Initiatives taken for Facilitating Large Scale Integration of Renewable Energy in India

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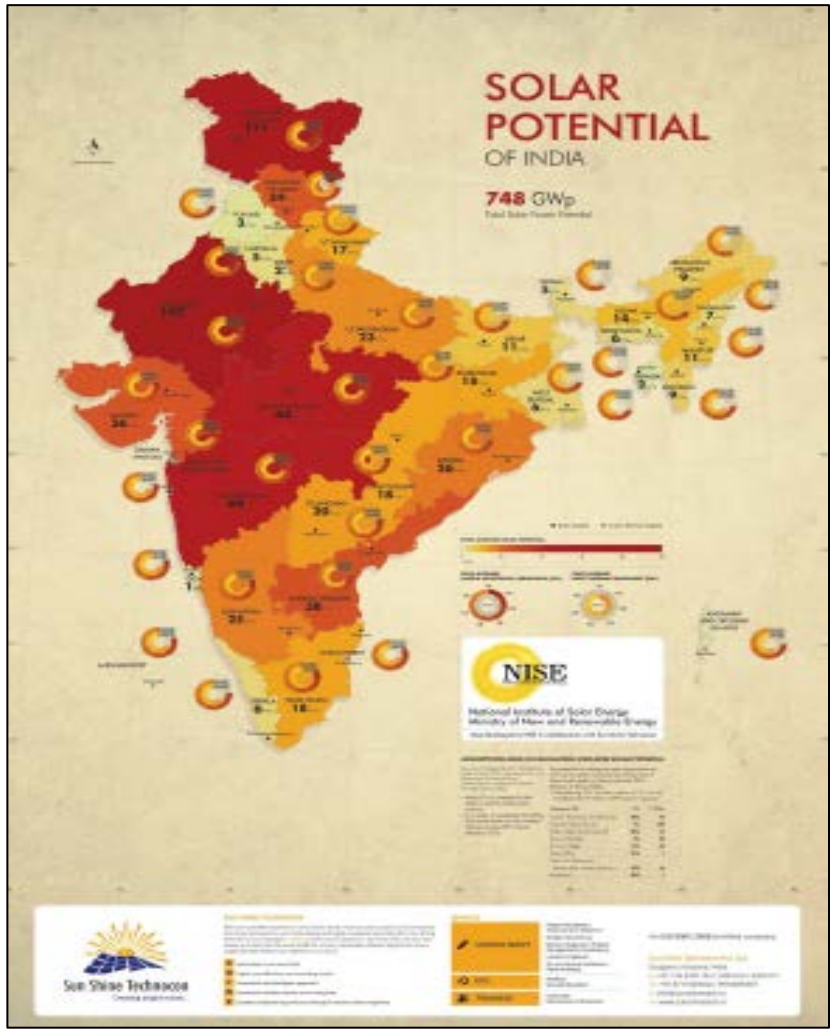
Introduction

- Huge RE Potential
  - 175 GW RE by 2022
  - 40% cumulative capacity from non-fossil fuel based energy resources by 2030
- High Growth rate of RE
- Large Scale RE Integration
  - Conducive Policy
  - Meticulous Planning
  - Level playing regulations
  - Reliable System Operation



Policy Measures

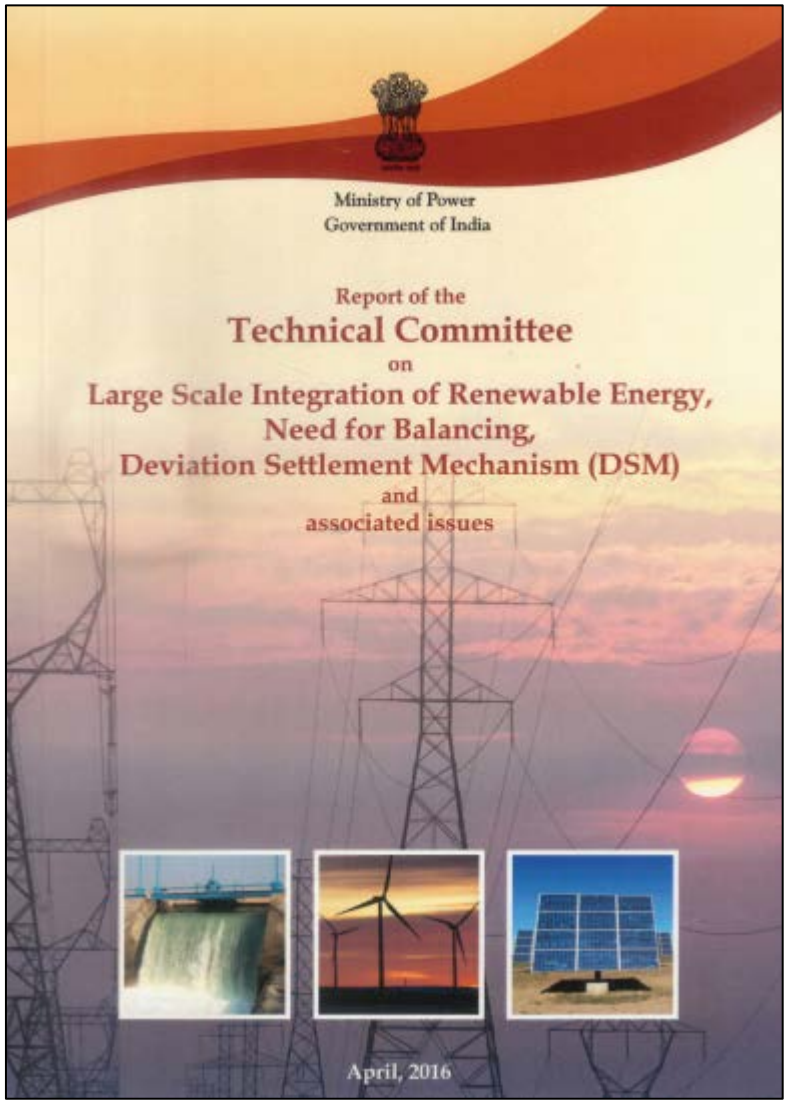
- Electricity Act 2003
  - Preambles defines the “promotion of efficient and environmentally benign policies” as an objective
- National Electricity Policy, 2006
  - Recognizes the need for promotion of generation from non-conventional sources of energy
- Tariff Policy, 2016
  - Provisions for 8% solar RPO by the year 2022, Renewable Generation Obligation
  - Guidelines for long term growth of RPOs for non-solar as well as solar energy.

Policy Measures

- National Solar Mission
  - 50 Solar Parks and Ultra Mega Solar Power Projects targeting over 40 GW of installed capacity within a span of 5 years starting from 2014-15
- India's Renewable Electricity Roadmap 2030
  - Legal, institutional and policy changes that will be needed to successfully adopt renewables on large scale
  - Recommends National RE Law or Policy
- National Electric Mobility Mission Plan (NEMMP)
  - Promotion of hybrid and electric vehciles
- Guidelines on Cross Border Trade of Electricity, 2016
  - Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perceptions of regulatory risks.
  - Larger footprint to facilitate large scale RE Integration

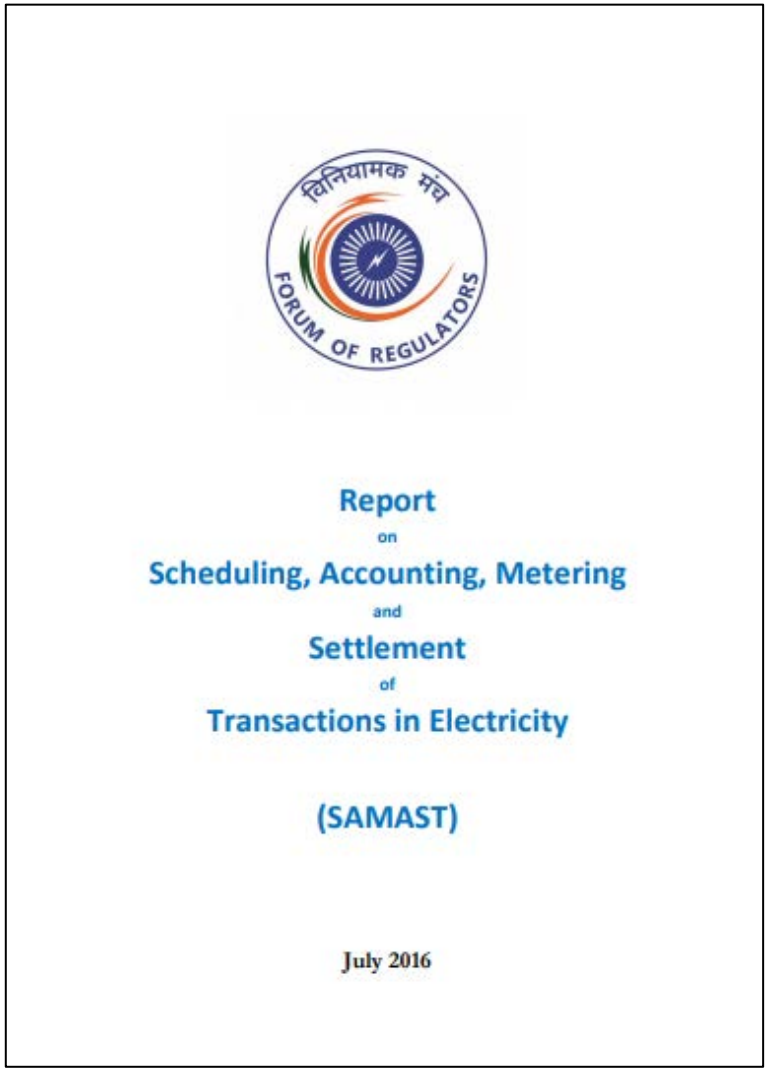
Policy Measures

- Expert Committee at GOI level on Large Scale Integration of RE
  - Committee constituted by Central Government in April, 2015
  - Key recommendations such as
    - Bringing flexibility in the conventional generation,
    - Tighter frequency control,
    - Maintaining generation reserves,
    - Introduction of ancillary services,
    - Forecasting, Scheduling, Imbalance handling mechanism and
    - Robust data telemetry and communication systems



Regulatory Interventions

- Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST)
- Model Regulations by FOR
  - Model Regulations on Forecasting, Scheduling and Deviation Settlement of Wind and Solar Generating Stations , Nov 2015
  - Model regulations for Deviation Settlement Mechanism at intra state level , March 2017
- Draft Connectivity Standards for Renewables
  - Provisions related to frequency response, HVRT, LVRT, ramping requirements, voltage regulations requirements, compliance monitoring etc



Regulatory Interventions

- Amendments to Indian Electricity Grid Code (IEGC) to incentivise Flexbility
  - 4th Amendment to IEGC
    - 55% Techncial Minimum
    - Additional compensation for degradation of Station Heat Rate (SHR) and frequent start/stop
  - 3rd Amendment to IEGC
    - Forecasting and Scheduling Framework for RE
    - Decentralised Forecasting
    - 40 MW Solar being scheduled by RLDCs
    - 16 revisions for RE in a day

Regulatory Interventions

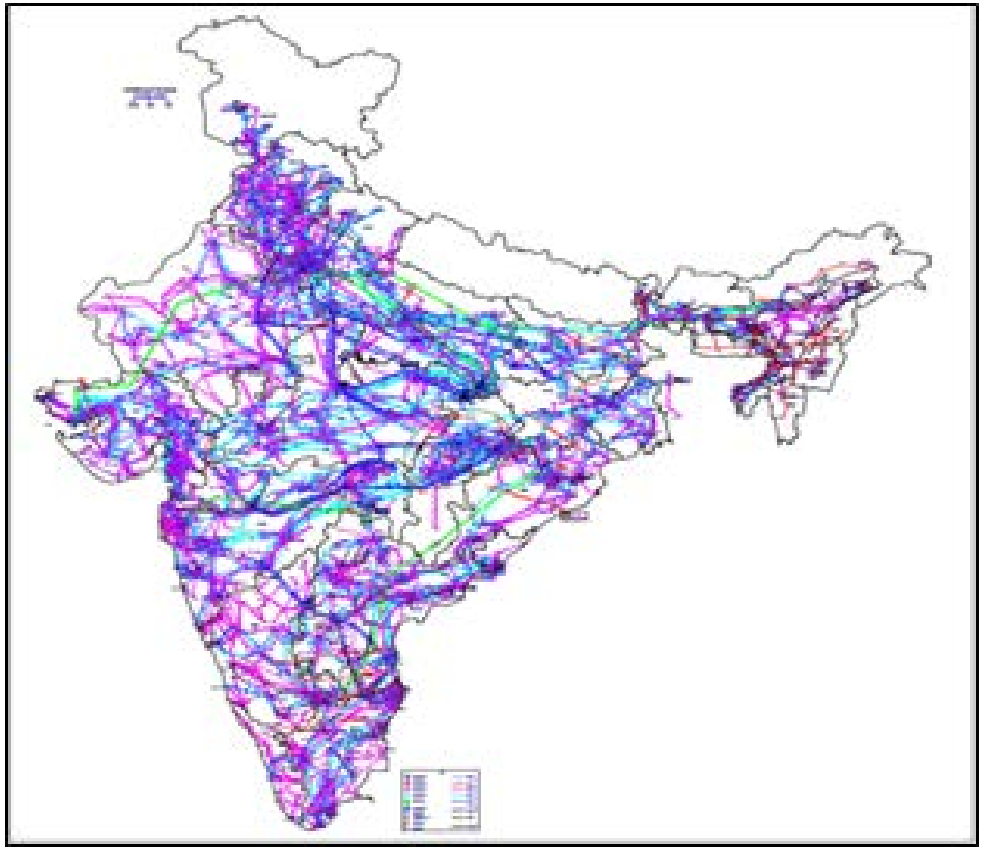
- Imbalance Handling
  - Definition of RE Rich state with more deviation limit
  - RE deviation charges delinked from frequency
    - Computed at a fixed rate for the shortfall energy for absolute error up to 15%.
- Ancillary Services
  - Implemented w.e.f April 2016
  - Tertiary Reserves (RRAS UP/DOWN)
  - Markup price of 50 pasie/unit for RRAS UP
  - 25% savigs of variable charges retained by generators for RRAS DOWN

Regulatory Interventions

- Reserves and Automatic Generation Control (AGC)
  - Reserves roadmap by CERC in Oct 2015
  - Primary Reserves : Size of Largest Genertaing Station in the country
  - Secondary Reserves : Largest Generating Unit size in a region
  - Tertiary Reserves : 50% of the largest generating unit available in the state control area
- Changes in Market Design
  - Sub hourly bidding in Power Exchanges since April 2012
  - 24 X 7 Electricity Market since July 2015
- Other Interventions
  - Draft regulations for Transmission Planning and staff paper for Electricity Storage
  - CERC regulations for communication system for inter-State transmission of electricity

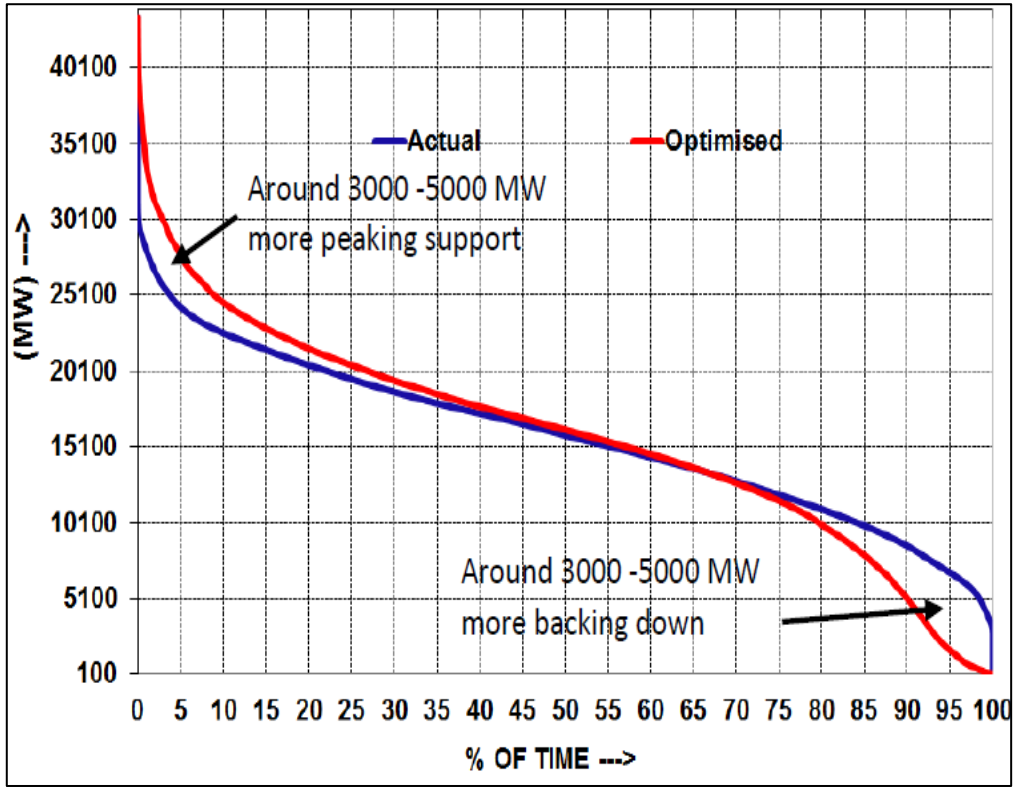
Transmission Planning

- Larger Footprint
  - Synchronous operation of all regions and trans-national interconnections
- Green Energy Corridors
  - Coordianted planning for RE
  - Planning of HVDCs
- National Electricity Plan
  - Draft in 2016
  - RE contribution around 20% in 2021-22 and 24% in 2026-27



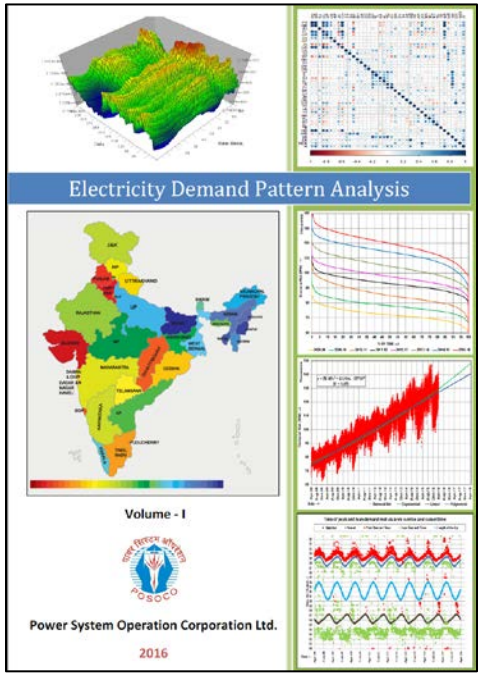
Power System Operation

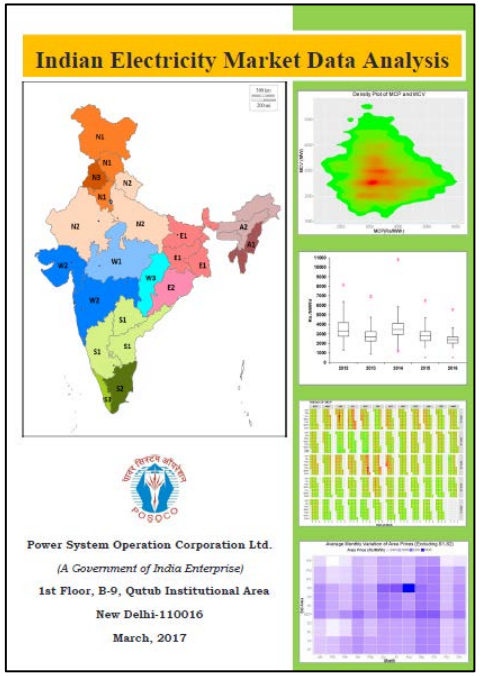
- Upgradation of Control Centres and Dedicated Control Centre for Renewables
  - Renewable Energy Management Centres
  - Upgradation of RLDCs/SLDC in 2016 and NLDC by 2019
- Large Scale deployment of Phasor Measurement Units (PMU)
  - More than 1600 PMUs under Unified Real Time Dynamic State Measurement (URTDS) scheme
- Optimization of Hydro Resources
  - Flexibility of hydro to be harnessed
  - FOLD report on optimization of hydro resources

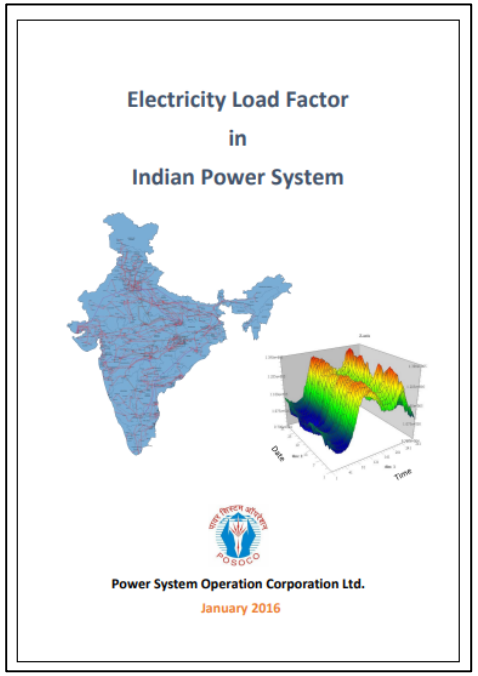


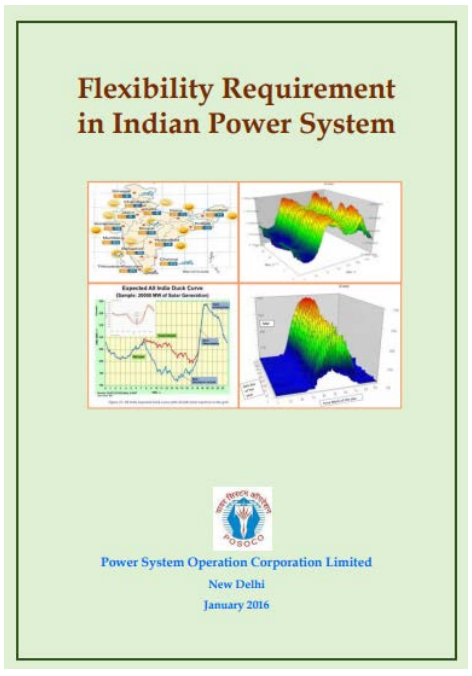
Power System Operation

- Big Data Analytics
  - Reports by POSOCO extracting wisdom out of the data archived in last eight years









RE Integration Studies

- RE Integration Studies
  - Assessement of high RE impact on power system
  - Joint project of MOP,GoI and USAID
  - Final report released in June 2017
  - Important recommondations in areas such as
    - Transmission Planning
    - RE Flexibility
    - Incentive for flexible generation
    - Balancing Area etc.