भारत सरकार/ Government of India
विद्युत मंत्रालय / Ministry of Power
केंद्रीय विद्युत प्राधिकरण/ Central Electricity Authority
प्रणाली योजना एवं परियोजना मूल्यांकन प्रभाग
System Planning & Project Appraisal Division
सेवा भवन, आर.के. पुरम, नई दिल्ली - 110066
Sewa Bhawan, R.K. Puram, New Delhi – 110066

[ISO : 9001 : 2008]

No. 51/4/(Joint AISCPSP)/SP&PA-2014/1882-1932 Date: 28-October-2014

Sub: **3rd Joint meeting** of the five Standing Committees on Power System Planning - **Minutes** of the meeting

Sir,

The **3rd Joint meeting of the five Standing Committees on Power System Planning,** chaired by Chairperson, CEA, was held on 29th September, 2014 in NRPC Committee room, Katwaria Sarai, New Delhi.

The Minutes of the meeting are enclosed for information and necessary action.

The Minutes are also available at CEA's website ( www.cea.nic.in ).

Yours faithfully,

28/10/2014

(प्रदीप जिंदल /Pardeep Jindal)
निदेशक (प्र यो एवं प मू )/Director (SP&PA) Division,
(Tel: 011-26198092, Fax: 011-26102945)

**To**

(As per Enclosed List)

# Address List

1. The Director (Projects )
   Power Grid Corp. of India Ltd.,
   "Saudamini",
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2. CEO,POSOCO
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   Katwaria Sarai,
   **New Delhi-110016**
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3. Director (Projects),
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   Sector – 33, NHPC,
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   **(Fax-0129-2277941)**
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**Northern Region**

1. Member Secretary
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   **Patiala - 147 001**
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8. Director (Projects)
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   **Panchkula - 134 109**
   **(Fax-0172-2560640)**

9. Development Commissioner (Power),
Civil Secretariat,
**JAMMU - 180 001**
(Fax-0191-2545447, 2530265)

10. Director (Transmission)
RRVPNL, Vidyut Bhawan,
Janpath, Jyoti Nagar,
**Jaipur ,Rajasthan**
Fax-0141-2740794

11. Chief Engineer (Operation)
Ministry of Power, UT
Secretariat,Sector-9 D
**Chandigarh - 161 009**
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12. Director(Technical)
THDC Ltd.
Pragatipuram, Bypass Road,
**Rishikesh, Uttarakhand- 249201**
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**Western Region**

1. The Member Secretary,
Western Regional Power Committee,
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2. The Managing Director,
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**Fax 0265-2338164**

3. Director (Operation),
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4. The Chief Engineer,
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5. Chairman and Managing Director,
MPPTCL, Shakti Bhawan,
Rampur, Jabalpur-482008
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6. Executive Engineer (Projects)
UT of Dadra & Nagar Haveli,
Department of Electricity , Silvassa
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7. The Managing Director,
CSPTCL, Dangania,
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8. Executive Engineer
Administration of Daman & Diu (U.T.)
Department of Electricity
Moti Daman-396220
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**Southern Region**

1. The Member Secretary,
Southern Regional Power Committee,
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2. Member (Distribution),
Tamil Nadu electricity Board (TNEB),
6th Floor, Eastern Wing, 800 Anna Salai,
**Chennai - 600002.**
FAX : 044-28516362

3. The Director (Grid Transmission and Management),
Transmission Corp. of Telangana Ltd.,
(TSTRANSCO)
Vidyut Soudha, Khairatabad
**Hyderabad – 500 082.**
**FAX : 040-23321751**

4. The Director (Power),
Corporate Office, Block – I,
Neyveli Lignite Corp. Ltd.,
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5. The Director (Transmission),
Karnataka State Power Trans. Corp.Ltd.,
Cauvery Bhawan,
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6. The Superintending Engineer –I,
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**Puducherry – 605 001.**
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7. The Member (Transmission),
Kerala State Electricity Board,
Vidyuthi Bhawanam, Pattom,
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**Thiruvananthapuram - 695 004.**
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8. The Director (Transmission),
Trans. Corp. of Andhra Pradesh Ltd.,
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Vidyut Soudha,
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**Eastern Region**

1. Member Secretary,
Eastern Regional Power Committee,
14, Golf Club Road, Tollygange,
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2. Director (System),
Damodar Valley Corporation
DVC Towers, VIP Road,
**Kolkata-700054.**

3. Managing Director,
Bihar State Power Transmission Co (BSPTC),
Vidyut Bhavan, Baily Road,
**Patna-800021.**

4. Director (Transmission),
Orissa Power Transmission Corporation (OPTCL)
Jan path,
**Bhubaneshwar-751022.**

5. Director (System Operation),
West Bengal State Electricity Transmission Company Ltd.(WBSETCL),
Vidyut Bhavan, 5th Floor, Block-D,
BidhanNagar, Sector-II
**Kolkata-700091.**

6. Member (Transmission),
Jharkhand State Electricity Board,
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Doranda,
**Ranchi - 834002.**

7. Principal Chief Engineer cum Secretary,
Power Department,
Government of Sikkim, **Sikkim**

**North Eastern Region**

1. The Member Secretary,
North Eastern Regional Power Committee (NERPC),
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2. The Chairman and Managing Director,
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3. The Chairman-cum-Managing Director,
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4. The Managing Director,
Assam Electricity Grid Corporation Limited, Bijulee Bhawan; Paltan Bazar, Guwahati (Assam) – 781001
Fax: 0361 – 2739513 & 0361 – 2739989

5. The Chairman-cum-Managing Director,
Meghalaya Energy Corporation Limited, Lum Jingshai, Short Round Road, Shillong (Meghalaya) – 793001.
Fax: 0364 – 2590355

6. The Chief Engineer (Power),
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7. The Chief Engineer, Department of Power, Nagaland, Kohima
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8. Engineer-in-Chief
Power & Electricity Department,
Govt. of Mizoram, Tuikhuahtlang,
Aizawl (Mizoram)
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9. The Chief Engineer (Power),
Vidyut Bhawan, Department of Power,
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**Copy to:**
SA to Chairperson,
Central Electricity Authority,
Sewa Bhawan, R. K. Puram,
New Delhi-110066.

Minutes of 3rd Joint meeting **of the five Standing Committees on Power System Planning** held on 29th September, 2014 at NRPC, Katwaria Saria, New Delhi

The list of participants is given at Annex 2.

**1.** Member (PS), CEA welcomed the participants to the meeting and informed that this meeting has been convened to share the details of the 20 year Perspective plan on transmission. He informed that the '20 - Year Perspective Transmission Plan' had been prepared by CEA in association with POSOCO and CTU under the directions of Ministry of Power. This plan is part of initiative of the Government under 100 days action programme. He added that though the perspective transmission plan for 14th and 15th Plan is basically indicative in nature, however, the details for the 13th Plan are required to be firmed up. For this, it is essential that the assumptions on load demands, load profile, generation addition in each State that has been considered in the formulation of 20-year perspective plan may be seen or if there are any changes, the same may be communicated to CEA. He said that the States own transmission expansion programme for 2014-24 period may be sent to CEA at the earliest. He emphasized to finish this activity on urgent basis so that region/state-wise transmission elements could be firmed up for implementation in 13th Plan period. He requested States to designate nodal officers who would interact with CEA and CTU. Based on the information sent by States joint studies would be performed for evolving transmission system including for integration of RES capacity. He emphasized the need of firming up time lines for Region-wise finalization of Transmission Additions and Regional Standing Committee meetings for firming up transmission schemes for implementation.

**2.** Director (SP&PA), CEA made a presentation (copy at Annex I) on Perspective Transmission Plan for twenty years (2014-34).

**3.** Chairperson, CEA requested States to sincerely participate in this exercise and provide data at the earliest. She said that the system which will emerge out of these exercise would be firmed up by the Regional Standing Committees and would be taken up for implementation as decided by the Empowered Committee. She then requested the representatives of the utilities to express the views/suggestions of the Perspective Plan and way forward for its implementation.

**4.** Director (Operation), MSETCL Maharashtra said that they agree with the forecasting of load and generation as given in 20 year Perspective plan. He said that fault level is important for 2021-22 scenarios and emphasized on the need of HVDC especially back to back in the future.

**5.** The representative of NEEPCO stated that their capacity addition for 12th Plan is same as projected in the Perspective Plan, however 13th Plan capacity addition projections are less which they would report soon.

**6.** Director (Trans Project), TANTRANSCO, Tamil Nadu stated that the required data has been submitted by them and they have started the process of planning for the strengthening of 220kV network also. The details would be worked out in association with CEA and CTU.

**7.** CEE, KPTCL, Karnataka stated that they have shared their 20 year perspective plan with CEA. CEA asked KPTCL to confirm the assumptions on peak load, load profile and the generation projects corresponding to Karnataka which has been taken in the prospective transmission plan.

**8.** SE, APRTRANSCO, Andhra Pradesh stated that certain factors need to be taken into account while planning their perspective plan namely – load demand of a new capital of the newly formed State of Andhra Pradesh and integration of RES in the State /ISTS grids.

**9.** SE, CSPTCL, Chhatisgarh opined that RPCs may call all DISCOMs, STUs and GENCOs in the region to gather the required data and carry out planning studies. Chairperson, CEA explained that transmission planning and its coordination with STUs and CTU is the duty and functions of CEA as per the Act. However, if RPCs facilitate gathering of data at regional level, this would help in completion of system studies and firming up of the transmission plan by CEA.

**10.** Director, KSEB, Kerala submitted that the load generation data as projected in the Perspective Plan is in order. He also informed that an HVDC for Kerala has been proposed which may be firmed up as early as possible. He informed that by the third week of October the data for 13$^{th}$ Plan would be provided. POSOOCO opined that load of Kerala is increasing and no generation capacity addition is envisaged in the State of Kerala. Therefore, to meet its load demand, Kerala will have to import large quantum of power and which would require more and more transmission links connecting Kerala with rest of national grid. This may have some operational and grid stability issues. CEA added that as Kerala generation is presently mostly hydro based which is seasonal and, therefore, Kerala may consider adding thermal i.e coal or gas base plants in the State. Further, constructing lines into Kerala is also facing RoW problems.

**11.** DE, TSTRANSCO, Telangnana informed that State Perspective Plan has been submitted by them and mentioned that some of the generation have not been considered i.e: Solar bidding of 500 MW at Mehboob nagar, Singreni Corralis U-3, Share of CGS units.

**12.** SE(Tr. Planning), UPPTCL, Uttar Pradesh requested CEA to provide technological guidelines for designing and construction of 220kV and 132kV transmission systems in the States.

**13.** GM, AEGCL, Assam informed that during low hydro, load shedding is an issue. The perspective plan should provide solution to mitigate the same.

**14.** MD, MPPTCL, Madhya Pradesh informed that during the last 7-8 months RE

Generations have come and reactive power is a big issue.

**15.** CGM, OPTCL, Orissa informed that a capacity addition of 62000 MW is envisaged by the end of 14th Plan and an investment of Rs 11000 Crores is expected in the next 5 years.

**16.** CE, GETCO, Gujarat informed that a 765 kV substation may be planned in South Gujarat by LILO of Dhule- Vadodara 765kV line.

**17.** Director, BSPTCL, Bihar emphasized on the need of mid term review of implementation of transmission plan.

**18.** CEO, POSOCO complimented the entire team involved in drafting the Perspective Plan 2014-2034 for bringing out the report in such a short time period. The effectiveness of the plan would be known only by posterity. He said that in 2004-07 period, while preparing the National Transmission Plan (2012), Southern Region was expected to be surplus and the transmission system was planned accordingly. In 2014, the actual situation was just the opposite leading to constraints in the transmission system. Similarly, the actual operation in 2024 only would indicate the effectiveness of the 2014-2034 Perspective Plan. He suggested that the following issues however merited closer attention which needs to be taken care of while detailing and converting 'a Perspective Plan' to 'the Plan' for execution:

i. The Plan has to be tested for resilience under extreme dispatch conditions such as a control area generation going out or maximum dispatch within a control area.

ii. Various ratios viz, Transfer Capability to Transmission Capacity, Transfer Capability to maximum demand of a state, Transfer Capability to Internal Generation of a State, LTA to transfer capability of a state are extremely important. An exercise based on the past data had been done for each state control area and these numbers were quite revealing.

iii. Reactive power resources, both static and dynamic are extremely important. After commissioning of SVC at Kanpur in 1991, we have not had any dynamic compensation and only recently STATCOMs have been planned at 12 locations in all regions.

iv. Controllability of power flows is important for high capacity corridors having power transfer capability greater than 4000 MW. HVDC's would provide this feature and therefore need to be planned accordingly.

v. With the interconnection of Southern Region and grid expansion, issues of Low Frequency Oscillation (LFO) have emerged. A report on the same had been recently brought out by NLDC and is available on public domain. In case of ER-WR synchronization in March, TCSC was envisaged. Similarly for ER-NR

synchronization, TCSC was envisaged. However for NEW grid-SR synchronization, the issue of LFO needs to be studied further and mitigation measures suggested in the planning horizon.

vi. The target system in year 2024 or 2034 can be planned/identified but the trajectory and the limiting constraints are important, as such priority of lines and the sequence of commissioning.

vii. Delay in commissioning of new transmission lines and generating units, extreme dispatch of renewable generation and cost of generation also need to be factored in the transmission planning process. He cited the example of Haryana where a number of load centre based generation is closed down and power is being procured from outside the region and the transmission system gets tested in such a scenario.

viii. The States need to sincerely participate in the exercise, particularly demand forecasts. Generally, the demand is seasonal in nature with the peak demand in any state occurring at the most three months in a year. Statistical techniques need to be employed on past data to estimate saturation in demand. Peak load is growing at twice that of off-peak. The duck curve (net load = actual load-variable generation) could be simulated for a prospective period considering high solar during the day time and the transmission system needs to be tested for such a scenario.

ix. The high level of uncertainty in factors brings out the need for using new simulation tools such as Plexos, NATGRID and the 8760 hours outlook is really required with confidence levels of estimate also indicated. The scenarios of low confidence level could be examined in detail in subsequent iterations.

x. Transfer Capability of each state is also important. More touch points for drawal of power from the ISTS needs to be provided for a better transfer capability rather than a single or double high capacity sources. The example of Delhi, Mumbai, Kolkata and Bangalore was cited. The problem of metropolitan cities was unique and low reliability of power supply in these areas leads to loss of credibility.

xi. The index of development of transmission viz. inter-regional transmission capacity needs to be phased out quickly.

xii. Re-conductoring of short lines with high capacity conductors could be taken up. At 220 kV level there was a huge scope and this needs to be done at the intra state level.

xiii. The perspective plan outlook of heavy exports from NER and ER towards SR needs to be carefully studied. It was stated that recently under a similar situation of 500 MW export from NER and 4800 MW import by SR, the angular

difference between Bongaigaon and Thrissur was of the order of 110 degrees as measured through the Phasor Measurement Units (PMUs). Such high angular difference needs to be studied as the system could be vulnerable.

xiv. N-1; element or event also needs a careful consideration considering tower failures, faults not getting cleared within 100 msec. Improvements are required in these areas but can we say that a disturbance occurred because the system was planned with N-1 criteria only? System Protection Schemes (SPS) is touted as a remedy but whether such a 'bandage' is effective, needs a serious examination.

xv. Multiple transformations in the transmission system need to be avoided, if possible. There is a need to examine the feasibility of 765/220 kV, 400/132 kV and 220/66 kV transformers. The latter two had been in use in many systems.

xvi. Examples of other large power systems suggests that the system could be planned in such a fashion that they could be clinically operated as two separate grids with HVDC connections/HVDC back to back at a later date.

**19.** With respect to above Director(SP&PA), CEA expressed the following:

a. Point i) & xiv): Regarding extreme contingency conditions, it was said that planning for investment into transmission expansion is done considering the credible contingencies as per the transmission planning criterion. SPS need to be planned to take care of extreme contingencies for securing the grid during operational stage. The failure/malfunctioning of the relays or circuit breakers causing delayed fault clearance must be minimized by adopting better operation and maintenance practices of such equipments.

b. Point ii): Regarding various ratios, CEA requested POSOCO to share the analysis carried out by POSOCO for benefit of stakeholders, and the same was agreed by them.

c. Point vii): Regarding total cost of delivery of power including cost of generation, transmission lines and losses, CEA agreed that cost of generation, transmission lines and losses must be analyzed in an integrated manner, while deciding need for transmission expansion. This is also as per the provisions in the Electricity Act.

d. Point xiii): Regarding high angular differences, CEA suggested that this need to be examined in detail for which nation/international experts from the industry may be involved in.

e. Point xv): In regard to 765/220 kV, 400/132 kV and 220/66 kV transformers, its technological feasibility need to be examined for which it was suggested that

design group of CEA and PGCIL may look into the matter.

f. Point xvi): This will require change in present planning approach of development of National Grid. However, we may attempt to assess the feasibility of developing National Grid in such a way so that it could be operated as two or more separate grids as suggested by POSOCO. The use of HVDC connections/HVDC back to back and the additional cost that may also be assessed.

**20.** After deliberation the following time lines was agreed for follow up action on the Perspective Plan

| | | |
|---|---|---|
| 1. | Feedback from States on today's discusssion | Within 3 weeks i.e: 20th Oct, 2014 |
| 2. | CEA and CTU to assimilate the information send by states | By 10th Nov, 2014 |
| 3. | State-wise interaction and joint studies for evolving transmission system including for integration of RES capacity | 2-3 weeks per region. |
| 4. | Region-wise finalization of Transmission Additions | About 1 week per region i.e: 1 month for All- India. |
| 5. | Regional Standing Committee meetings for firming up transmission schemes for implementation | Giving 15 days notice after circulation of the Agenda for the meeting(s) |

**21.** The States would provide the following details/information:

1. List of generation projects including state IPPs coming in the state during period (2014-22).
2. Annual peak and Month-wise load profile for their State for seasonal variation of load, month wise off peak and peak demand data
3. State's own transmission plan, if any, for 2014-22

# Annex - I

**3rd Joint Meeting of all the five Standing Committees on Power System Planning**

# 20-year Transmission Perspective Plan (2014-34)

**29th September,2014**
**at New Delhi**



## Perspective Transmission Plan for Twenty Year (2014-2034)

| Sl. No. | Chapter |
|---|---|
| 1. | Introduction and Approach |
| **Part-I:** | **Evolving Transmission System Additions for 13th Plan i.e. up to 2021-22** |
| 2. | Load and Generation Assumptions for 13th Plan |
| 3. | Assessment of Transmission needs for meeting Demand and evacuation of Generation for 13th Plan |
| 4. | Evolving Transmission System for 13th Plan |
| **Part-II:** | **Evolving Broad Transmission Corridors for period 2022-34 i.e. 14th, 15th Plans and beyond** |
| 5. | Load and Generation Assumptions for 14th and 15th Plans and up to 2033-34 |
| 6. | Evolving Transmission Corridors for 14th and 15th Plans and up to 2033-34 |

# Assumptions

- Generation additions, 12th and 13th Plan (given in Brief Note along with meeting notice)
- Planning methodology
- Load demand – Peak and Off-peak (annual peak assumed as per 18th EPS, seasonal peaks and off-peaks as given in the report at Table 3.6 of report)

| | Summer Peak | Summer Off-peak | Monsoon Peak | Monsoon Off-peak | Winter Peak | Winter Off-peak |
|---|---|---|---|---|---|---|
| **NR** | 100% | 70% | 96% | 70% | 95% | 70% |
| **WR** | 95% | 70% | 90% | 70% | 100% | 70% |
| **SR** | 98% | 70% | 90% | 70% | 100% | 70% |
| **ER** | 100% | 70% | 95% | 70% | 95% | 70% |
| **NER** | 100% | 70% | 95% | 70% | 95% | 70% |
| **SAARC Exports** | 100% | 70% | 100% | 70% | 100% | 70% |



# Way Forward

- Way forward:
  - ✓ State-wise interaction and joint studies for evolving transmission system including for integration of RES capacity
  - ✓ Region-wise finalization of Transmission Additions
  - ✓ Regional Standing Committee meetings for firming up transmission schemes for implementation
  - ✓ Time-lines for above
  - ✓ Name of Key contact persons for each utility

## Time Lines (proposed)

| S.No | Project | Time lines |
|---|---|---|
| 1 | Feedback from States on today's discussion | Within 3 weeks i.e: 20th Oct, 2014 |
| 2 | CEA and CTU to assimilate the information send by states | By 10th Nov, 2014 |
| 3 | State-wise interaction and joint studies for evolving transmission system including for integration of RES capacity | 2-3 weeks per region. |
| 4 | Region-wise finalization of Transmission Additions | About 1 week per region i.e: 1 month for All- India. |
| 5 | Regional Standing Committee meetings for firming up transmission schemes for implementation | Giving 15 days notice after circulation of the Agenda for the meeting(s) |



## Installed Capacity during 12th and 13th Plans

(in MW)

| Plan-Wise Generation Addition (Region - Wise) | | | | |
|---|---|---|---|---|
| | Up to July 2014 (Actual) (A) | Balance in XII Plan (B) | Addition in XIII Plan (C) | Total (End of XIII Plan) (D = A+B+C) |
| NR | 64387 | 20929 | 16890 | 102206 |
| WR | 91847 | 36709 | 20262 | 148818 |
| SR | 57232 | 38650 | 23076 | 118958 |
| ER | 33881 | 12738 | 31195 | 77813 |
| NER | 2910 | 3511 | 8202 | 14623 |
| Bhutan | 1416 | 3066 | 2120 | 6602 |
| **Total** | **251673** | **115603*** | **101745** | **469020** |

* 88.5 GW planned capacity( ~ 40 GW commissioned) + 9.6 GW additional capacity, + about 25 GW capacity under construction, and about 33 GW of renewable capacity

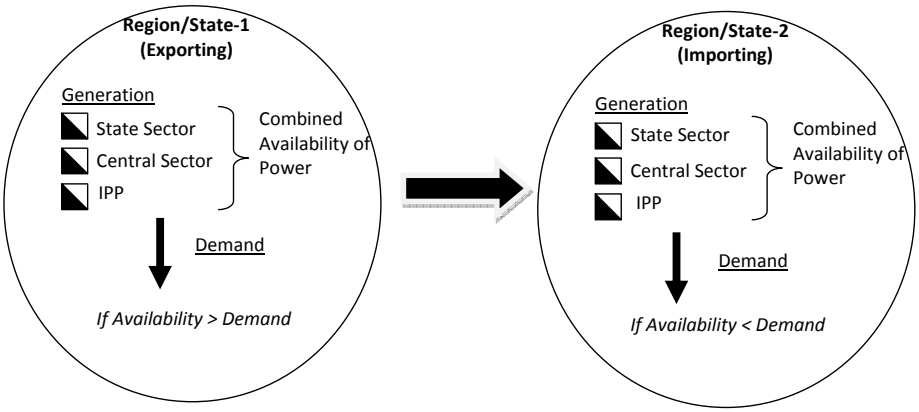
## Installed Capacity fuel-wise by end of 13th Plan (in MW)

| | Fuel Mix of Generation (Region Wise) (end of XIII Plan) | | | | | | Demand |
|---|---|---|---|---|---|---|---|
| | Coal | Nuclear | Gas | Hydro | RES | Total | |
| NR | 51238 | 4420 | 6714 | 26656 | 13178 | 102206 | 86461 |
| WR | 106478 | 3940 | 11804 | 7879 | 18717 | 148818 | 86054 |
| SR | 59520 | 4820 | 9673 | 12765 | 32180 | 118958 | 82199 |
| ER | 68617 | 0 | 207 | 8572 | 417 | 77813 | 35928 |
| NER | 810 | 0 | 1803 | 11358 | 651 | 14623 | 4056 |
| SAARC | 0 | 0 | 0 | 6602 | 0 | 6602 | 1000 |
| Total | 286663 | 13180 | 30202 | 73832 | 65143 | 469020 | **283470 #** |

# with diversity without SAARC Export



## Planning Methodology




- Transmission System planned based on Import-Export Requirement.
- Region-wise Import Export Requirement worked out for 3 Seasons : Winter, Summer and Monsoon
- State-wise import-Export requirement to be worked out
- RES Capacity Integration to be worked out

# Diversity in demand among Regions and States

| | Terminal year of the Plan periods | | | |
|---|---|---|---|---|
| Region | 2016-17 | 2021-22 | 2026-27 | 2031-32 |
| Northern | 20.1% | 20.1% | 21.1% | 22.1% |
| Western | 10.5% | 10.5% | 11.5% | 12.5% |
| Southern | 7.6% | 7.6% | 8.6% | 9.6% |
| Eastern | 12.1% | 12.1% | 13.1% | 14.1% |
| North_East | 19.8% | 20.8% | 16.3% | 17.3% |
| All –India (Inter-Regional) | 4.0% | 4.0% | 5.0% | 6.0% |
| **All –India** | **17.3%** | **17.4%** | **19.4%** | **21.6%** |

## Region-wise Load Generation for seasonal variation of Load

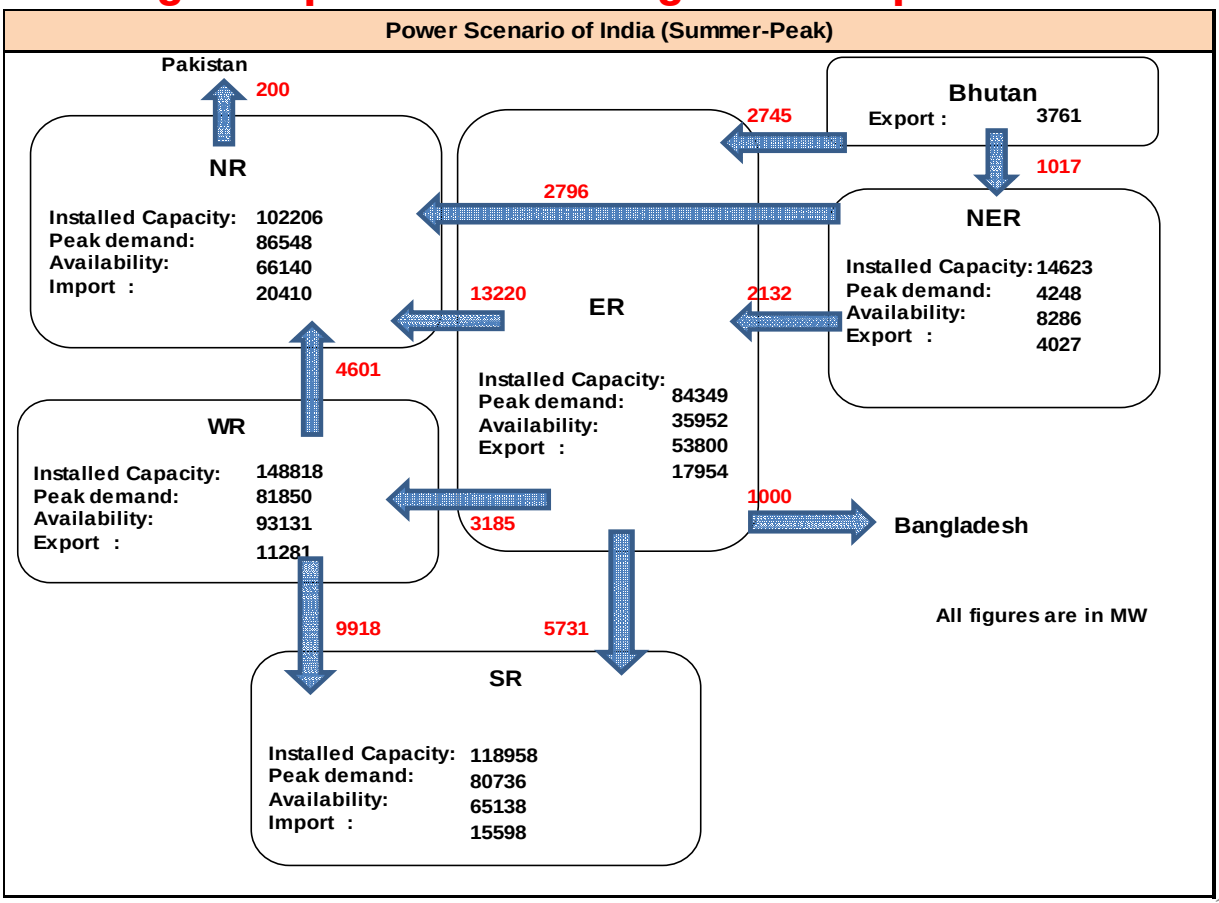
| | Summer Peak | | | Monsoon Peak | | | Winter Peak | | |
|---|---|---|---|---|---|---|---|---|---|
| | Availability | Demand | Sur(+) / Def(-) | Availability | Demand | Sur(+) / Def(-) | Availability | Demand | Sur(+) / Def(-) |
| NR | 68532 | 86461 | -17929 | 71178 | 83003 | -11825 | 61883 | 82138 | -20255 |
| WR | 102803 | 81751 | 21052 | 99657 | 77449 | 22209 | 99356 | 86054 | 13302 |
| SR | 69429 | 80555 | -11126 | 68113 | 73979 | -5866 | 63658 | 82199 | -18541 |
| ER | 61060 | 35928 | 25132 | 62692 | 34132 | 28560 | 59304 | 34132 | 25172 |
| NER | 9746 | 4056 | 5690 | 11296 | 3853 | 7443 | 7409 | 3853 | 3556 |
| Bhutan | 4621 | 0 | 4621 | 5942 | 0 | 5942 | 3301 | 0 | 3301 |
| Bangladesh | | 1000 | -1000 | | 1000 | -1000 | | 1000 | -1000 |
| Pakistan | | 200 | -200 | | 200 | -200 | | 200 | -200 |
| All India | 316192 | 289951 | **26241** | 318878 | 273615 | **45263** | 294911 | 289576 | **5335** |
| | Summer Off-Peak | | | Monsoon Off-Peak | | | Winter Off-Peak | | |
| | Availability | Demand | Sur(+) / Def(-) | Availability | Demand | Sur(+) / Def(-) | Availability | Demand | Sur(+) / Def(-) |
| NR | 56507 | 60523 | -4016 | 61838 | 60523 | 1315 | 48510 | 60523 | -12013 |
| WR | 93357 | 60238 | 33119 | 94933 | 60238 | 34695 | 90994 | 60238 | 30756 |
| SR | 59796 | 57539 | 2257 | 62349 | 57539 | 4810 | 55967 | 57539 | -1573 |
| ER | 58364 | 25150 | 33215 | 60079 | 25150 | 34929 | 55793 | 25150 | 30643 |
| NER | 5256 | 2839 | 2417 | 7528 | 2839 | 4689 | 1849 | 2839 | -990 |
| Bhutan | 2641 | 0 | 2641 | 3961 | 0 | 3961 | 660 | 0 | 660 |
| Bangladesh | | 700 | -700 | | 700 | -700 | | 700 | -700 |
| Pakistan | | 140 | -140 | | 140 | -140 | | 140 | -140 |
| All India | 275921 | 207129 | **68793** | 290688 | 207129 | **83559** | 253772 | 207129 | **46643** |

# Load Generation Balance at the end of 13th Plan (2021-22) for Study

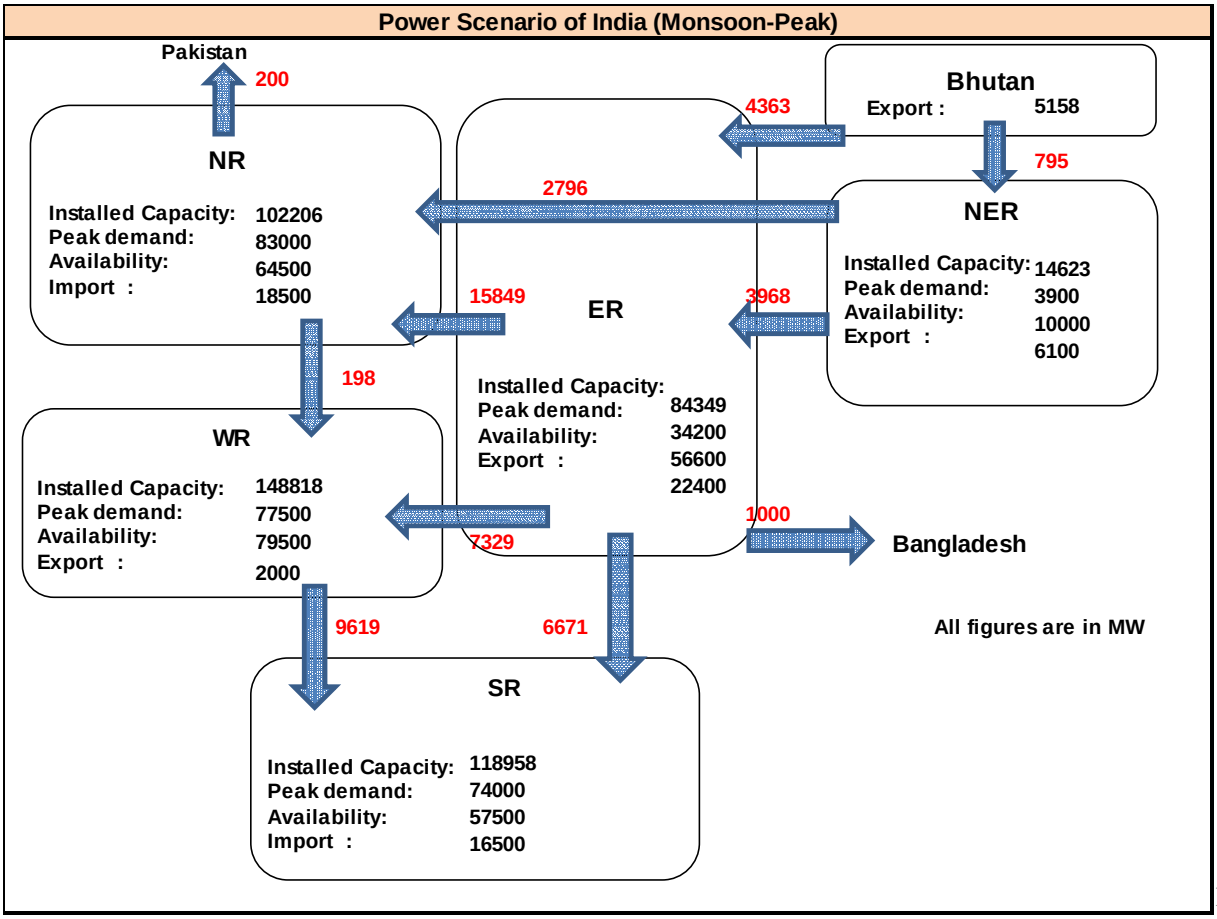
| | Summer Peak | | | Monsoon Peak | | |
|---|---|---|---|---|---|---|
| | Dispatch (% of IC) | Demand | Sur(+) /Def(-) | Dispatch (% of IC) | Demand | Sur(+) /Def(-) |
| NR | 66000 (65%) | 86500 | -20500 | 64500 (63%) | 83000 | -18500 |
| WR | 93200 (63%) | 81700 | 11500 | 79500 (53%) | 77500 | 2000 |
| SR | 65000 (55%) | 80500 | -15500 | 57500 (48%) | 74000 | -16500 |
| ER | 53800 (69%) | 36000 | 17800 | 56800 (73%) | 34200 | 22600 |
| NER | 8000 (55%) | 4100 | 3900 | 10000 (68%) | 3900 | 6100 |
| Bhutan | 4000 (61%) | 0 | 4000 | 5500 (83%) | 0 | 5500 |
| Bangladesh | | 1000 | -1000 | | 1000 | -1000 |
| Pakistan | | 200 | -200 | | 200 | -200 |
| All India | **290000 (62%)** | **290000** | **0** | **273800(58%)** | **273800** | **0** |

| | Winter Peak | | | Winter Off-Peak | | |
|---|---|---|---|---|---|---|
| | Dispatch (% of IC) | Demand | Sur(+)/Def(-) | Dispatch (% of IC) | Demand | Sur(+) /Def(-) |
| NR | 59800 (59%) | 82000 | -22200 | 40000 (39%) | 61000 | -21000 |
| WR | 97900 (66%) | 86000 | 11900 | 75900 (51%) | 60000 | 15900 |
| SR | 62900 (53%) | 82000 | -19100 | 45000 (38%) | 58000 | -13000 |
| ER | 5800 (75%) | 33300 | 24700 | 45000 (58%) | 25200 | 19800 |
| NER | 6700 (46%) | 3900 | 2800 | 1500 (10%) | 2900 | -1400 |
| Bhutan | 3100 (47%) | 0 | 3100 | 600 (9%) | 0 | 600 |
| Bangladesh | | 1000 | -1000 | | 700 | -700 |
| Pakistan | | 200 | -200 | | 200 | -200 |
| All India | **288400 (61%)** | **288400** | **0** | **208000 (44%)** | **208000** | **0** |

# Inter-regional power flow during Summer-peak condition

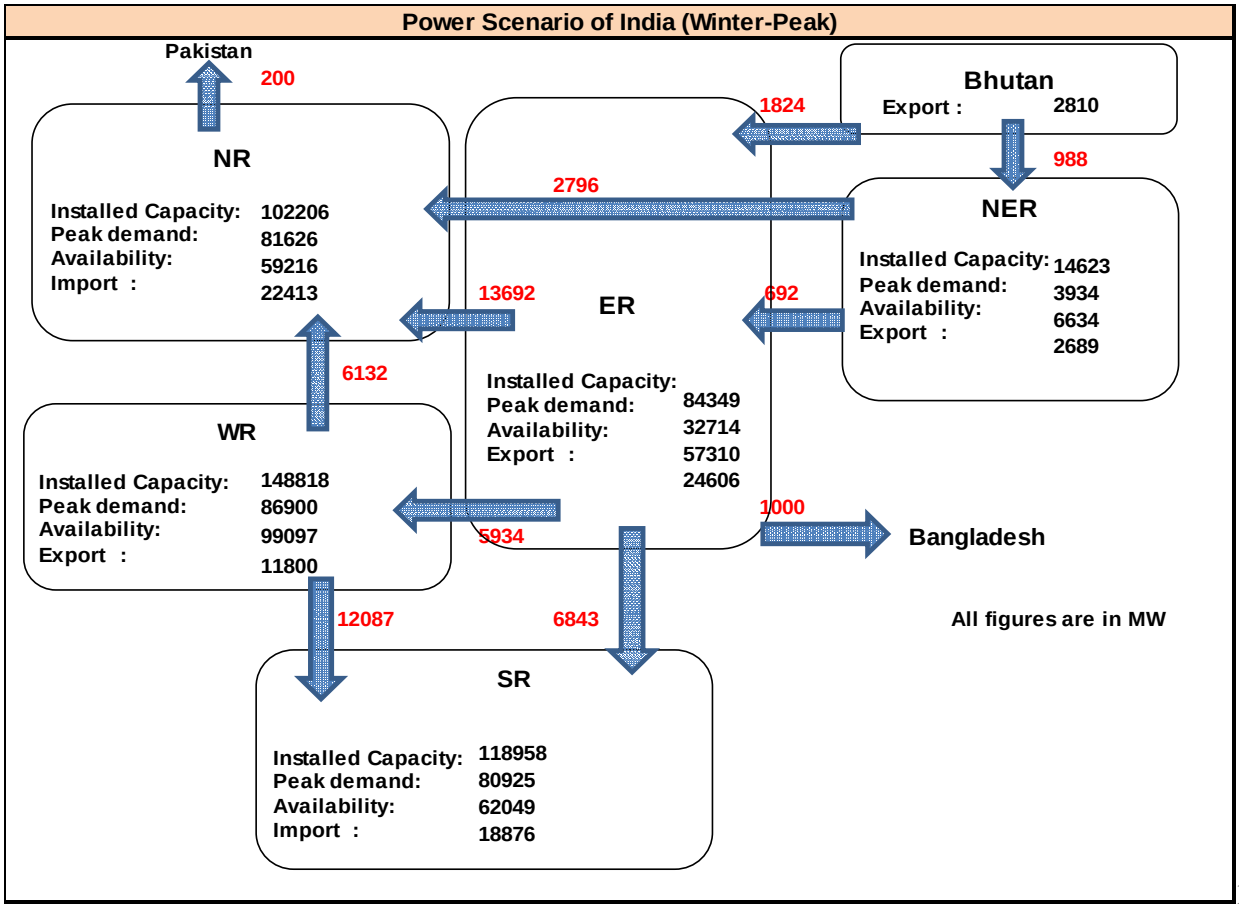


# Inter-regional power flow during Monsoon-peak condition

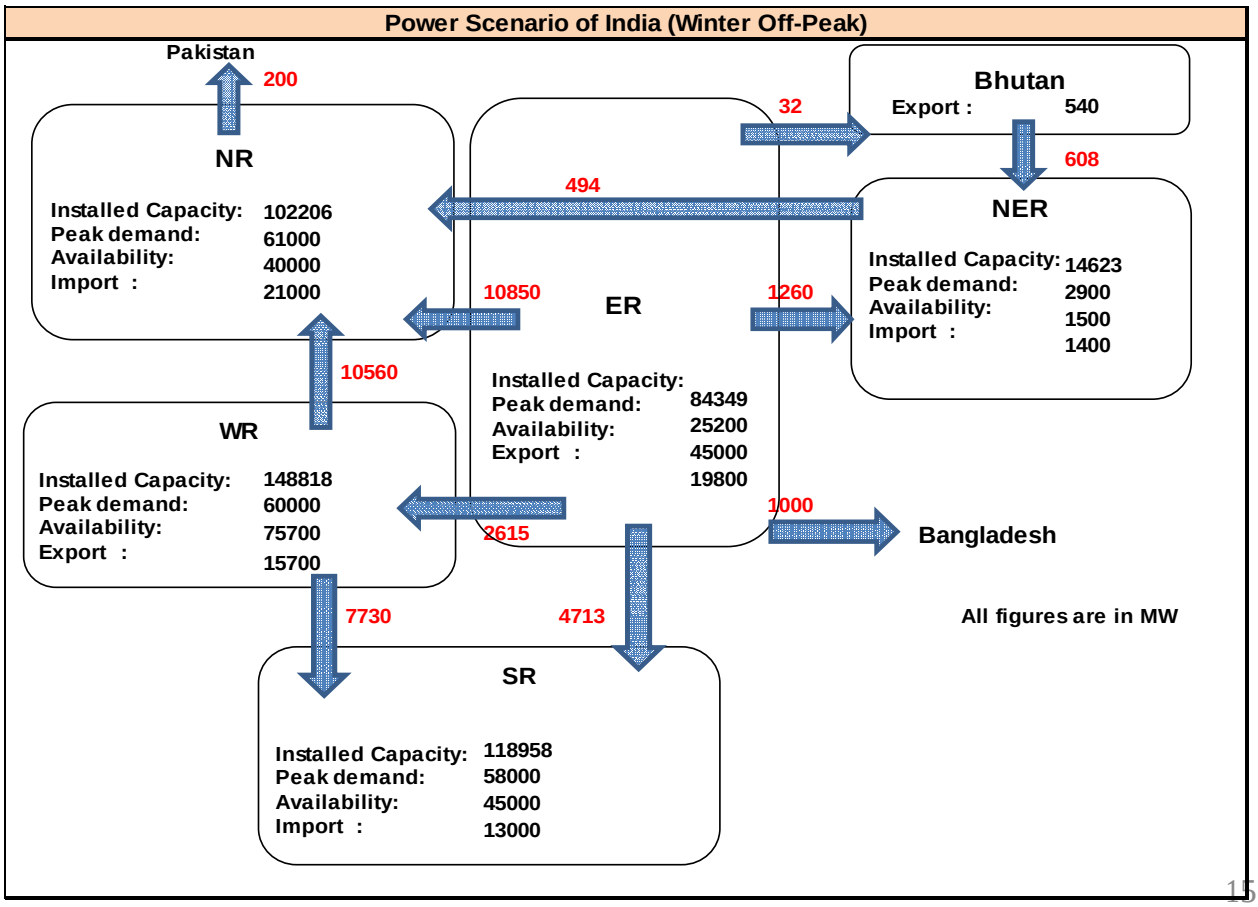





# Inter-regional power flow during Winter-peak condition



# Inter-regional power flow during Winter-off-peak condition






# Summary of Inter- Regional Transmission Capacity

| Transmission Corridor | Existing | 12th Plan | End of 12th Plan | 13th Plan | Total Transmission Capacity |
|---|---|---|---|---|---|
| **EAST-NORTH** | 14230 | 5300 | 19530 | 7200* | 26730 |
| **EAST-WEST** | 6490 | 6300 | 12790 | 8400 | 21190 |
| **EAST-SOUTH** | 3630 | 4200 | 7830 | 4200 | 12030 |
| **EAST-NORTH EAST** | 1260 | 1600 | 2860 | 0 | 2860 |
| **WEST - NORTH** | 8720 | 8200 | 16920 | 15600 | 32520 |
| **WEST - SOUTH** | 5720 | 2200 | 7920 | 14400 | 22320 |
| **NORTH - NORTH EAST** | 0 | 6000 | 6000 | 3000* | 9000 |
| **Total** | **40050** | **33800** | **73850** | **52800*** | **126650** |

* - About 6000 MW, may be required in 13th or 14th Plan, in which case 13th plan Ir addition would be 46800 MW. One of these HVDC biploes if needed may be planned towards Southern Region instead of towards Northern region

# Inter- Regional Transmission Capacity during 13th Plan

| Sl. | Name of link | Capacity(MW) | Status |
|---|---|---|---|
| **A** | **EAST-NORTH** | | |
| **1** | Tillaiyya (ER-Bihar) – Balia (NR–UP) 765kV D/c line, one ckt via Gaya | 4200 | Planned |
| **2** | Angul (ER- Orissa) – Badarpur (NR-Delhi) ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity | 3000 | New* |
| | **Sub-total** | **7200** | |
| **B** | **EAST-WEST** | | |
| **3** | Jharsuguda (Orissa) - Dharamjaygarh (Chattishgarh) (to be LILOed at Raigarh-Tamnar) 765kV D/c line (2nd) | 4200 | UC |
| **4** | Jharsuguda (ER-Orissa) - Raipur Pool (WR-Chattishgarh) 765kV D/c line | 4200 | Planned |
| | **Sub-total** | **8400** | |
| **C** | **WEST- NORTH** | | |
| **5** | Upgradation of Champa (WR-Chattishgarh) – Kurukshetra (NR-Haryana) ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity | 3000 | UC |
| **6** | Jabalpur (WR – MP) – Orai (NR – UP) 765kV D/c line | 4200 | Planned |
| **7** | Banaskanta(WR-Gujarat) – Chittorgarh (NR-Rajasthan) 765kV D/c line | 4200 | Planned |
| **8** | Dhanvahi(WR – MP) – Fatehpur (NR – UP) 765kV D/c line | 4200 | New |
| | **Sub-total** | **15600** | |
| **D** | **EAST- SOUTH** | | |
| **9** | Angul (ER-Orissa) - Srikakulum (SR- Andhra Pr) 765kV D/c line (2nd) | **4200** | New |
| **E** | **WEST- SOUTH** | | |
| **10** | Wardha (WR-Maharastra) - Nizamabad (SR- Telengana) 765kV D/c line | 4200 | Planned |
| **11** | Raigarh (WR-Chattishgarh) - Pugalaur (SR-TN) +/- 800kV, 6000 Bi-pole | 6000 | Planned |
| **12** | Warora Pool (WR-Maharastra) - Warangal (SR-Telengana) 765kV D/c line | 4200 | Planned |
| | **Sub-total** | **14,400** | |
| **F** | **NORTH EAST-NORTH** | | |
| **13** | Rangia/Rowta (NER-Assam) – Gurudaspur (NR - Punjab) ±800kV, 6000/6500 MW HVDC bipole with 3000MW terminal Capacity | 3000 | New* |
| | **Total** | **52,800** | |



# Strengthening of Existing Transmission Corridors

- Following Transmission Corridors envisaged to be re-conductored with higher capacity Conductor / upgraded at higher voltage level

**Northern Region:**
- Singrauli – Anpara 400 kV S/c line
- Meerut – Muzaffarnagar 400 kV S/c line
- Ballabagarh – Badarpur 220 kV S/c line

**Southern Region:**
- Kolar – Hosur 400 kV D/c line
- Kaiga – Guttur 400 kV D/c line

**Eastern Region:**
- Maithon RB – Maithon 400 kV D/c line
- Maithon – Raghunathpur 400 kV line
- Jeypore – Jayanagar 220 kV D/c line

**North Eastern Region:**
- Biswanath Chariyali – Balipara 400 kV 2XD/c line
- Balipara – Bongaigaon 400 kV D/c line
- Byrnihat –Misa 220 kV D/c line (to be upgraded to 400 kV High capacity line)

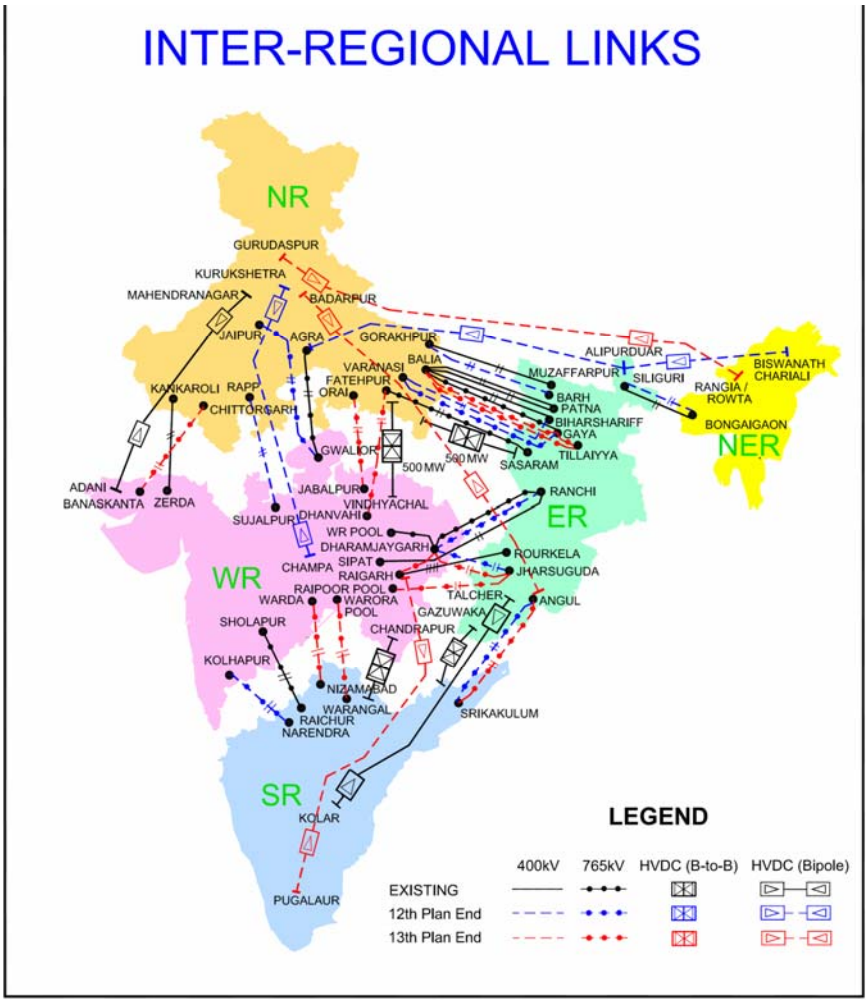
# Transmission System Required upto 13th Plan Condition

| Transmission Lines (400kV and above system) (values in ckm) | At end of 11th Plan | Expected Addition in 12th Plan | Expected by end of 12th Plan | Expected Addition in 13th Plan | Expected by end of 13th Plan |
|---|---|---|---|---|---|
| **HVDC Bipole lines** | 9432 | 7440 | 16872 | 10600 | 27472 |
| **765 kV** | 5250 | 27000 | 32250 | 22200 | 54450 |
| **400 kV** | 106819 | 38000 | 144819 | 30000 | 174819 |
| **Total** | **121501** | **72440** | **193941** | **62800** | **256741** |

| Substations (AC & HVDC) (400kV and above) | At end of 11th Plan | Expected Addition in 12th Plan | Expected by end of 12th Plan | Expected Addition in 13th Plan | Expected by end of 13th Plan |
|---|---|---|---|---|---|
| HVDC Terminals: | | | | | |
| HVDC back-to-back | 3000 | 0 | 3000 | 0 | 3000 |
| HVDC Bipole terminals | 6750 | 12750 | 19500 | 15000 | 34500 |
| **Total- HVDC Terminal Capacity, MW** | 9750 | 12750 | 22500 | 15000 | 37500 |
| AC Substations | | | | | |
| 765 kV | 25000 | 149000 | 174000 | 79000 | 253000 |
| 400 kV | 151027 | 45000 | 196027 | 49000 | 245027 |
| **Total- AC Substation capacity, MVA** | **176027** | **194000** | **370027** | **128000** | **498027** |

**Total Fund requirement would be about Rs 2,60,000 Crore**
**(assuming about Rs. 100,000 crore for 220kV and below systems)**





# Generation Scenario – I

Table – 6.3 : Region-wise Installed Capacity and Demand at the end of 14th plan (Scenario-I)

All Figures in MW

| Region | Installed Capacity by the end of 14th Plan (2026-27) (Scenario - I) | | | | | | | Peak Demand |
|---|---|---|---|---|---|---|---|---|
| | Coal | Nuclear | Thermal | Hydro | Gas | Res. | Total | |
| NR | 63959 | 7220 | 71179 | 38945 | 14946 | 39719 | 164789 | 121979 |
| WR | 128847 | 8240 | 137087 | 7879 | 19217 | 43402 | 207585 | 120620 |
| SR | 72907 | 6220 | 79127 | 13436 | 29214 | 47663 | 169440 | 118764 |
| ER | 87486 | 0 | 87486 | 9064 | 1779 | 3294 | 101623 | 53053 |
| NER | 810 | 0 | 810 | 18006 | 3043 | 1840 | 23699 | 6169 |
| SAARC | 0 | 0 | 0 | 23986 | 0 | 0 | 23986 | 3200 |
| **Total** | **354009** | **21680** | **375689** | **111316** | **68199** | **135918** | **691122** | **403800** |

Table – 6.4 : Region-wise Installed Capacity and Demand by the end of 15th plan (Scenario-I)

| Region | Installed Capacity by the end of 15th Plan (2031-32) (Scenario - I) | | | | | | | Peak Demand |
|---|---|---|---|---|---|---|---|---|
| | Coal | Nuclear | Thermal | Hydro | Gas | Res. | Total | |
| NR | 71846 | 10020 | 81866 | 43317 | 41058 | 64932 | 231173 | 164236 |
| WR | 155437 | 15089 | 170526 | 8011 | 32791 | 71568 | 282896 | 163222 |
| SR | 86834 | 10471 | 97305 | 13436 | 40791 | 66025 | 217557 | 165336 |
| ER | 111820 | 0 | 111820 | 9811 | 1779 | 5406 | 128816 | 72874 |
| NER | 810 | 0 | 810 | 35370 | 2463 | 2890 | 41533 | 8450 |
| SAARC | 0 | 0 | 0 | 46534 | 0 | 0 | 46534 | 4300 |
| **Total** | **426747** | **35580** | **462327** | **156479** | **118882** | **210821** | **948509** | **546000** |



# Generation Scenario – II

Table – 6.3 : Region-wise Installed Capacity and Demand at the end of 14th plan (Scenario-II)

All Figures in MW

| Region | Installed Capacity by the end of 14th Plan (2026-27) (Scenario - II) | | | | | | | Peak Demand |
|---|---|---|---|---|---|---|---|---|
| | Coal | Nuclear | Thermal | Hydro | Gas | Res. | Total | |
| NR | 68076 | 7220 | 75295.5 | 38945 | 10830 | 39719 | 164789 | 121979 |
| WR | 132554 | 8240 | 140794 | 7879 | 15511 | 43402 | 207585 | 120620 |
| SR | 82678 | 6220 | 88898 | 13436 | 19444 | 47663 | 169441 | 118764 |
| ER | 88272 | 0 | 88272 | 9064 | 993 | 3294 | 101623 | 53053 |
| NER | 1430 | 0 | 1430 | 18006 | 2423 | 1840 | 23699 | 6169 |
| SAARC | 0 | 0 | 0 | 23986 | 0 | 0 | 23986 | 3200 |
| **Total** | **373009** | **21680** | **394689** | **111316** | **49200** | **135918** | **691123** | **403800** |

Table – 6.4 : Region-wise Installed Capacity and Demand by the end of 15th plan (Scenario-II)

| Region | Installed Capacity by the end of 15th Plan (2031-32) (Scenario - II) | | | | | | | Peak Demand |
|---|---|---|---|---|---|---|---|---|
| | Coal | Nuclear | Thermal | Hydro | Gas | Res. | Total | |
| NR | 88743 | 10020 | 98762.5 | 43317 | 23886 | 64932 | 230897 | 164236 |
| WR | 165931 | 15089 | 181020 | 8011 | 22298 | 71568 | 282896 | 163222 |
| SR | 102394 | 10471 | 112865 | 13436 | 25232 | 66025 | 217558 | 165336 |
| ER | 112606 | 0 | 112606 | 9811 | 993 | 5406 | 128816 | 72874 |
| NER | 1208 | 0 | 1208 | 35370 | 2108 | 2890 | 41576 | 8450 |
| SAARC | 0 | 0 | 0 | 46534 | 0 | 0 | 46534 | 4300 |
| **Total** | **470880** | **35580** | **506460** | **156479** | **74516** | **210821** | **948276** | **546000** |

# Generation Scenario – for 2033-34

All Figures in MW

| Region | Installed Capacity by the end of 2033-34 | | | | | | | Peak Demand (2033-34) MW |
|---|---|---|---|---|---|---|---|---|
| | Coal | Nuclear | Thermal (Coal+ Nuclear) | Hydro | Gas | Res. | Total | |
| NR | 82623 | 10020 | 92643 | 43317 | 45164 | 64932 | 246056 | 184987 |
| WR | 178753 | 15089 | 193842 | 8011 | 36070 | 71568 | 309491 | 184214 |
| SR | 99859 | 10471 | 110330 | 13436 | 44870 | 66025 | 234661 | 188730 |
| ER | 128593 | 0 | 128593 | 9811 | 1957 | 5406 | 145767 | 82740 |
| NER | 932 | 0 | 932 | 35370 | 2709 | 2890 | 41901 | 9583 |
| SAARC Exchange | 0 | 0 | 0 | 51534 | 0 | 0 | 51534 | 4500 |
| **Total** | **490759** | **35580** | **526339** | **161479** | **130771** | **210821** | **1029410** | **615700** |



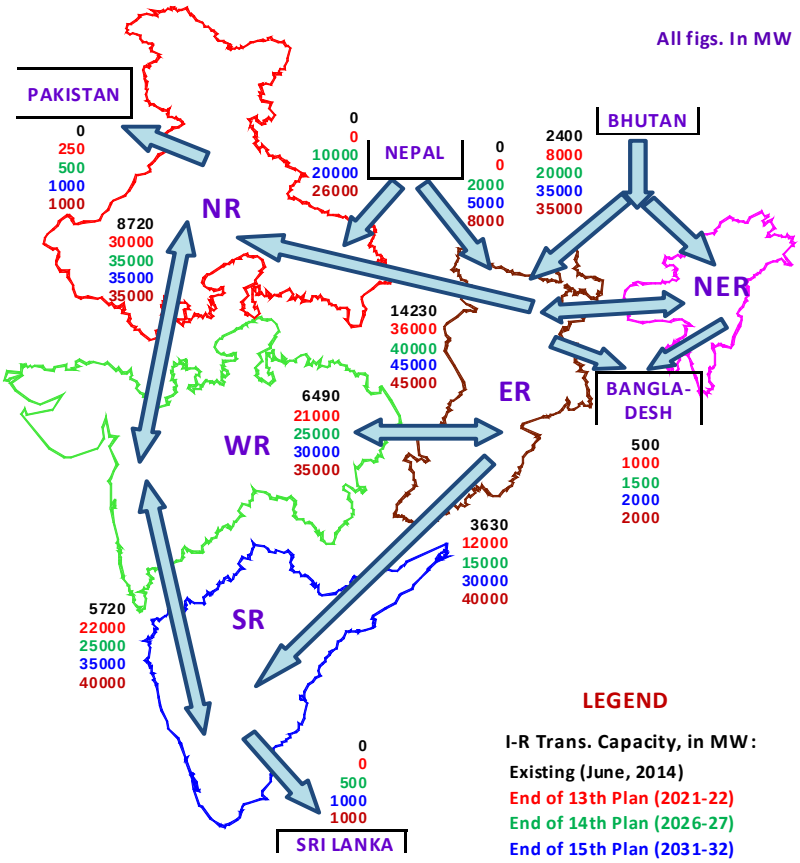
# Maximum Import/ Export of different Regions / SAARC Countries

| Region | 13th Plan (2021-22) | 14th Plan (2026-27) | 15th Plan (2031-32) | 2033-34 |
|---|---|---|---|---|
| NR (Import) | 22000 | 23000 | 34000 | 44000 |
| WR (Export) | 16000 | 28000 | 30000 | 33000 |
| SR (Import) | 19000 | 21000 | 42000 | 51000 |
| ER (Export) | 25000 | 30000 | 31000 | 35000 |
| NER (Export) | 6000 | 14000 | 27000 | 44000 |
| | | | | |
| Bhutan (Export) | 6600 | 14000 | 26500 | 26500 |
| Nepal (Export) | 0 | 10000 | 20000 | 25000 |
| Sri Lanka (Import) | 0 | 500 | 800 | 1000 |
| B'Desh (Import) | 1000 | 1500 | 2000 | 2000 |
| Pakistan (Import) | 200 | 500 | 800 | 1000 |

## Inter-Regional Transmission Capacity (upto 2033-34)

(including SAARC Exchanges)

All figs. In MW




**LEGEND**

I-R Trans. Capacity, in MW:

Existing (June, 2014)

End of 13th Plan (2021-22)

End of 14th Plan (2026-27)

End of 15th Plan (2031-32)

End of 2033-34



**Annex 2**

| Sl. No. | Name | Designation |
|---|---|---|
| | **CEA** | |
| 1. | Neerja Mathur | Chairperson |
| 2. | Major Singh | Member (PS) |
| 3. | K.K. Arya | CE (SP & PA) |
| 4. | Pardeep Jindal | Director (SP & PA) |
| 5. | Goutam Roy | Director (SP & PA) |
| 6. | A. K. Saha | Dy. Director (SP&PA) |
| 7. | Awdhesh Yadav | Dy. Director (SP&PA) |
| 8. | Chandra Prakash | Dy. Director (SP&PA) |
| 9. | Santosh Kumar | Dy. Director (SP & PA) |
| 10. | Shivani Sharma | Dy. Director (SP&PA) |
| 11. | Satyendra Dotan | Asst. Director (SP&PA) |
| 12. | Vikas Sahu | Engineer (SP & PA) |
| | **POSOCO** | |
| 13. | S. K. Soonee | COO (CTU) |
| 14. | S. R. Narasimhan | AGM (System Operation) |
| | **NRPC** | |
| 15. | P.S. Mhaske | MS |
| | **NRLDC** | |
| 16. | A. Mani | GM |
| 17. | D.K. Jain | AGM |
| | **ERPC** | |
| 18. | A K Bandopadhyaya | MS I/c |
| 19. | B. Sarkhel | IS(PS) |
| | **NERPC** | |
| 20. | B. Lyngkhoi | SE(O) |
| | **WRPC** | |
| 21. | S. D.Taksande | MS |
| 22. | P.D. Lone | Ex. Engineer |
| | **SRPC** | |
| 23. | S. R. Bhat | MS I/c |
| | **NTPC** | |
| 24. | S.S. Mishra | AGM |
| | **GETCO** | |
| 25. | B.B. Chauhan | CE(Project) |

| | | |
|---|---|---|
| 26. | Dipak H. Patel | DE(STU) |
| | **AEGCL** | |
| 27. | J. K. Das | GM |
| 28. | Karuna Sharma | AGM |
| | **MPPTCL** | |
| 29. | Umesh Rautji | M.D. |
| 30. | R. Sethi | C. E. |
| | **OPTCL** | |
| 31. | R. R. Panda | CGM (E) |
| | **DTL** | |
| 32. | K. M. Lal | DGM(T), Planning |
| 33. | A. C. Agrawal | GM(T), Planning |
| | **BSPTCL** | |
| 34. | B. Sharma | Director (Proj.) |
| | **NEEPCO** | |
| 35. | Elizabeth Pyrbot | DM (E) |
| 36. | D.P. Singh | Mngr. (E) |
| | **POWERGRID** | |
| 37. | Ashok Pal | AGM |
| | **MSETCL** | |
| 38. | O.K. Yempal | Director (OP) |
| 39. | S.G. Kelkar | ED(Ops) |
| 40. | S.S. Kulkarni | CE(STU) |
| | **TANTRANSCO** | |
| 41. | Rangaraj. K. | Director (Transmission Project) |
| | **TSTRANSCO** | |
| 42. | M. Sheshagiri | ADE(SS) |
| 43. | K. Ashok | DE/SS & LTSS |
| | **TANGEDCO** | |
| 44. | S. Ravichandran | SE/SS |
| | **BBMB** | |
| 45. | A. K. Ghai | Dy. C. E. (Power Regulation) |
| 46. | Anil Gautam | Addl. S.E. |
| | **KSEB** | |
| 47. | K. Vikraman Nair | Director |
| 48. | S. R. Anand | EE, LD |
| | **CSPTCL** | |

| | | |
|---|---|---|
| 49. | H. K. Pandey | SE(PL) |
| 50. | S. Patel | ED (C & P) |
| | **APTRANSCO** | |
| 51. | Ch. V. S.Subbarao | SE/PS |
| 52. | B. S. Rao | D. E. |
| 53. | Y.V. Ramakrishna | A.D.E. |
| | **KPTCL** | |
| 54. | A. J. Hosamani | CEE |
| | **THDCL** | |
| 55. | R. K. Semwal | DGM |
| | **UPPTCL** | |
| 56. | Suman Guchh | SE(Trans. Planning) |