

**First International Conference on large scale grid
integration of Renewable Energy in India**

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Scientist C**

Ministry of New and Renewable Energy

Derivative Power Market in India

Background :

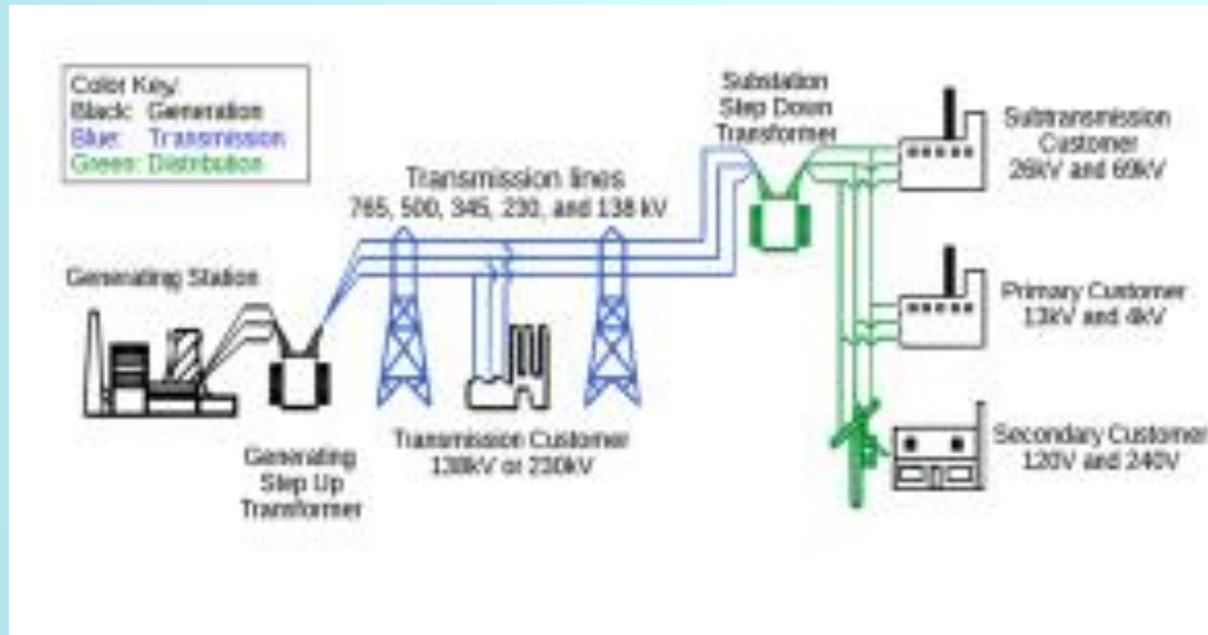
Grid : Electric Transmission Line

Two types of Current A/C and D/C

The main electric current is A/C and it has a frequency.

Production and Consumption are always in sync.

Schematic Diagram of Power Generation



**HYDRO
RESOURCES**

DELHI

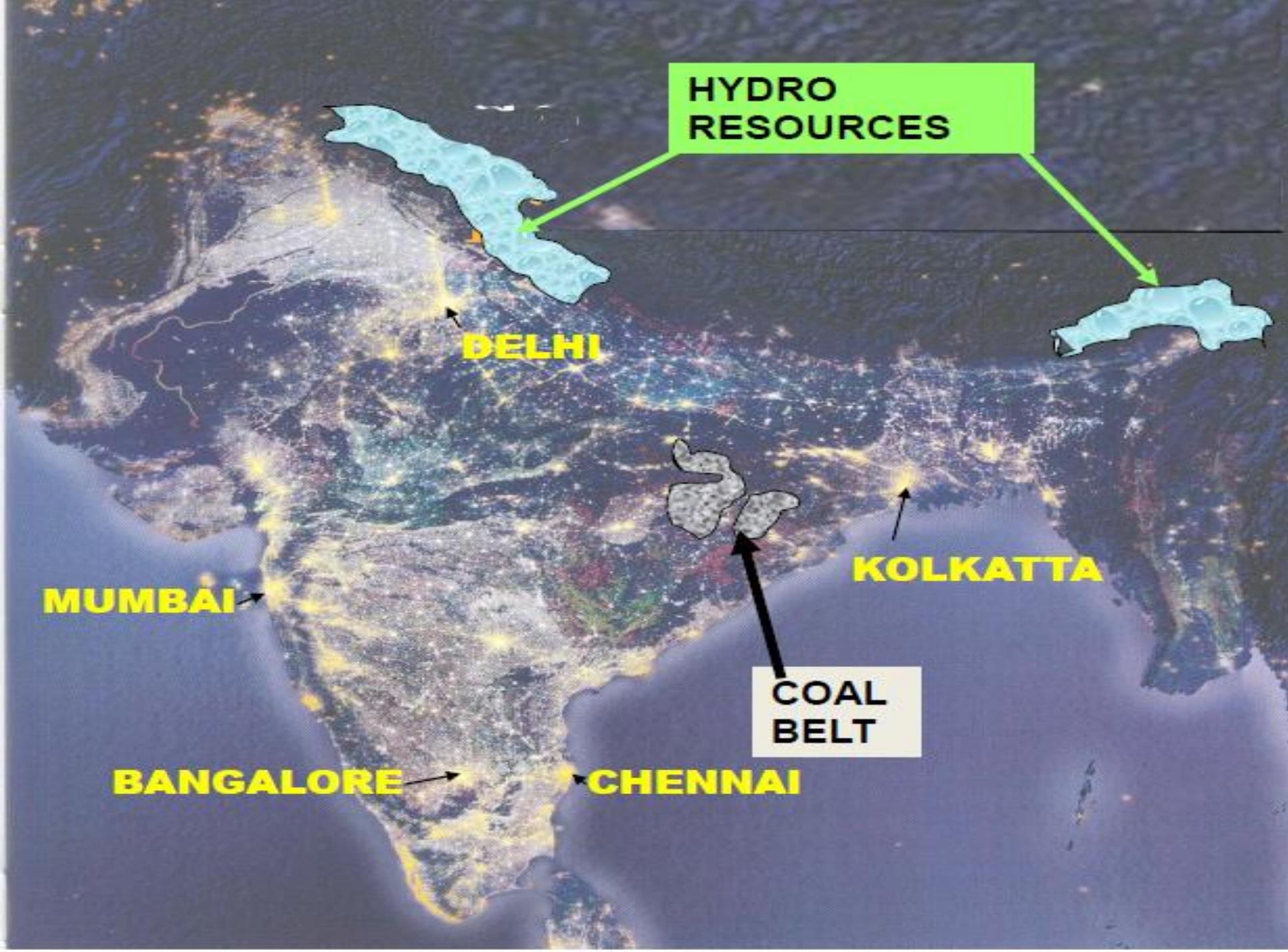
KOLKATTA

MUMBAI

**COAL
BELT**

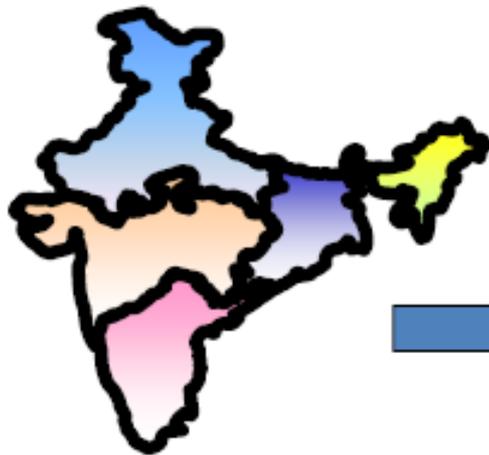
BANGALORE

CHENNAI



Evolution of the Grid

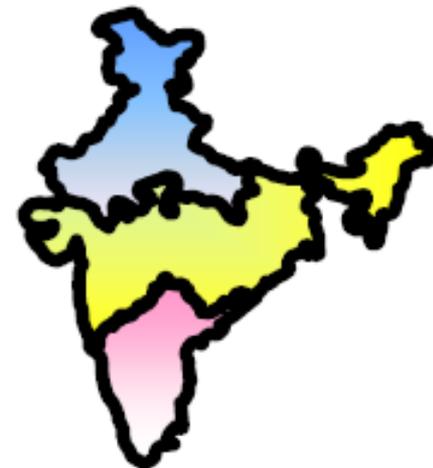
Five Regional Grids
Five Frequencies
Pre - October 1991



October 1991
East and Northeast
synchronized



March 2003
West synchronized
With East & Northeast



August 2006
North synchronized
With Central Grid



December, 2013
All India Synchronized Grid

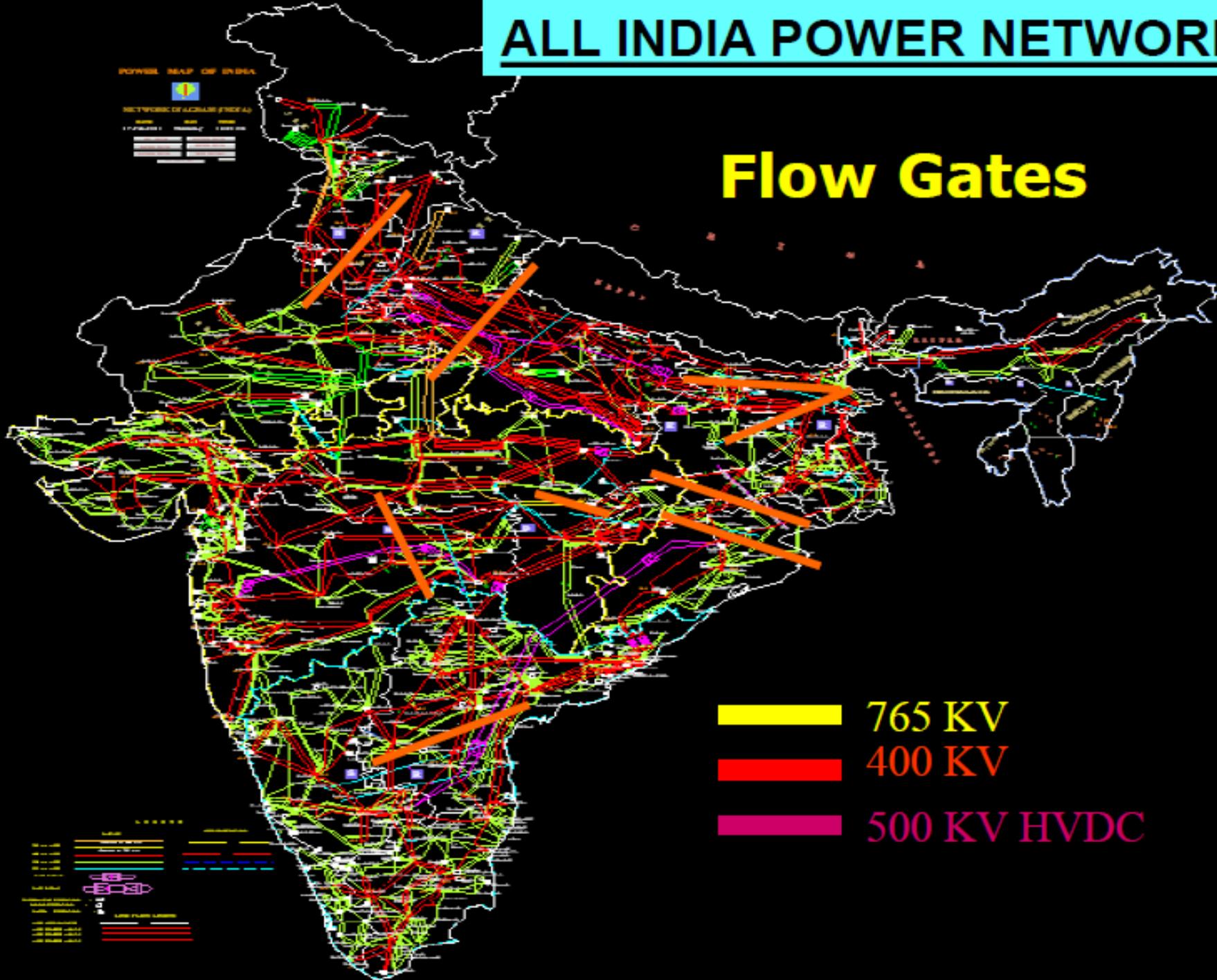


Five Regional Grids
Two Frequencies
Post August 2006

One Frequency
Post 2013

ALL INDIA POWER NETWORK

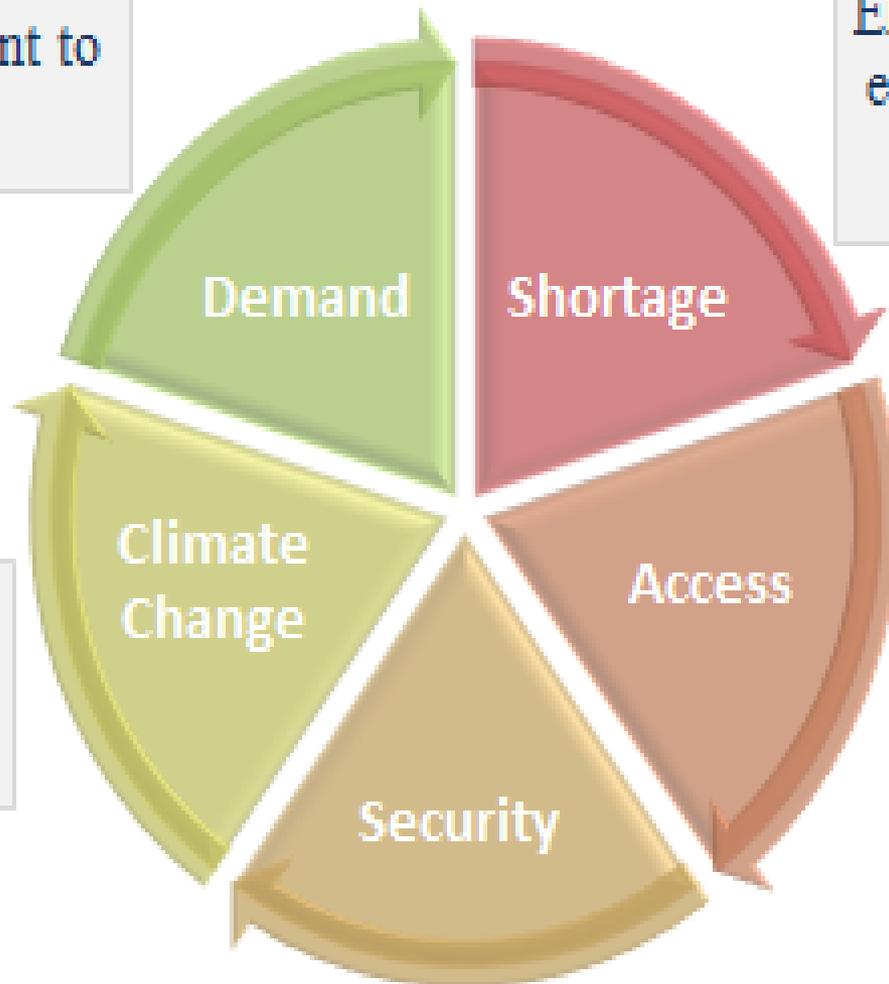
Flow Gates



India's Energy Challenge

In next 12 years India's electricity requirement to grow 2.5 times

Electricity shortage estimated at 25-35 GW



Climate Change is also an important issue

400 Million people still without access to electricity

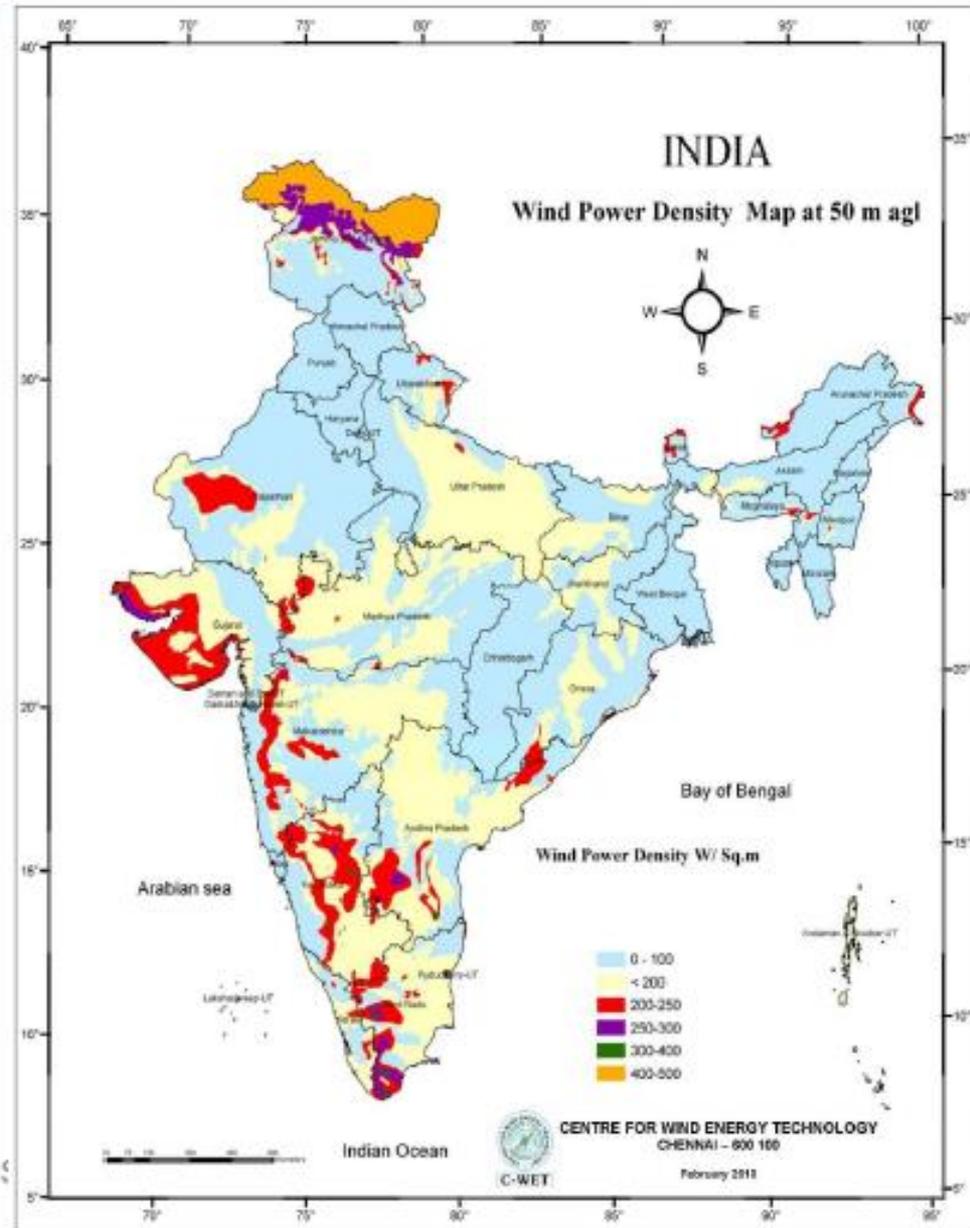
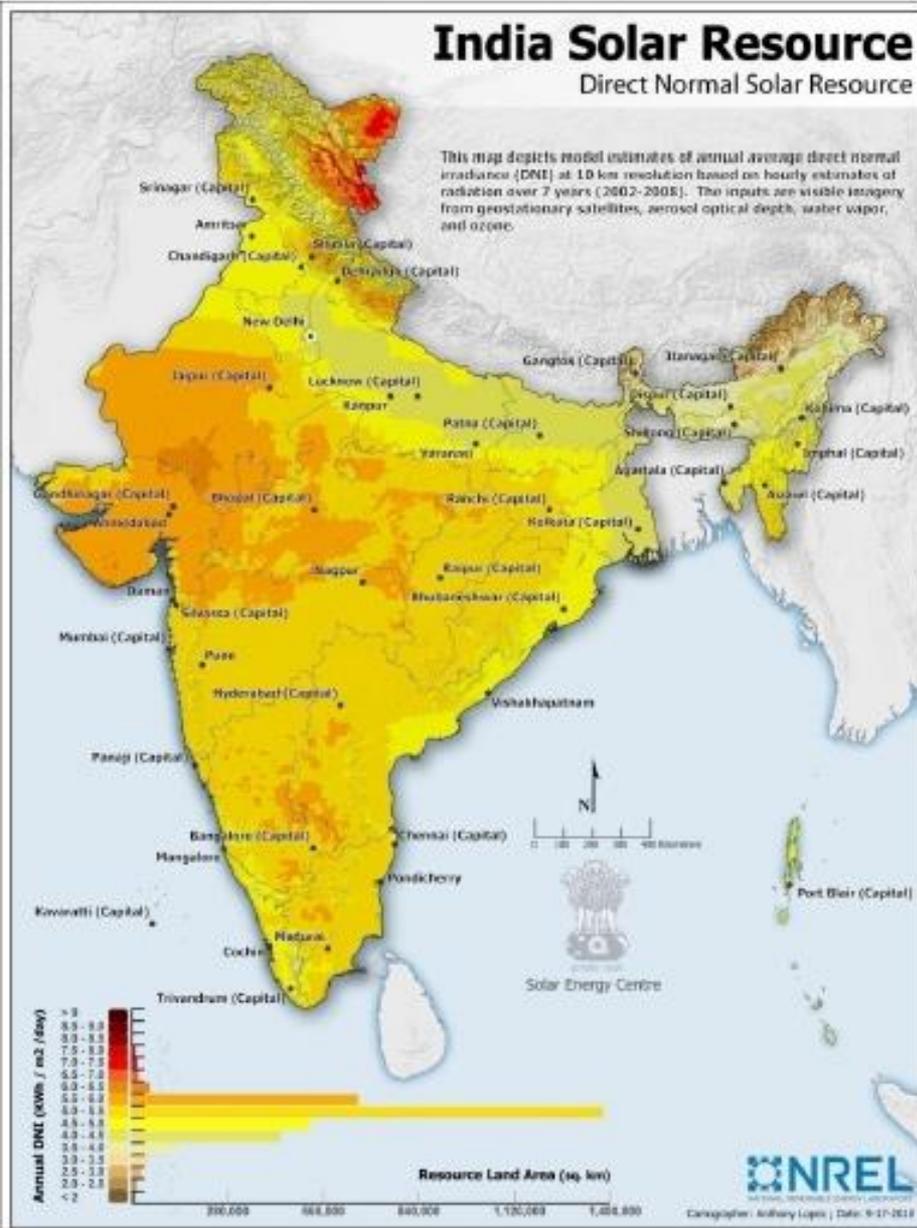
India is dependent on oil imports for 80% of its demand

Renewable Energy In India – Solar &

India Solar Resource

Direct Normal Solar Resource

This map depicts model estimates of annual average direct normal irradiance (DNI) at 10 km resolution based on hourly estimates of radiation over 7 years (2002-2008). The inputs are visible imagery from geostationary satellites, aerosol optical depth, water vapor, and ozone.



Introduction

Indian Government sets target of 175 GW of Renewable Energy by 2022.

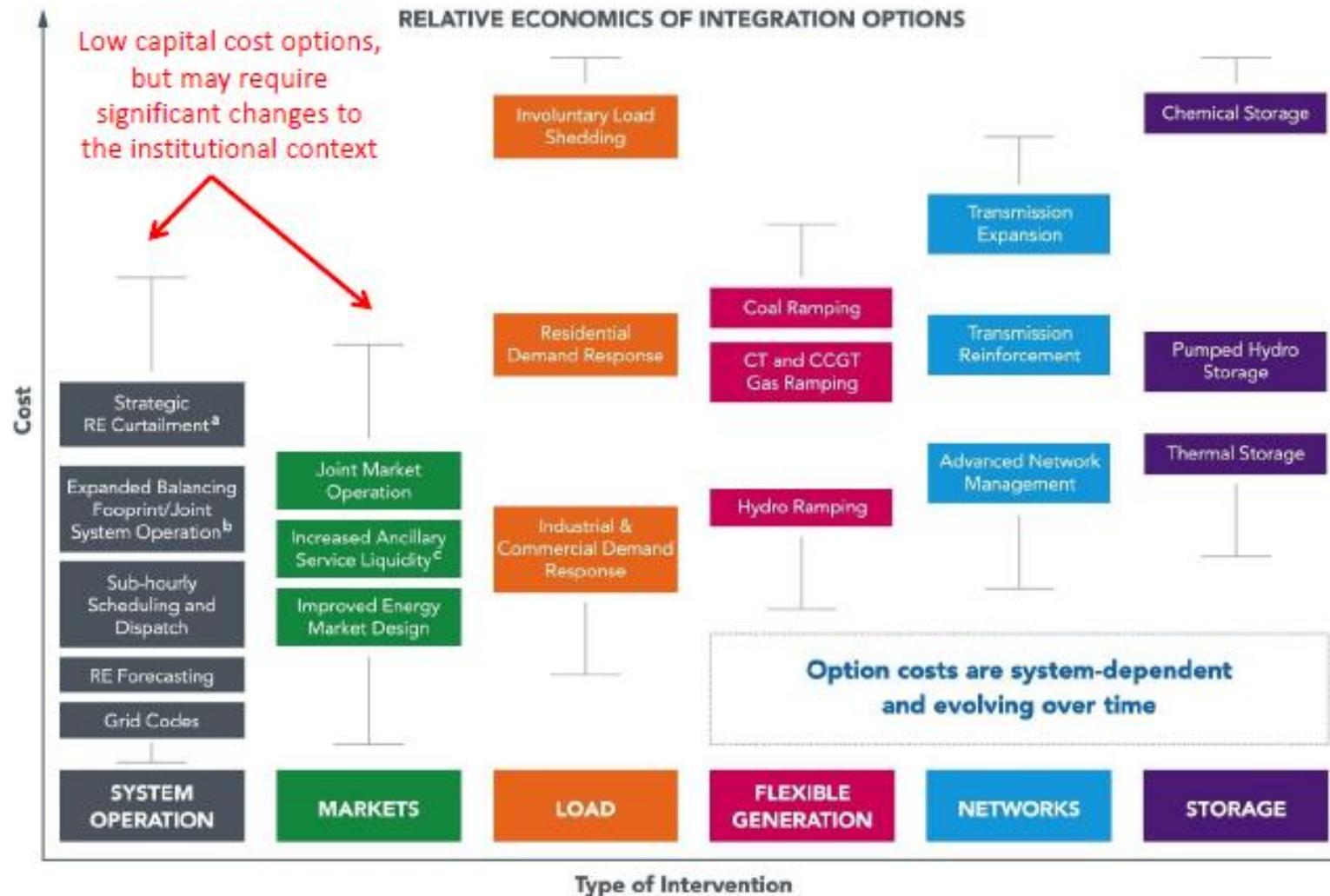
Renewable Energy mainly Solar and Wind runs on variable sources Sun and Wind respectively.

This variability throws many challenges for stability of Grid.

Challenges of grid Integration

- ▶ Forecasting
- ▶ Scheduling
- ▶ Problems in Deviation Settlement
- ▶ Requirement of Reserves/flexible generation

Frequently Used Options to Increase Flexibility



Target up to 2021-22 from Renewable Energy Sources in MW

REGION	SOLAR	WIND	SHP	BIO-MASS
NORTHERN	31120	8600	2450	4149
SOUTHERN	26531	28200	1675	2612
EASTERN	12237		135	244
WESTERN	28410	22600	125	2875
NORTH-EASTERN	1205		615	

Introduction of Power Market in India

- ▶ Indian Power exchanges have three main platforms namely
 - a) Spot Market
 - b) Term Ahead Market
 - c) Renewable Energy Certificate (REC) Mechanism.
- ▶ Due to technical constraints and financial constraints, for Renewable, there is only REC market.

Challenges for Renewable Energy to Participate in Power Market

1. Difficulty in forecasting
2. Higher Tariffs
3. Transmission Cost
4. Power Dispatch is variable
5. Higher Risk

Introduction to Derivative Market in India

Derivative is defined as an instrument which derives its value from underlying assets. In the case of electricity derivative, underlying asset is price of electricity.

Futures Market

- ▶ Future contracts include an obligation to buy or sell a specified quantity of an asset at a certain future time for a certain price.

Forward Market

- ▶ Forward contracts are almost similar to future contracts. They include an obligation to buy or sell a specified quantity of an asset at a certain future time for a certain price. Forward contracts are traded bilaterally or over the counter between two financial institutions or between a financial institution and one of its corporate clients and the contracted parties usually customize the contract in order to make it fit their needs.

Contract for Difference

- ▶ CfDs, which are mechanisms to stabilize the power costs to consumers and revenues to generators, is one form of forward contract. These contracts are suggested due to the fact that the spot price set by pooling company fluctuates over a wide range and difficult to forecast over a long period.

Contract for Difference Contd.

When spot price is above the strike price, the seller pays buyer an amount equal to difference between the spot price and strike price and when the spot price is below the strike price, buyer pays the seller an amount equal to the difference between strike price and spot price. Thus both parties have hedged their exposure to spot price.

Option Contracts

An option contract includes a right (not obligation) to buy or sell a specified quantity of an asset at a certain future time for a certain price.

REGULATORY INTERVENTIONS REQUIRED TO GET DERIVATIVES IMPLEMENTED IN INDIA

- ▶ In India, Electricity is a scheduled commodity as such provisions of Forward Contracts Regulation Act, 1952. Options in Commodities are not permitted by this act. Therefore, first of all, it needs to get it clarified that whether Electricity Market will be regulated by Forward Contracts Regulation Act, 1952 or not. Derivative market used for hedging should be allowed keeping in mind the interests of end consumer.

Conclusion

In future reforms of Indian Power Market, electricity derivatives play an important role in establishing price signals, providing price discovery, facilitating effective risk management, inducing capacity investments in generation and transmission, and enabling capital formation.

Thank You