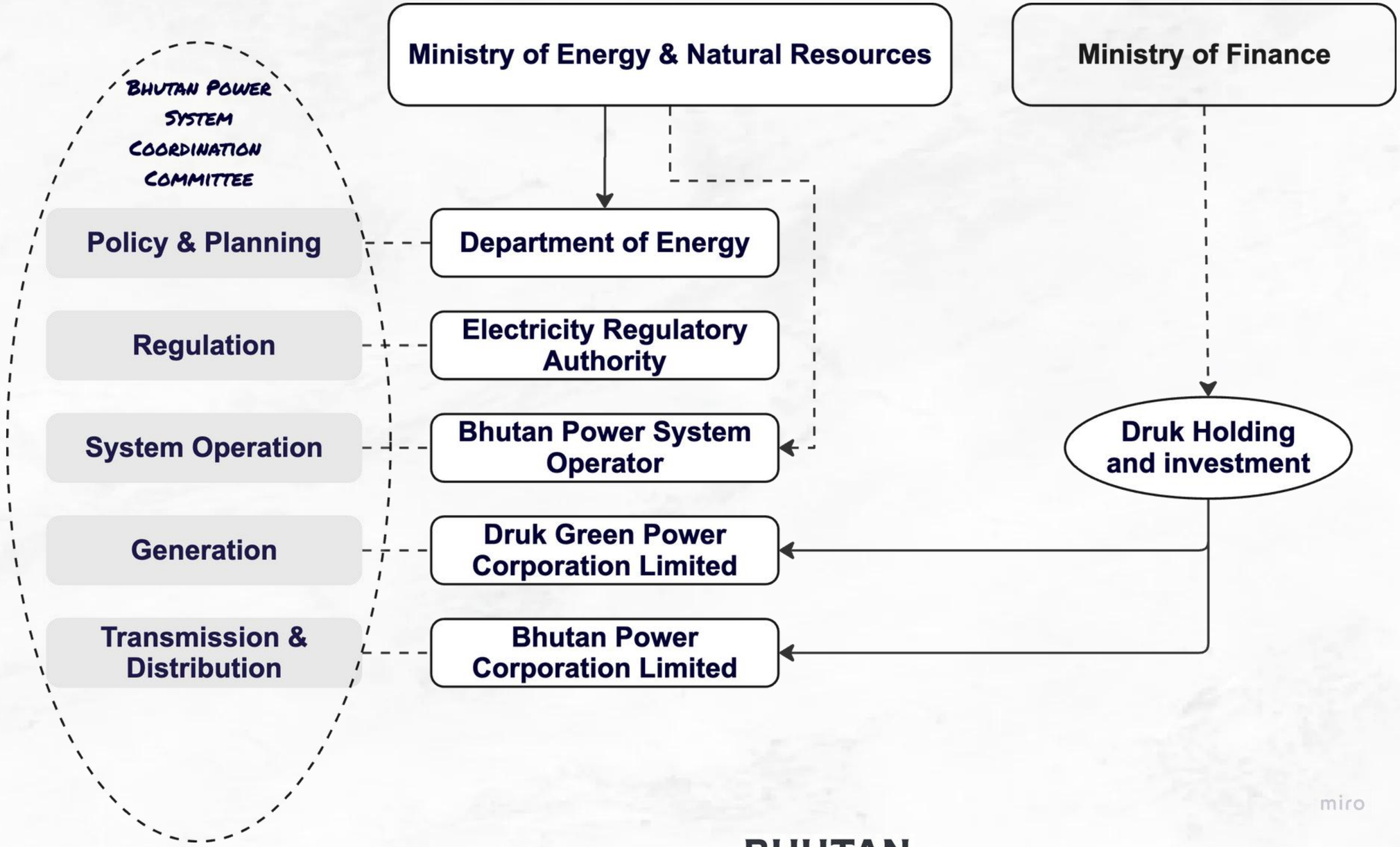
BIMSTEC ENERGY CENTER

BHUTAN
Believe

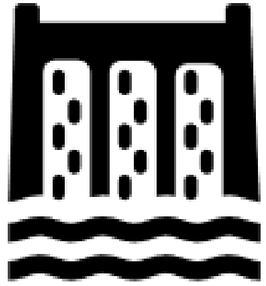
Outline

- Institutional Arrangement
- Renewable Energy Potential
- National Transmission Grid 2026
- Renewable Energy Development Plan
- Importance of Transmission Planning
- Key Transmission Planning Challenge
- Best Practices
- Conclusion

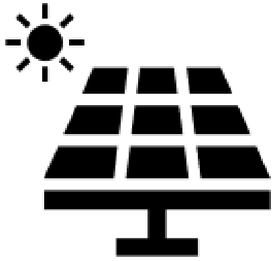
INSTITUTIONAL ARRANGEMENT



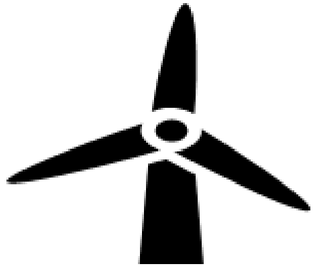
RENEWABLE ENERGY POTENTIAL



Hydro Potential
(36,888 MW)
(32,600 MW 90 Sites)



Solar Potential
(12,018 MW)



Wind Potential
(761 MW)

RE RESOURCE DEVELOPMENT PLAN

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Renewable Energy Development Roadmap 2024

&

National Energy Policy 2025

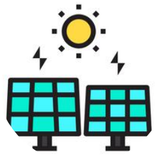
HYDROPOWER

2029 - 3,119 MW

2034 - 11,000 MW

2040 - 15,000 MW

Existing 3,576 MW



SOLAR

2029 - 1,000 MW

2034 - 1,500 MW

2040 - 5,000 MW

Existing ~34 MW

WIND

2029 - 28 MW

Existing 0.6 MW

NATIONAL TRANSMISSION GRID-2026

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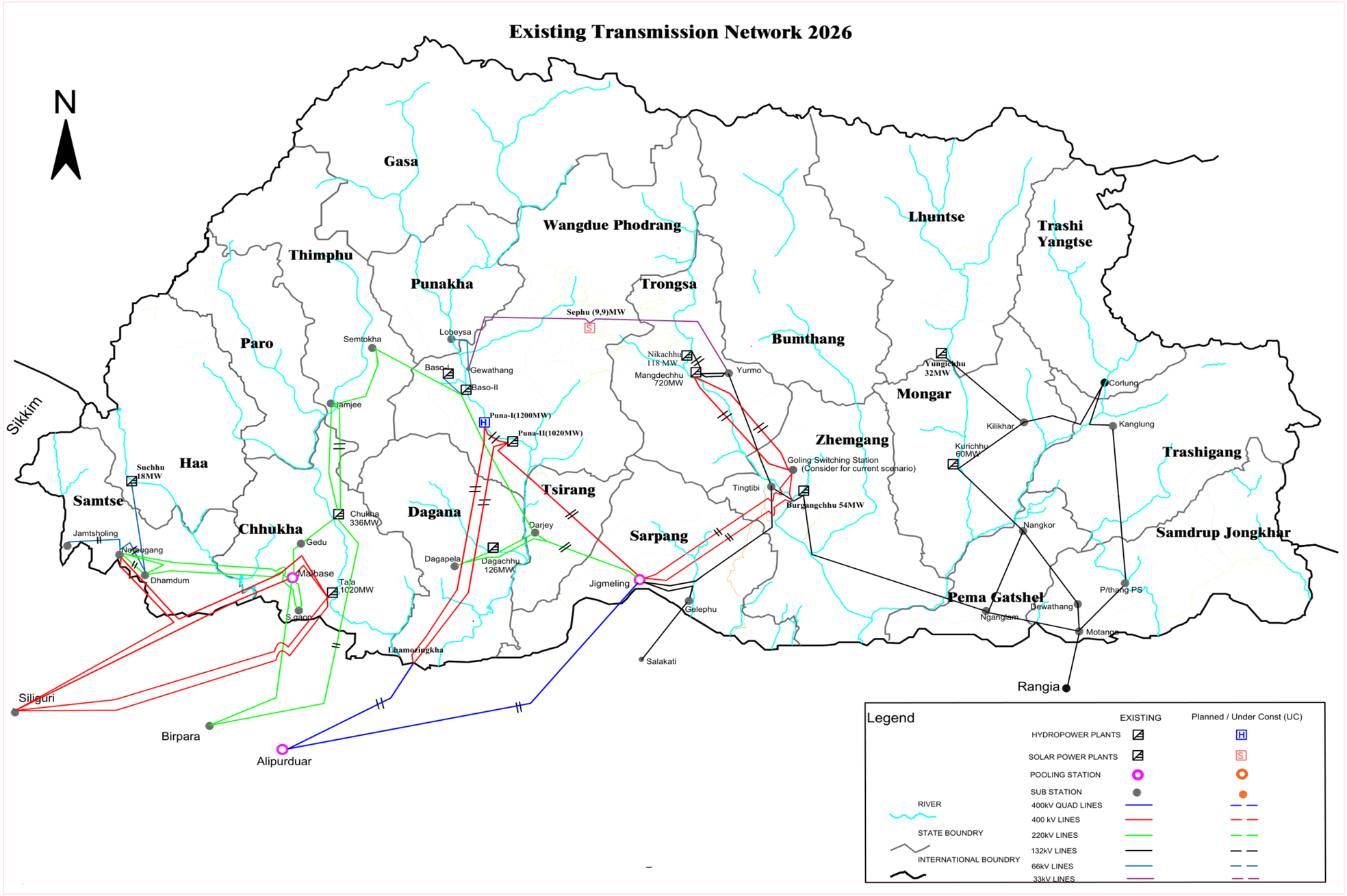

WHY TRANSMISSION PLANNING IS CRITICAL?

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Bhutan's power system is entering a major transition. The grid must evolve to support new realities.

Generation Growth

Large hydro expansion, emerging solar PV, and industrial corridors

Demand Shifts

Rising domestic demand, EV charging, and regional power trade

Grid Imperative

Must become more reliable, resilient, flexible, and interconnected

> "Future generation is only useful if the transmission system can safely evacuate and deliver the power."

KEY TRANSMISSION PLANNING CHALLENGE

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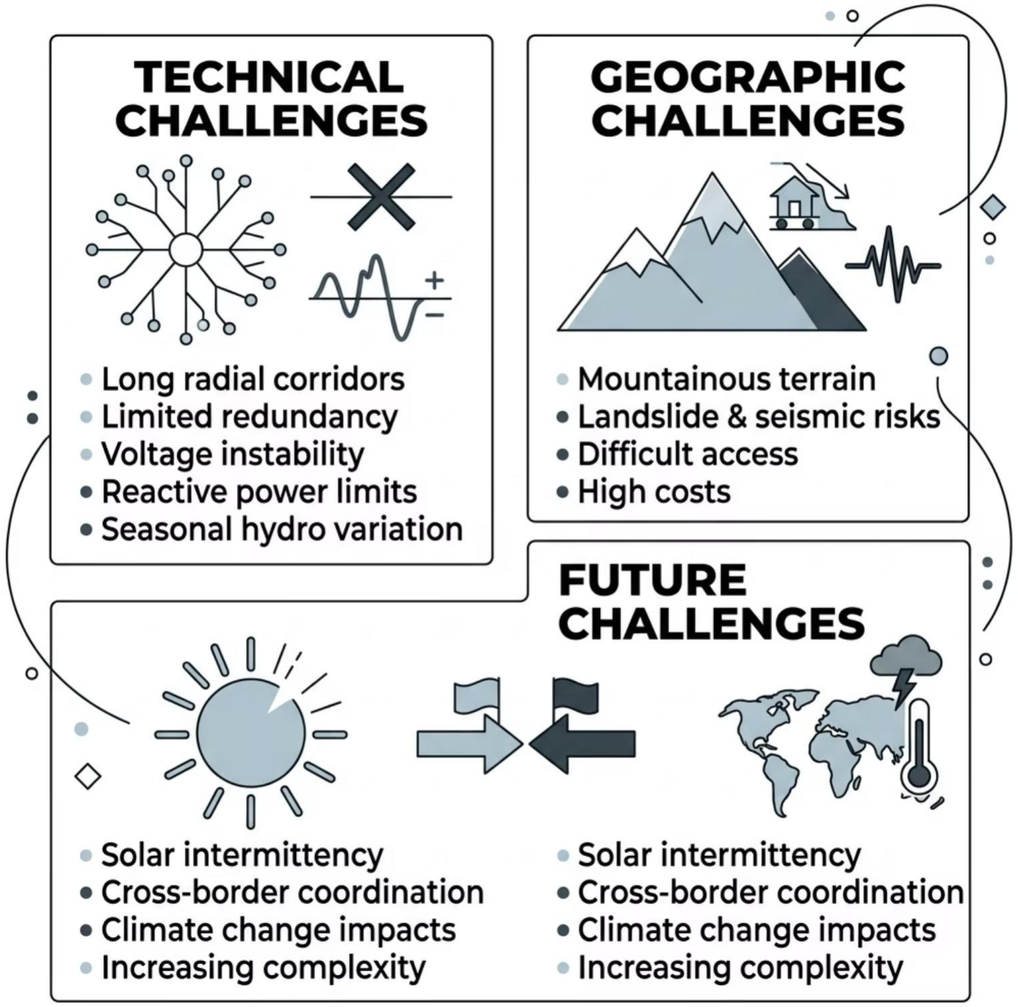


Technical

- Long radial corridors with limited redundancy
- Voltage instability and reactive power limitations

Geographic

- Mountainous terrain, landslide and seismic risks
- High construction costs and difficult access

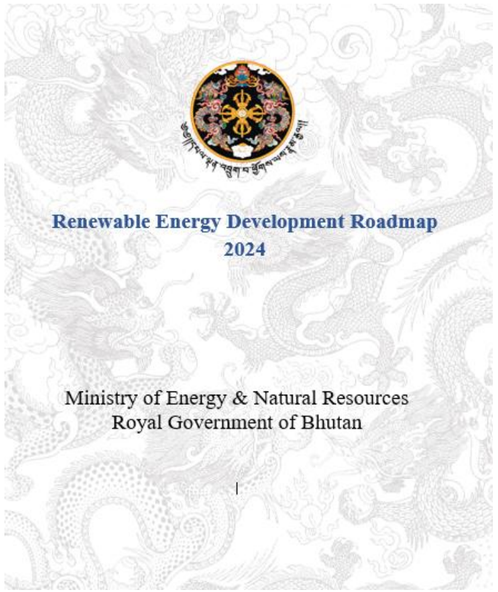
Future

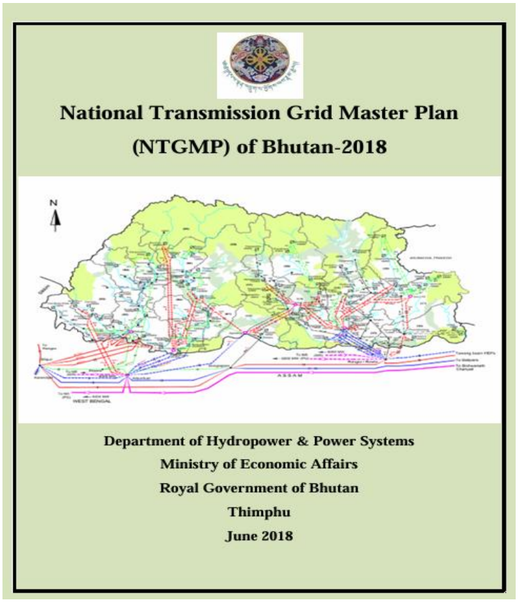
- Solar intermittency and climate change impacts
- Cross-border coordination complexity

BEST PRACTICES

Integrated Generation–Transmission Planning

- Update Renewable Energy Development Roadmap
- Update National Transmission Grid Master Plan



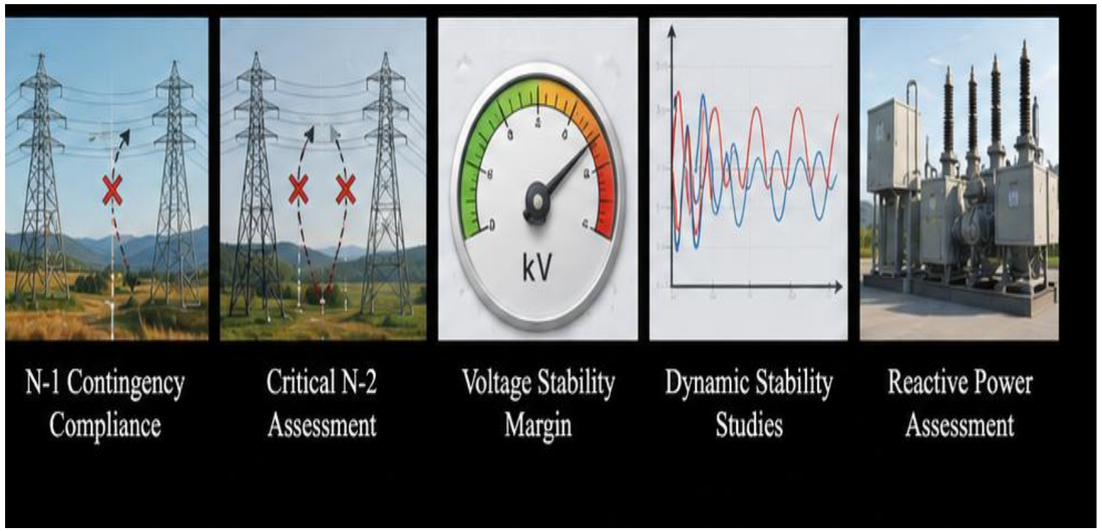


Reliability-Centred Planning Criteria

- Follow the Grid Code Regulation 2024

✓ N-1 contingency compliance
✓ Critical N-2 assessment
✓ Voltage limit

- Carry out the power system analysis twice a year



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Renewable Energy Integration

Key Challenges

Intermittency, voltage fluctuations, reverse power flow, reduced system inertia

Hydro-solar hybrid operation with BESS near solar pooling stations and Pumped Storage Hydropower Plant

Technologies

FACTS devices, and renewable forecasting systems

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Resilient Network & Smart Grid

Stronger, Meshed Network

Move beyond radial structures towards:

- Ring network configurations
- Multiple evacuation corridors
- Stronger 400 kV backbone

Smart Grid Technologies

- PMU / WAMS systems
- Digital substations
- Wide-area protection & AI forecasting

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Climate Resilience & Regional Integration

Climate Risks & Best Practices

- Landslides, GLOF, seismic and flood risks
- Climate-resilient tower design

Regional Interconnection

- Joint planning and harmonised grid codes with India
- Coordinated protection and regional stability studies

CONCLUSION

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Reliable

Secure during contingencies

Flexible

Capable of integrating renewables

Resilient

Withstands climate and disaster risks

Intelligent

Supported by smart-grid technologies

Regionally Integrated

Supporting regional power trade

> "Transmission planning is no longer only about building lines. It is about enabling Bhutan's future energy transition."

THANK YOU