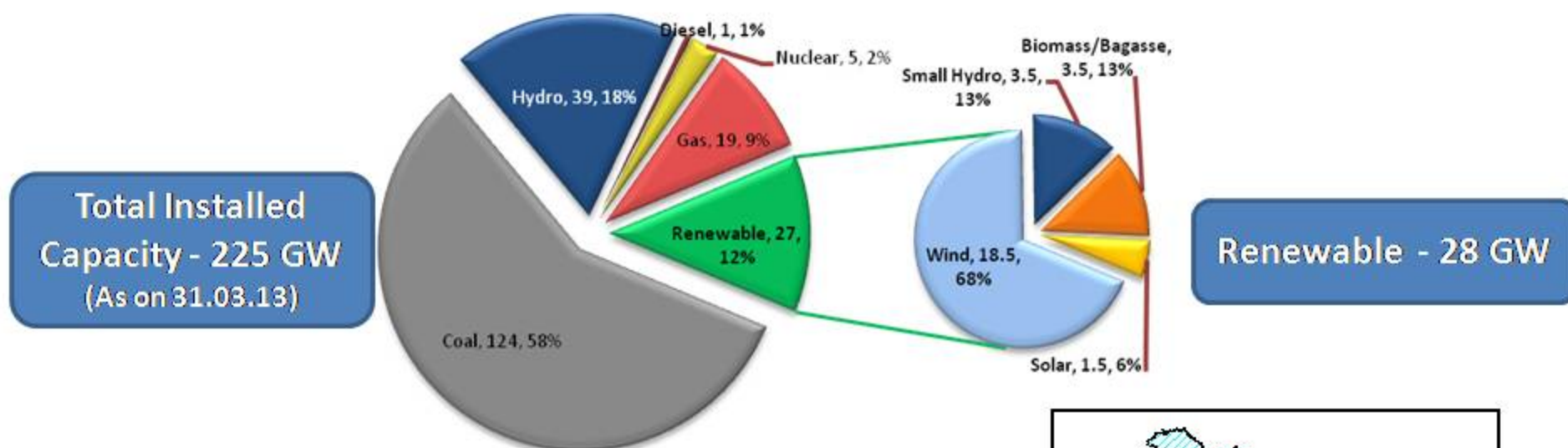


Interconnection with SAARC Countries

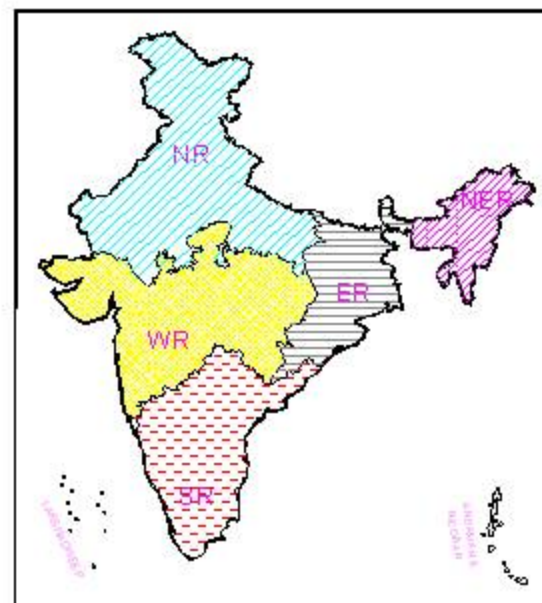
India - Present Power Scenario

- Indian Power System is growing in all fronts

– Generation, Transmission & Distribution segment

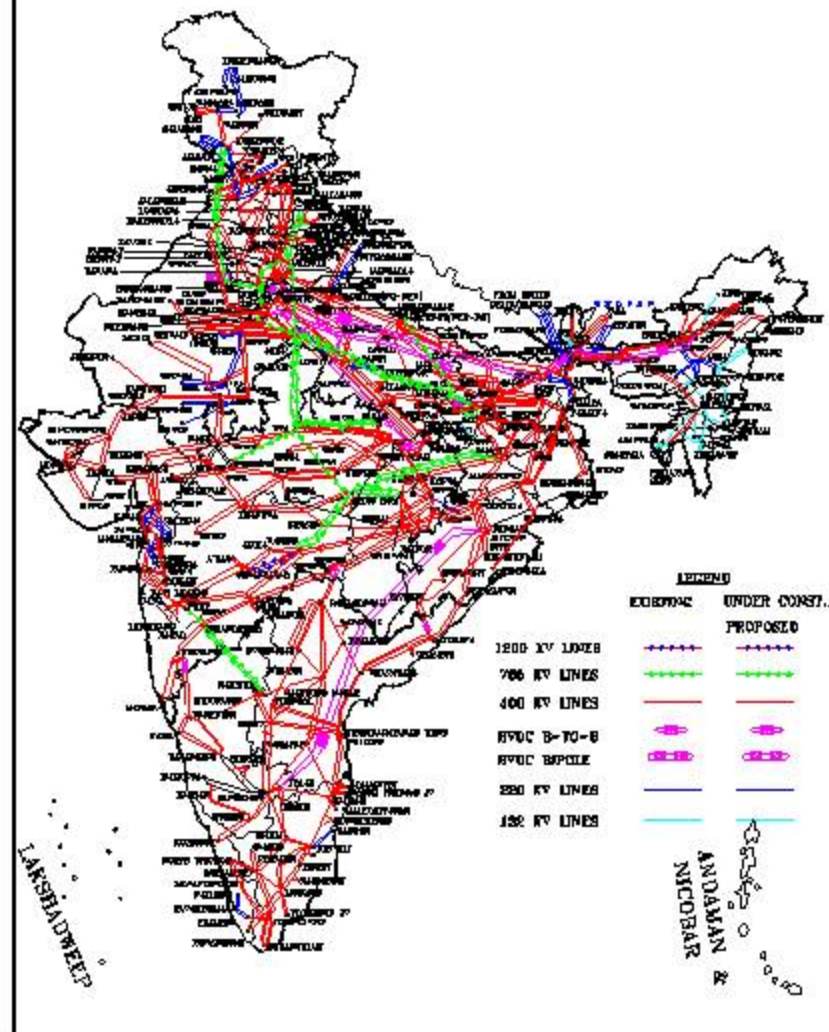


- **Peak Demand** : 135 GW
- **Growth Rate** : 9 – 10 % (per annum)



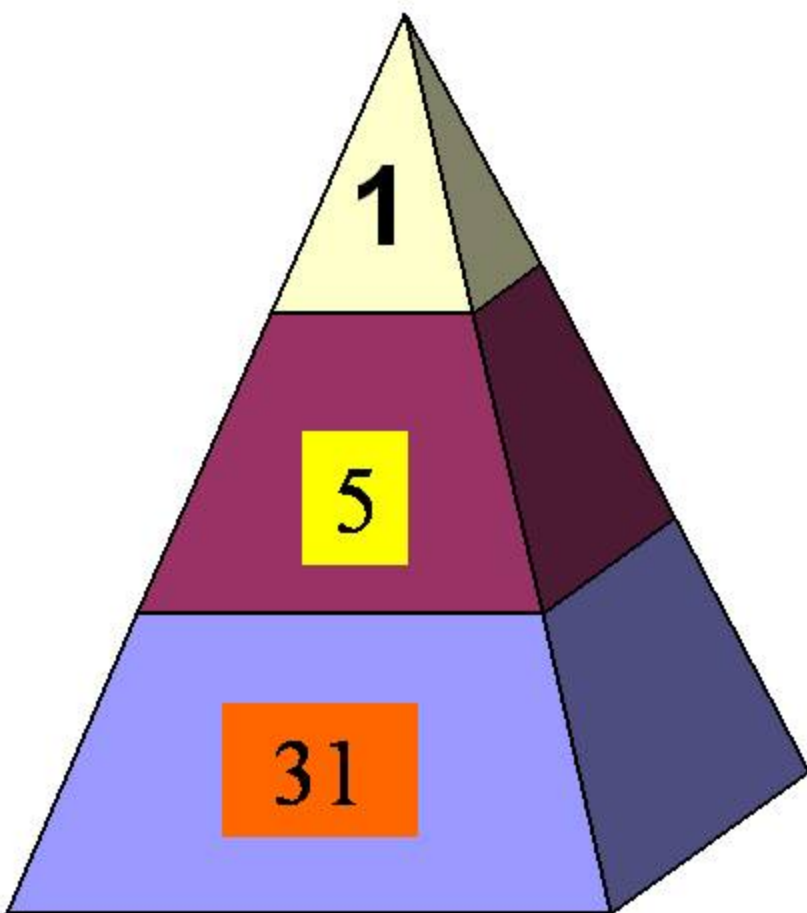
Existing Transmission System

POWER MAP OF INDIA



- **765kV lines** : 6,500 ckms
- **400kV lines** : 1,15,800 ckms
- **220kV lines** : 140,000 ckms
- **HVDC Bipole (± 500 kV):** 9,000 ckms
- **HVDC Back-to-back** : 3000MW
- **Transformation Capacity:** 4,00,000 MVA
- **FSC – 33 nos.; TCSC – 6 nos.**

Grid Management Hierarchy



NLDC

**Ensure integrated operation of
National Grid**

RLDC

**Ensure integrated operation of
Regional Grid**

SLDC

**Ensure integrated operation of State
Grid**

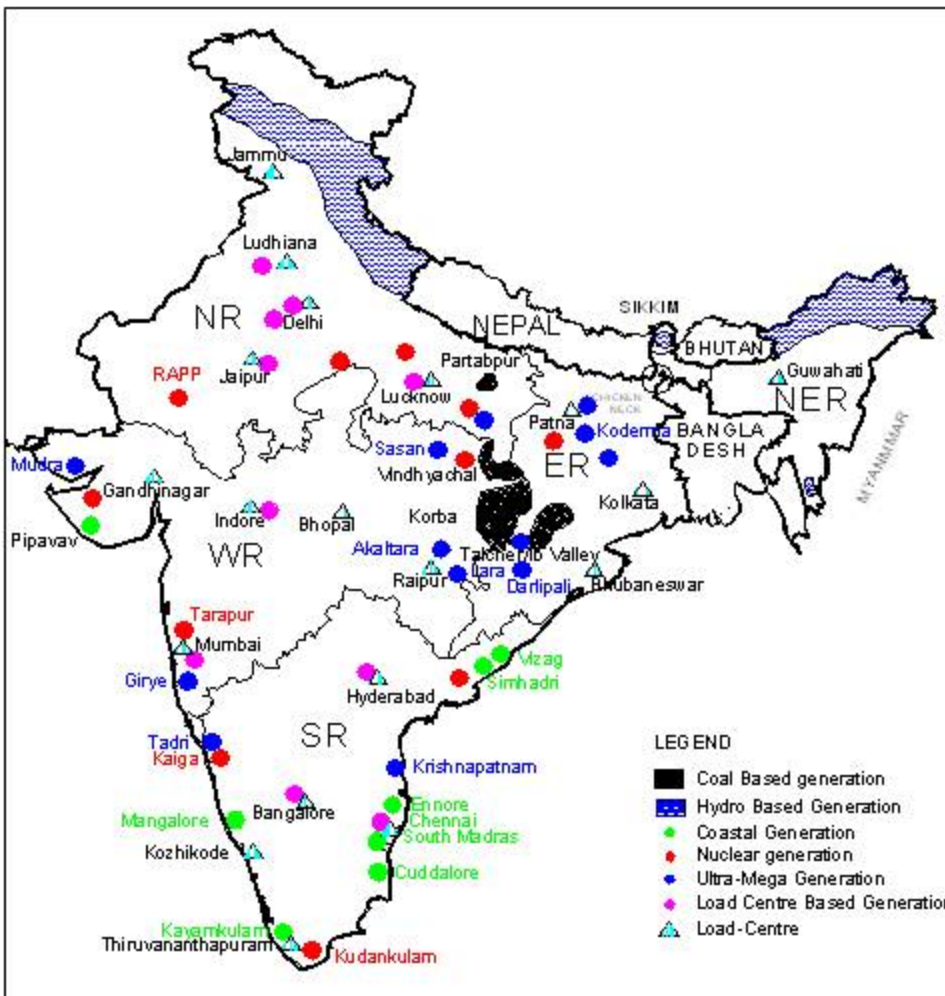
National Grid - Present

Inter-Regional Capacity – 32,000MW



Energy Resources Map

Energy resources (coal, water etc.) unevenly distributed



■ Coal – In Central India

- Chhattisgarh : 58000 MW
- Orissa : 30000 MW
- Jharkhand : 15000 MW
- Madhya Pradesh: 16000 MW

■ Hydro – In North Eastern & Northern Himalayan region

■ Coastal based

- Andhra Pradesh: 24000 MW
- Tamil Nadu : 10000 MW
- Gujarat : 11000 MW

Future Generation Scenario (5-6 Years)

■ 12th Plan (2012-17) Capacity Addition : 88 GW

- Thermal – 72 GW
- Hydro – 11 GW
- Nuclear – 6 GW

■ Renewable Capacity Addition in 12th Plan (2012-17) : 42 GW

- Wind – 30 GW
- Solar – 10 GW
- Small Hydro – 2 GW

Future Transmission Planning - Consideration

- ❖ **Increased role of ISTS power transfer**
- ❖ **Need of long distance Transmission system**
- ❖ **Minimum use of land and Right-of-Way**
- ❖ **Optimal cost per MW transmission**
- ❖ **Optimal Transmission Losses**
- ❖ **Controllability at Grid Level**
- ❖ **Adequate margin – to cater trading, contingencies**
- ❖ **Implementation – Equipment availability, manpower**

Technology being Adopted

❖ High Voltage line

- EHVAC : 400kV → 765kV → 1200kV
- HVDC : $\pm 500\text{kV}$ → $\pm 800\text{kV}$

❖ Increase the capacity of trans. corridor through HSIL/re-conductoring with HTLS /Upgradation

❖ Utilisation of transmission lines upto full thermal capacity – Series capacitors, SVC, FACTS

❖ Optimization of Tower design – tall tower, multi-ckt. tower

❖ GIS substation

High Capacity Transmission Corridors for IPP Projects



South Asian Countries Around India



Common Features of SAARC Countries

- **Abundant reserves of Natural resources**

	Hydro (MW)	Natural Gas (TCF)
Afganistan	25,000	15
Bangladesh		8
India	1,50,000	39
Nepal	42,000	-
Pakistan	45,000	33
Bhutan	30,000	-

- **Low per capita electricity consumption**
- **Fast Growth in Demand & deficit of Power in some countries**
- **Similar Voltage Class and Frequency**

Cross-Border Interconnection - Purpose

A. Optimal Utilization of Natural Resources

- **Need of meeting growing power demand** (*Utilising Peak Diversity and time diversity*)
- **Concentration of various types of energy in different countries**
 - *Limitation in Large scale trading of coal and natural gas due to constraints in its handling & transportation*
 - *Hydel energy can be traded thru transmission network only*
 - *Transmission of power - only feasible solution for exchange of energy*
- **Economy of scales** (*investment on large sized generating stations can be deferred*)
- **Better hydro-thermal mix**

B. Improved Security and Reliability

C. Economic Benefit

- *exporting country would earn revenue by exporting power and the importing country can defer the investment*

D. Increased economic efficiency in system operation

- *Merit order operation on larger scale*

E. Reduced Environmental Damage

Opportunities for Interconnection

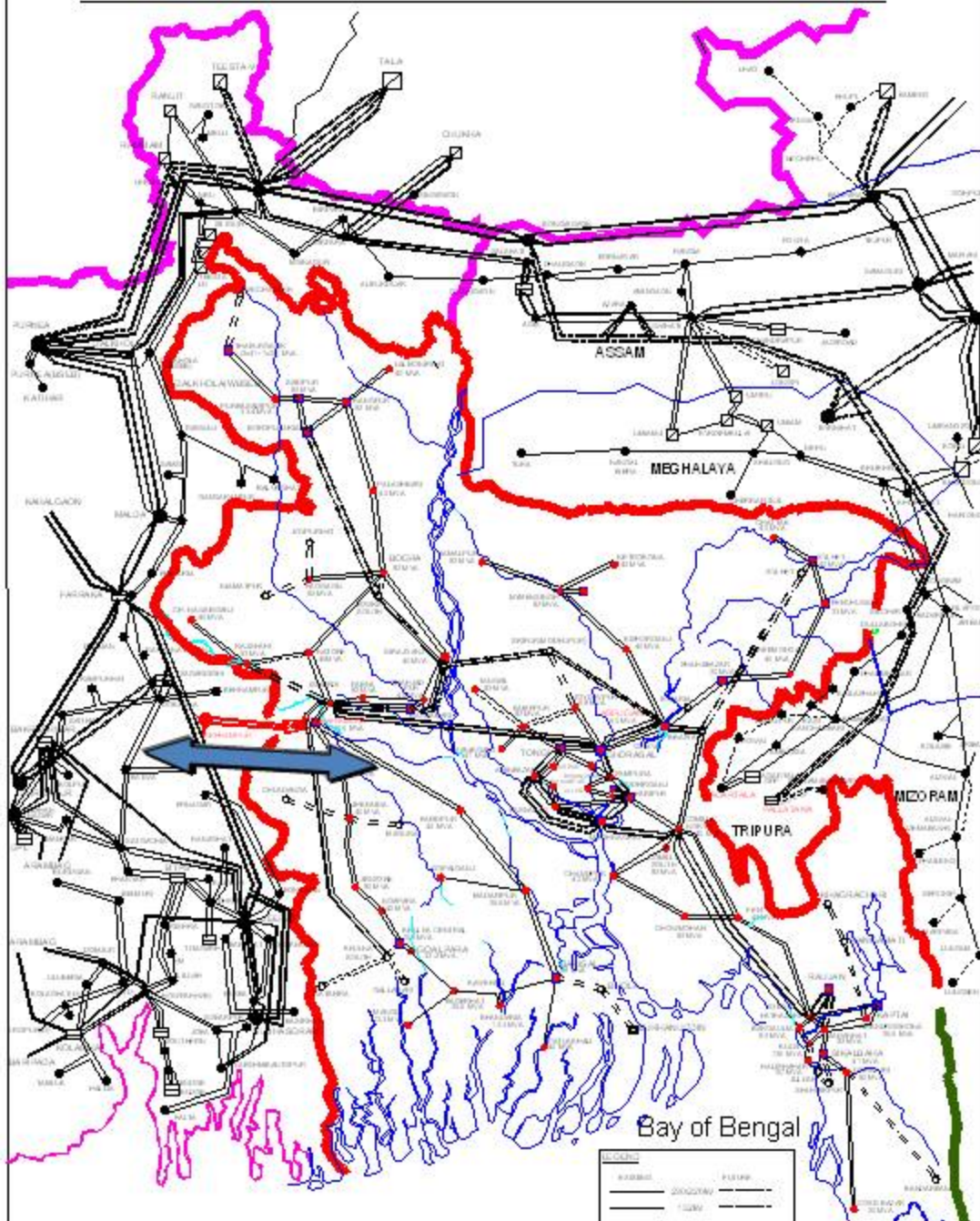
- **Evolving Open Electricity market**
- **Countries with limited resources would be benefited, e.g. Sri Lanka**
- **Thermal resources – cheaper to transport in electricity form;
Hydro resources – can only be transported in electricity form**
- **Huge hydro Resources of Bhutan can be effectively utilised**
- **Export countries benefited economically, Import countries benefited by deferring investment towards setting up power plants**

Interconnection of India with Bangladesh

India & Bangladesh Interconnection

- **MOM signed** between Indian Delegation and BPDB & PGCB officials, Bangladesh on November 24, 2009 at Dhaka.
- **Executing Agency :**
 - Indian portion : POWERGRID, India
 - Bangladesh portion : PGCB (Power Grid Company of Bangladesh Ltd.), Bangladesh.
- **Cost Estimate :**
 - India Portion : Rs. 169.86 Crore (USD 37.75 million)
 - Bangladesh Portion : Rs. 736.84 Crore (USD 163.75 million)
- **Commissioning Schedule** : Oct, 2013

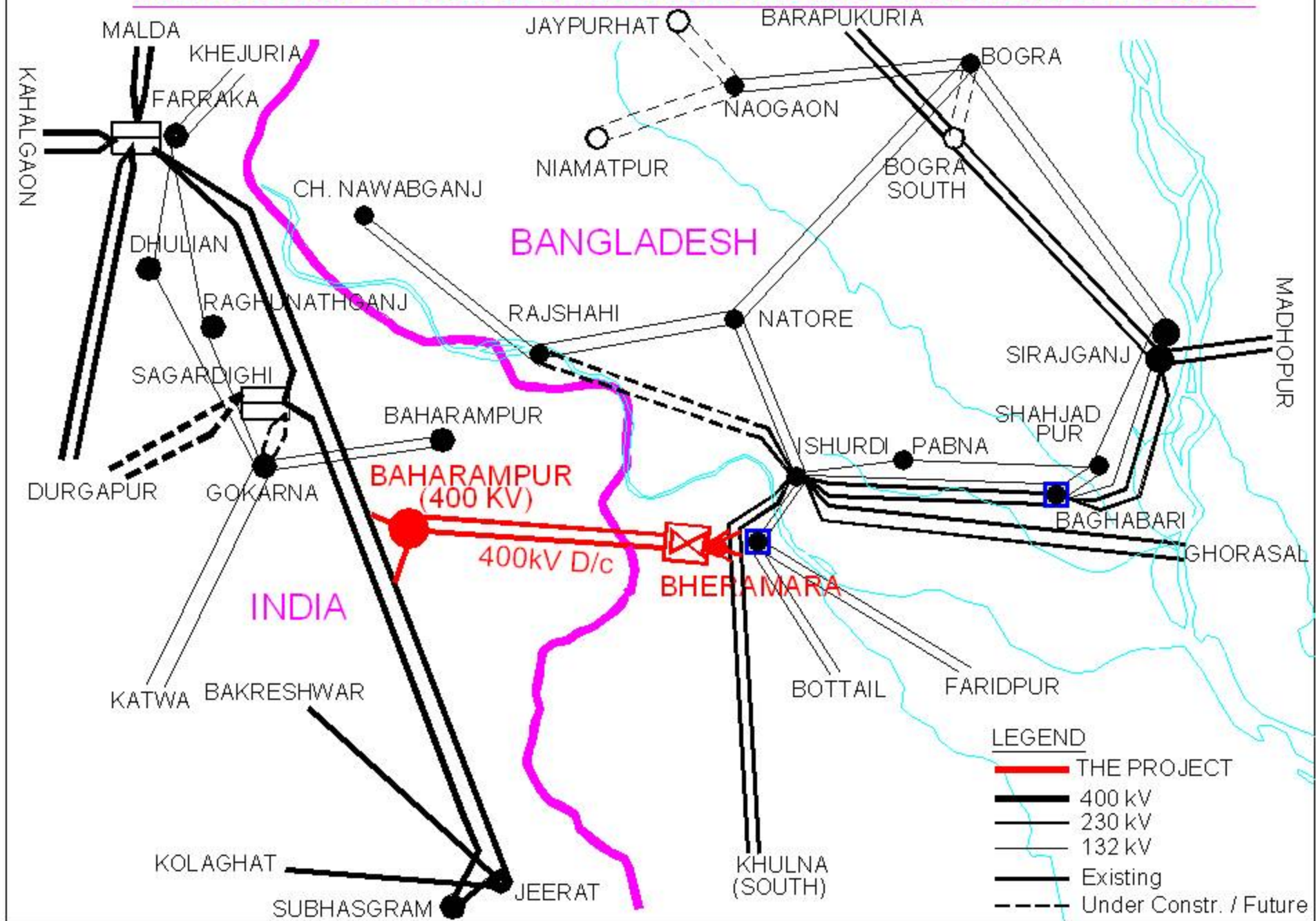
POWER MAP OF BANGLADESH AND INDIA



Interconnection between India & Bangladesh Grids

- Purpose :
 - Exchange of Power between India and Bangladesh
- Interconnection :
 - Baharampur(India)-Bheramara(Bangladesh) 400kV D/c line
 - 500MW HVDC B/b stn at Bheramara(Bangladesh)
- Type of connection :
 - Asynchronous(HVDC)
- Transfer Capacity :
 - 500MW (upgradable to 1000MW)

INTERCONNECTION BETWEEN INDIA AND BANGLADESH GRIDS



Interconnection of India with Bhutan

India - Bhutan : Existing Interconnections

For import of power from following Projects

- **Chukha HEP (4x84 = 336 MW)**
 - Chukha – Birpara 220kV 3 ckt
- **Kurichu HEP (4x15 = 60 MW)**
 - Kuruchu - Geylegphug(Bhutan) – Salakati(NER) 132 kV S/c
- **Tala HEP (6x170 MW = 1020 MW)**
 - Tala – Siliguri 400kV 2x D/c line

India - Bhutan : On Going Trans. System

❑ Tr. System for Punatsangchu-I (1200 MW)

- **Interconnection (Bhutan Portion)** : Punatsangchu-I HEP – Lhamoizingkha (Bhutan Border) 400 kV 2xD/c line with twin moose Conductor.
- **Interconnection (Indian Portion)** : Lhamoizingkha (Bhutan Border) – Alipurduar 400kV D/c (Quad)
- **Other Major Transmission System in India**
 - New ± 800 kV, 3000MW HVDC pooling station at Alipurduar.
 - Extn. of ± 800 kV, 3000MW HVDC station at Agra
 - LILO of Bishwanath Chariali – Agra 800kV, 6000MW HVDC line at Alipurduar
 - LILO of Bongaigaon – Siliguri 400kV D/c line(quad) at Alipurduar
 - LILO of Tala-Siliguri 400kV D/c line at Alipurduar.

❑ Estimated Cost (Indian Part) : Rs. 4400Cr. (USD 978 million)

India - Bhutan : Future Scenario

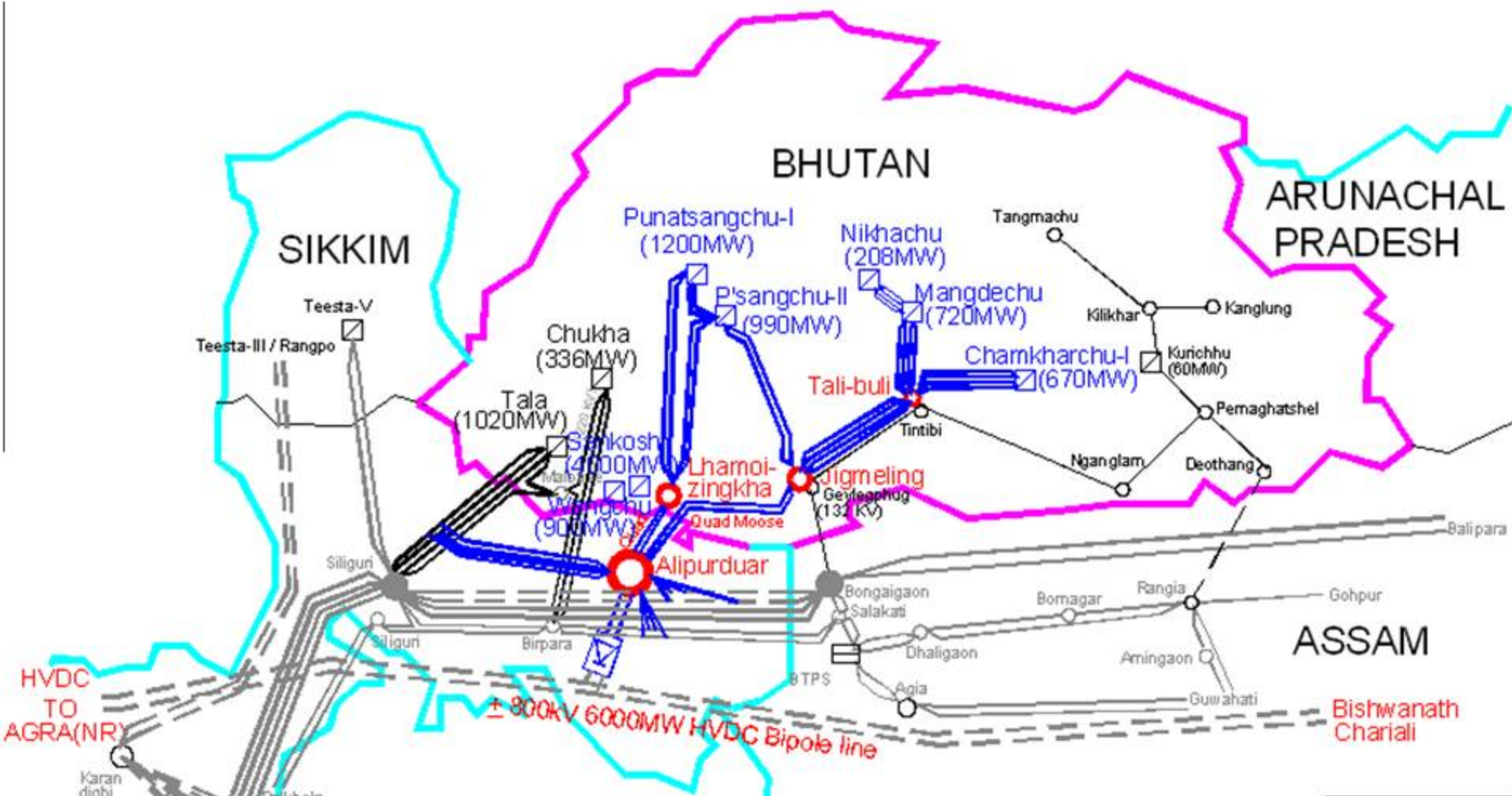
- **Hydro Potential** : About 21000 MW
- **Major Hydro Projects**
 - By 2020 : 11,784 MW (from 14 HEP)
(Existing : 1480MW, Addition by 2020 : 10,304MW, 14 HEP)
 - By 2030 : 26,504 MW (from 75 HEPs)
(Exis. : 1480MW, Add. by 2030 : 25,024MW, 75 HEP; Add. bet. 2020 and 2030 : 14,720MW, 61 HEP)
- **Major Projects by 2020**

Sl. No.	Name of HEP	Capacity (MW)	Year of commissioning	DPR by
1.	Punatsangchhu-I	1200(6x200)	2015	WAPCOS
2.	Punatsangchhu-II	990(6x165)	2017	WAPCOS
3.	Mangdechhu	720(4x180)	2017	NHPC
4.	Sankosh Main HEP	2500	2020	THDC
5.	Sankosh LB HEP	85	2020	THDC
6.	Kuri-Gongri	1800/3400	2020	NHPC
7.	Wangchhu	570(4x142.5)	2019	SJVNL
8.	Bunakha Reservoir	180(3x60)	2020	THDC
9.	Kholongchhu	600(4x150)	2018	SJVNL
10.	Chamkarchhu-I	770(4x192.5)	2018	NHPC
11.	Amochhu RS	540(4x135)	2018	NTPC
12.	Nikachhu	210/140	2020	DGPC
13.	Bindu Khola	13	2020	DGPC
14.	Dagachhu	126(2x63)	2020	DGPC & Tata
Total		10304		

India – Bhutan : Transmission system from future Projects

- In view of future demand growth of Bhutan (Existing : 372MW, by 2020 : 1500MW; by 2030 : 2500 MW), it is envisaged that major portion of power from the future generation projects in Bhutan is to be imported into Indian grid.
- Total 5(five) no 800kV, 6000-7000MW HVDC high capacity corridors (2 nos. by 2020 & balance 3 nos by 2020) required for transfer of power to Indian Grid.
- The 1st of the 3000MW HVDC terminal being established at Alipurduar along with 6000MW NER-NR/WR interconnector)
 - Would take care of evacuation from projects like Punatsangchu-I (1200MW), Punatsangchu-II(990 MW) & Mangdechu(720MW)
 - To be commissioned in 2014-15.

India – Bhutan Interconnection



Interconnection of India with Nepal

India - Nepal : Present Interconnection

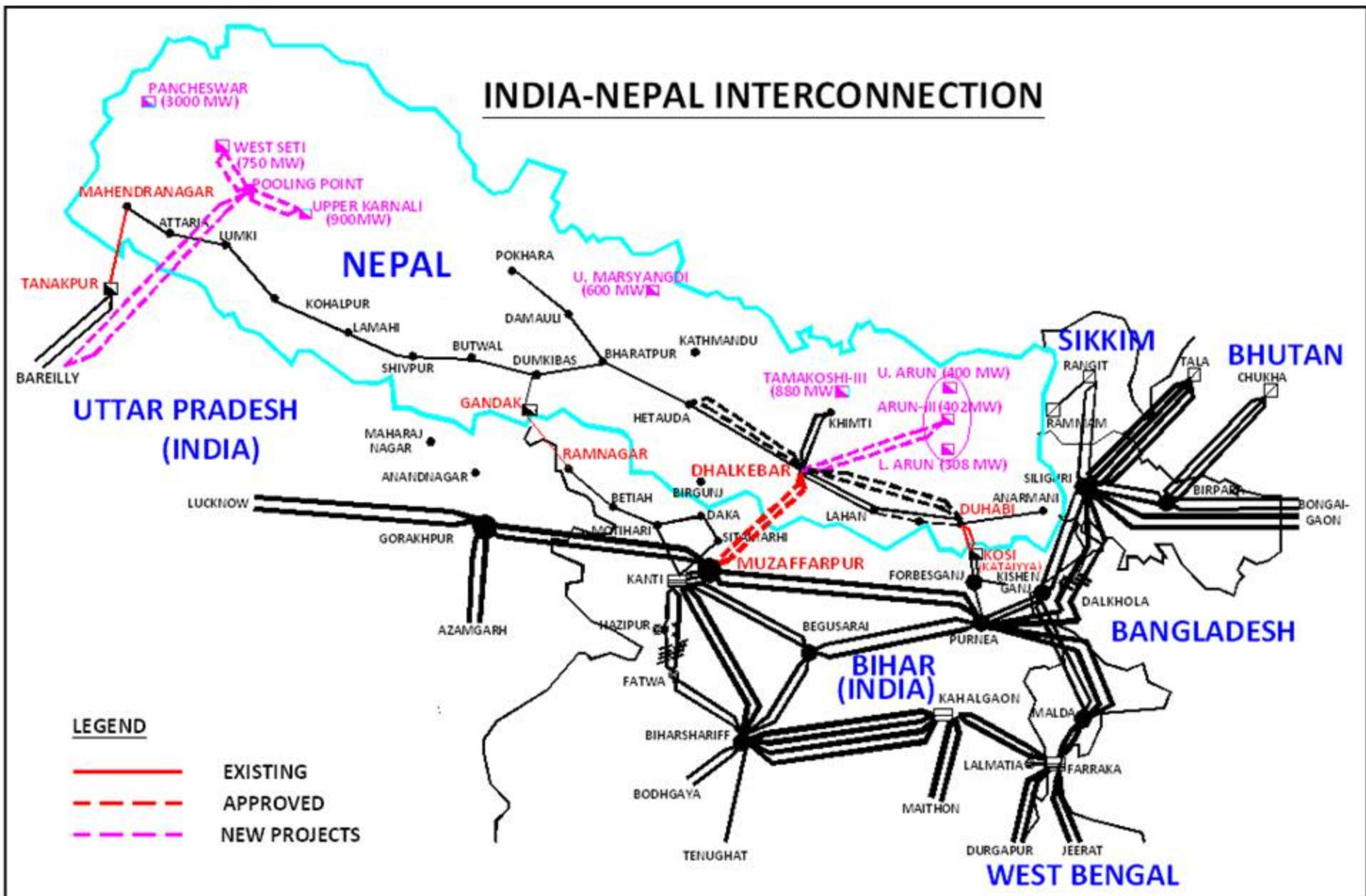
■ Power Scenario in Nepal

- Installed Capacity : 617MW (Hydro – 91%)
- Demand : 900 MW
- Peak Deficit : 300 - 400 MW

■ Interconnection : 22 links at 132/33/11 kV

- About 80-100 MW of power being exchanged in radial mode
- Supply of 70MU/annum from Tanakpur (India) to Nepal (as per the Mahakali Agreement)
- Net export to Nepal (about 10-15% of demand of Nepal met from India)

India - Nepal : Interconnection



India – Nepal : On–Going Trans. System

- **Transmission Line**

- 400kV inter-connection (initially op. at 220kV level) between Muzaffarpur(India) and Dhalkebar(Nepal) : 125 km

- **Indian Portion :**

- Line length : 86.43km; Estimated cost : Rs. 131.75 Crs. (USD 29.28million)
- To be implemented by Cross Border Power Transmission Company Pvt. Ltd. (CPTC)

[Proposed equity shares of JV partners : IL&FS(38%), POWERGRID (26%), SJVNL (26%) and NEA (10%)]

- **Nepalese Portion :**

- Line length : 39km ; Estimated cost : Rs. 127.54 Crs. (USD 28.34million)
- To be implemented by Power Transmission Company Nepal Ltd. (PTCN)

[Proposed equity shares of JV partners : NEA(50%), POWERGRID (26%), Financial Institutions of Nepal (14%), IL&FS (10%)]

India – Nepal : On–Going Trans. System

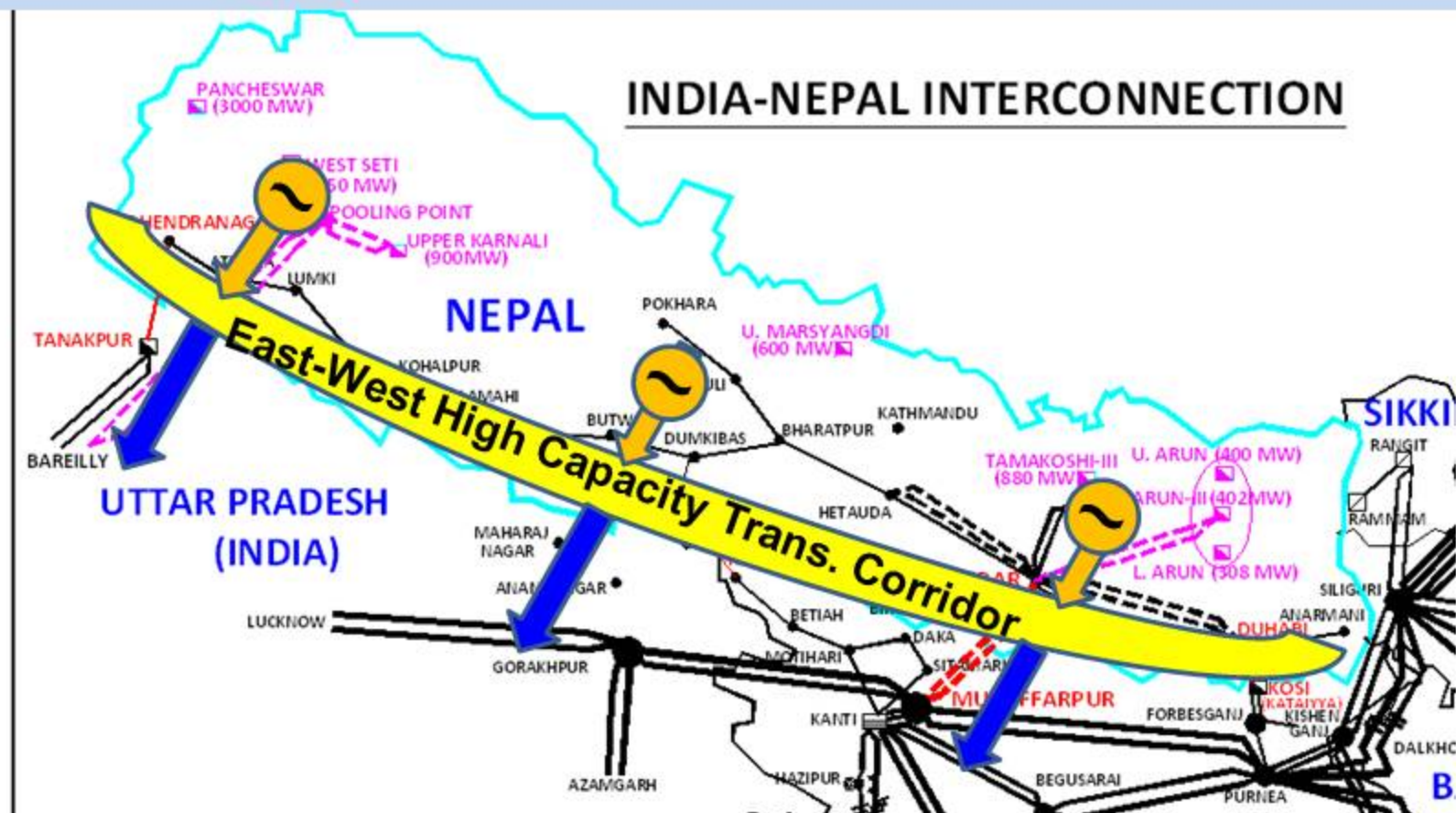
• Status of Implementation

Milestone	Status
Transmission License	Granted for both portions
PSA (Power Sale Agreement)	Signed on 12th December,2011 between NEA and PTC for 150 MW
ITSA between JVs & NEA	Signed on 13-Dec-2011 between CPTC & NEA and PTC & NEA
Shareholder Agreement (SHA)	SHAs have been signed for both the JVs are signed on 09 th July, 2012.
Implementing Agency	POWERGRID as per agreement signed with CPTC (on 10 th Aug, 2012) and PTCN (on 13 th August)
Commissioning Schedule	Dec, 2014

India – Nepal : Future

- **Hydro Potential** : about 83,000 MW
- **Future Hydro Projects** :
 - Karnali - 10,800 MW (Upper Karnali - 900MW)
 - Tamakoshi III - 880 MW
 - U. Marsyangdi – 2 - 600 MW
 - Pancheshwar HEP - 5,600 MW
 - Sapta Koshi - 3,300 MW
 - Arun HEP - 1,100 MW
 - West Seti HEP - 750 MW
 - Lower Marsyangdi - 300 MW
- **High capacity transmission** interconnection between Nepal and India need to planned for evacuation and transfer of power from future hydel projects in Nepal.

India - Nepal : Future Plan



- ☐ East-West High capacity transmission Corridor need to be planned in Nepal
- ☐ This corridor may be connected with hydro projects in Nepal and Load centres in India
- ☐ Development may be carried out through SPVs

India – Sri Lanka interconnection

- ❑ **MoU Signed** between Gol & GoSL for carrying out feasibility study
- ❑ **Executing Agency** : POWERGRID (India) & CEB (Sri Lanka)
- ❑ **Proposed Interconnection** :
 - India(Madurai) – Sri Lanka(Anuradhapura) HVDC bipole line : 360 km
(*Stage-I : 500MW; Stage-II : 1000MW*)
 - Indian Territory : 130 km
 - Sea Route : 120km
 - Sri Lankan Territory : 110 km
- ❑ **Tentative cost** : Rs. 5000 Cr. (USD 867 Million)
 - Rs. 3300 Cr. (USD 645 Million) (Stage-I)
 - Rs. 1700 Cr. (USD 222 Million) (Stage-II)
- ❑ **Feasibility Study Report** : Completed. Consultations/Clearances from various agencies are in process. Possibilities are explored for reduction of the cost of the project.

India – Sri Lanka Interconnection



Issues for Interconnection

- **Purpose of Interconnection**
 - Generation Linked (e.g. with Bhutan)
 - Strengthening Scheme for power exchange (e.g. with Bangladesh)
- **Techno-economical viability need to be assessed**
 - Voltage, Capacity, Mode(synchronous/asynchronous), location, time frame
 - Quantum of power exchange in either direction, its duration and source
 - Cost-benefit analysis to be carried out
- **Funding of the project**
- **Recovery of transmission charges**
- **Issues like scheduling of power exchange, operation, maintenance etc to be firmed up**
- **Regulatory Framework**
- **Institutional Arrangement for settling legal disputes etc.**

Thank You