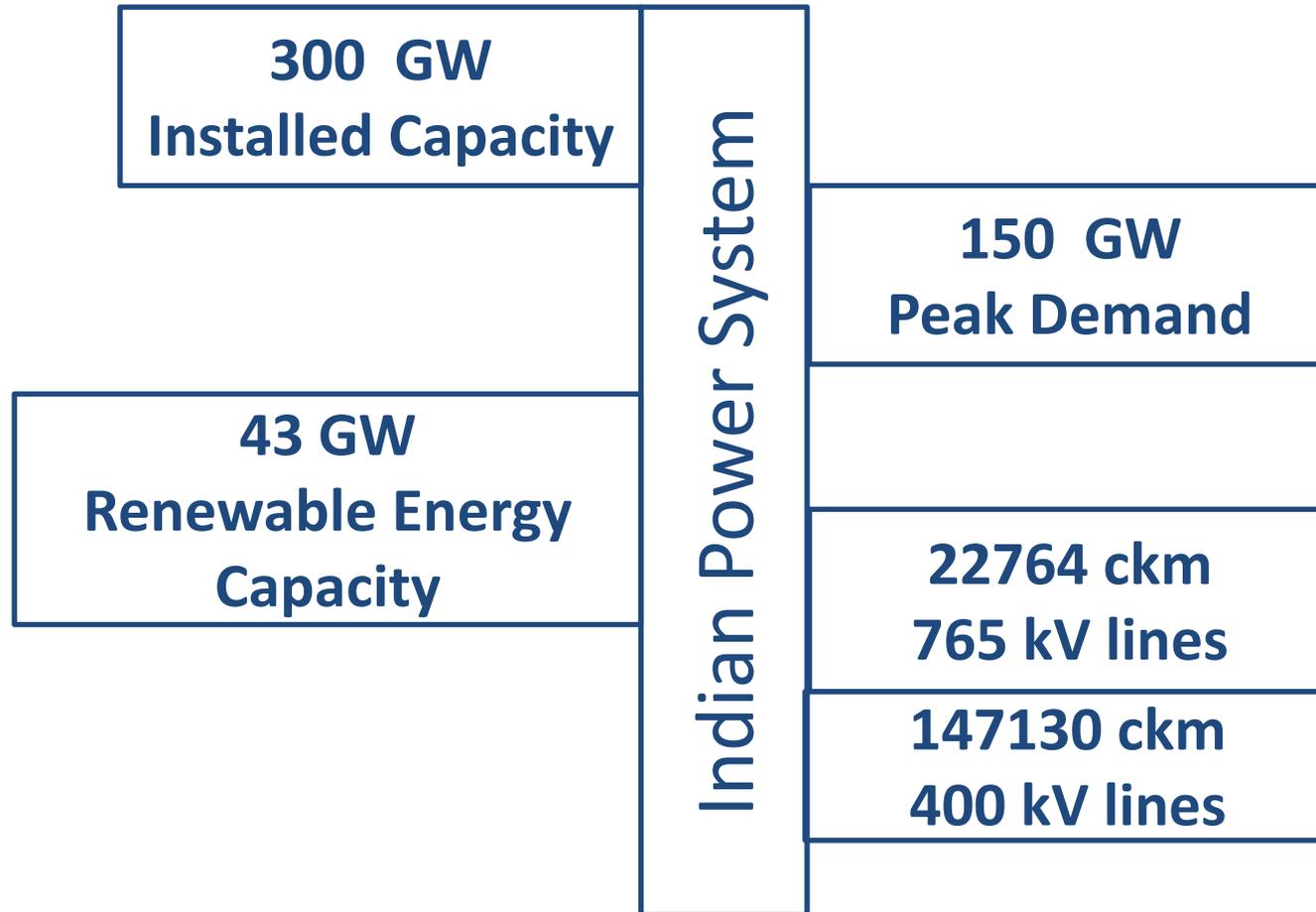


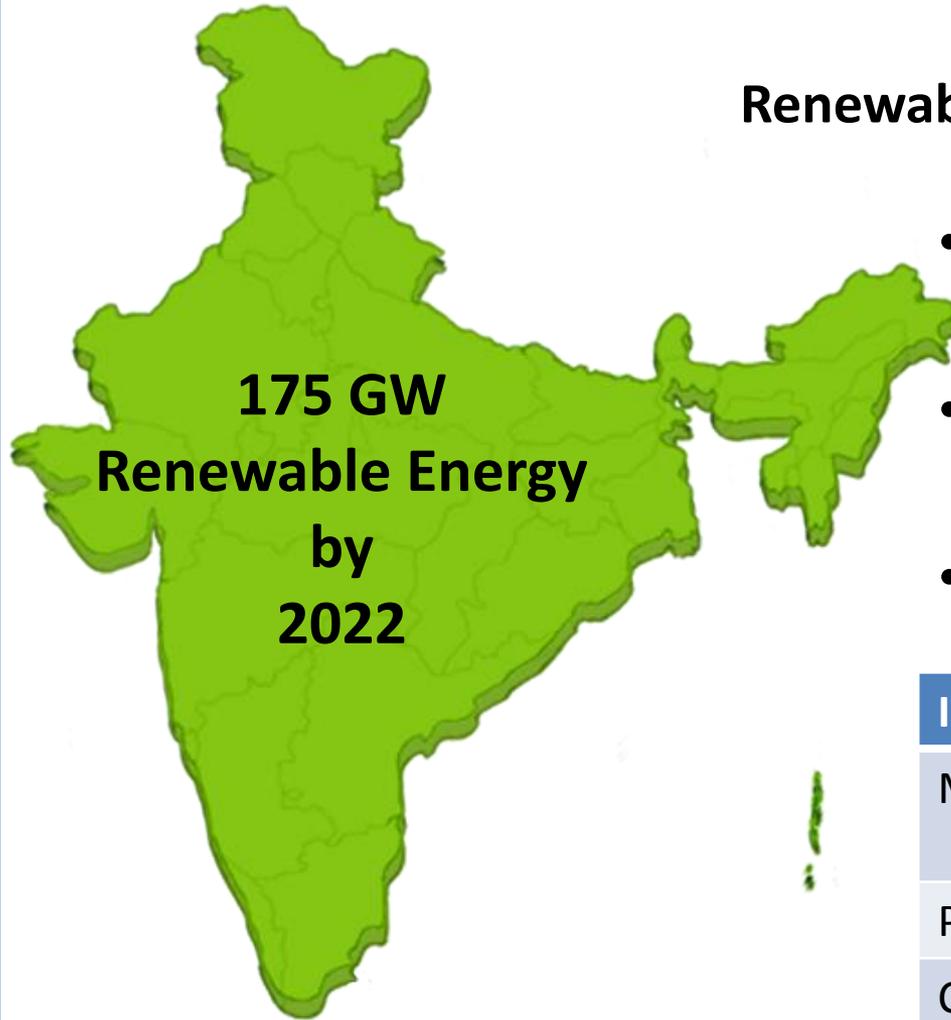
Evaluating Indian power system with high RE; evaluation of scenarios, approach and modelling requirements



Overview of Indian Power System



Greening The Grid



Renewable Energy Grid Integration Studies

- Evaluation of Power System under High RE scenario
- Collaboration of India and USA
- Agencies Involved

India	USA
Ministry of Power	Department of Energy
POSOCO	USAID and USEA
CTU and CEA	NREL and LBNL

Possible Answers from the Study

Ramping requirements

RE penetration that can be handled successfully.

Potential stress areas

Transmission line flows on important corridors

Optimal hydro operation by regions, including pumped mode plants.

Cost/generation regionwise

Scenarios to be Studied



50 GW Wind and 20 GW Solar



60 GW Wind and 100 GW Solar



100 GW Wind and 60 GW Solar



100 GW Wind and 150 GW Solar

Modelling Requirements

Power System Network

- Load and Generation
- Transmission Network

Constraints

- Ramp Rate
- Min Gen
- Water Inflows
- Interface Limits
- Outage Rate

Forecast

- Load Forecast
- Generation Capacity Expansion
- Renewable Generation

Commercial

- Variable Cost
- Heat Rate
- Hurdle Rate

Methodology

Build a operations model of present power system and validate the same with actual operations

For future year, forecast load and necessary capacity to meet load

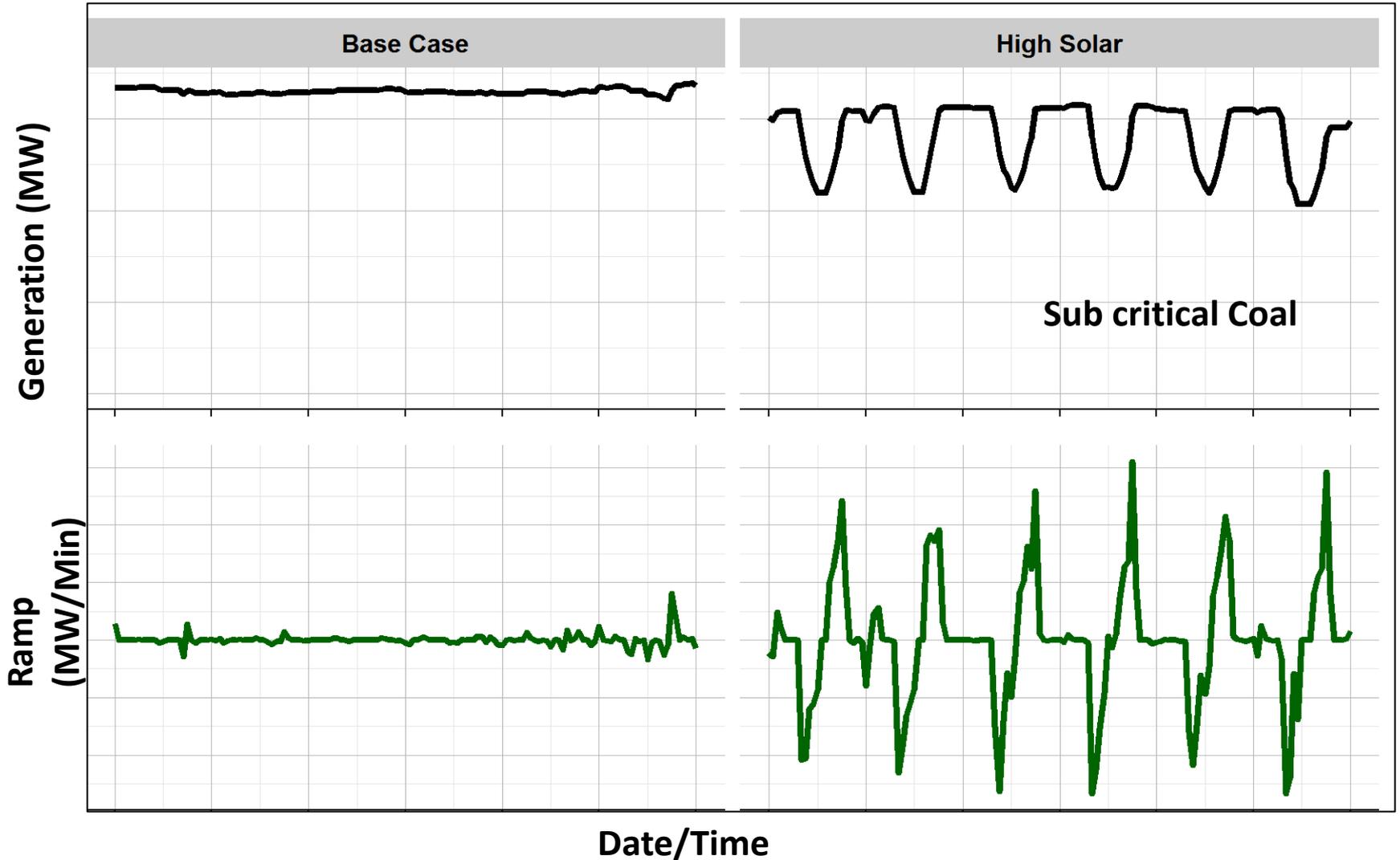
Simulate Power Systems operation in the future year

One National Study and Two Regional Studies.

Sensitivity Analysis

- Various assumptions involved in study
- Sensitivity Analysis to assess impact of deviation from assumptions :
 - Load Curve
 - Flexibility Reserve
 - Five minute economic dispatch
 - More Flexible Generation etc.

Some Sample Results



Some Sample Results

