

Grid Integration of Renewable in India - Challenges and Policy Responses

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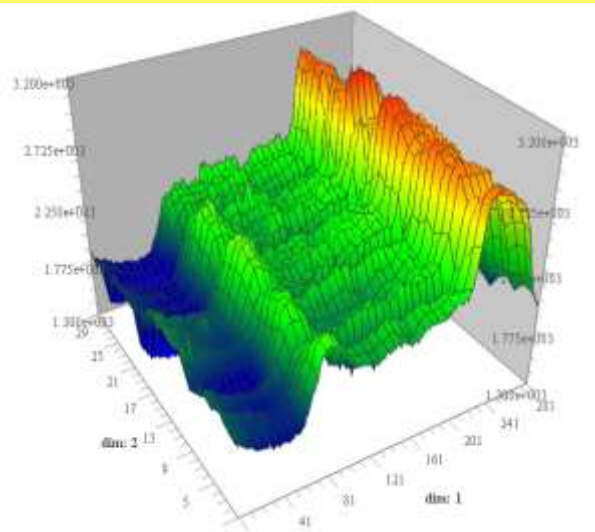
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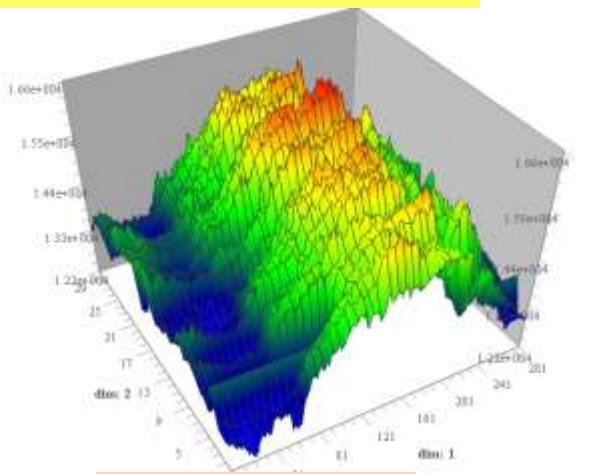
Peculiarities of Indian Power System

- In India, electricity is a concurrent subject- dealt at Central as well as at States' level.
- The State sector covers electricity generation, transmission and distribution, including by private sector.
- Power sector in each state is independent and is regulated by the respective State Electricity Regulatory Commission.
- UMPPs cater to a number of states.
- At Central level, the sector is regulated by CERC.
- The interstate and inter- regional transmission system is with PGCIL- Central Sector.
- Most of the renewable power generation is either by private developers, or, by state sector.

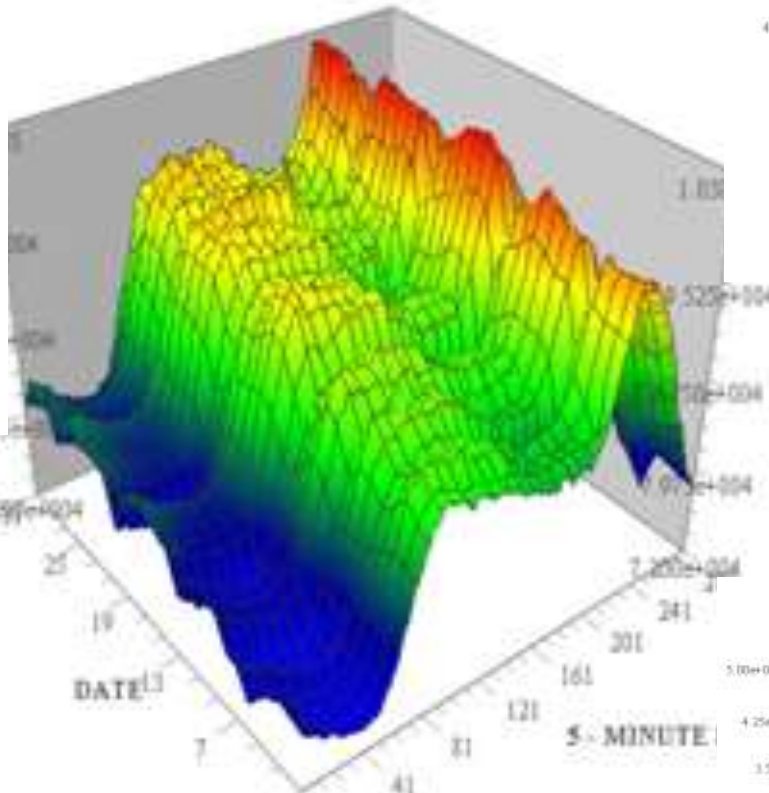
Variation in Demand



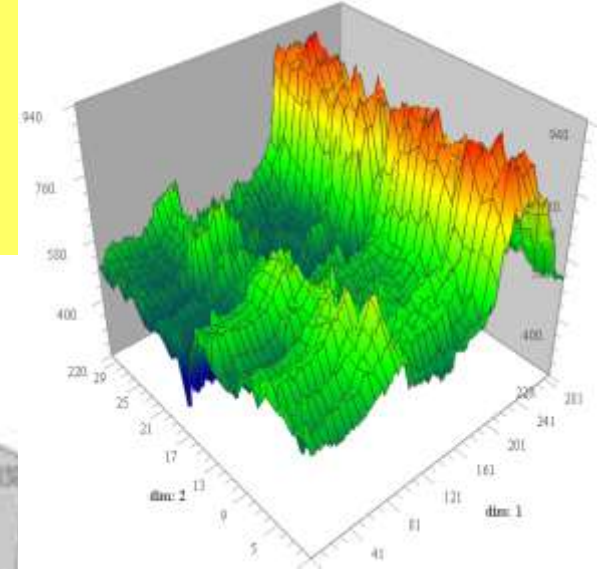
Kerala



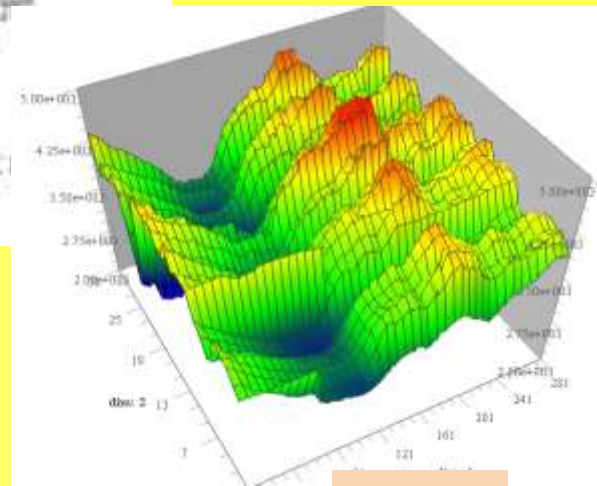
Maharashtra



All India



Assam



Delhi

REGIONAL GRIDS

Area : 1010,000 SQ KMS
Population : 369 Million
Peak Demand : 41 GW
Max energy
Consumption: 957 MU

NORTHERN REGION

Area : 255,090 SQ KMS
Population : 44 Million
Peak Demand : 1.9 GW
Max energy
consumption : 36 MU

NORTH- EASTERN REGION

Area : 951470 SQ KMS
Population : 273 Million
Peak Demand : 40 GW
Max energy
consumption : 902 MU

SOUTHERN REGION

Area : 433680 SQ KMS
Population : 271 Million
Peak Demand : 15 GW
Max energy
consumption: 335 MU

Area : 636280 SQ KMS
Population : 252 Million
Peak Demand : 31 GW
Max energy
consumption : 732 MU

ALL INDIA INSTALLED CAPACITY

NORTH	:-	60.7 GW
EAST	:-	28.5 GW
SOUTH	:-	56.0 GW
WEST	:-	76.8 GW
NORTH-EAST	:-	2.8 GW
TOTAL	:-	225 GW

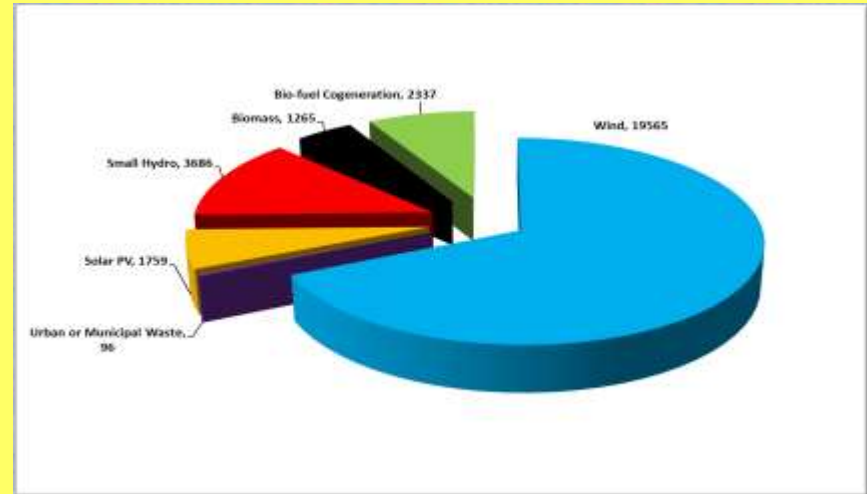
Total 3,287,263 sq. km area
More than 1.2 Billion people

As on 31st May, 2013

Potential of Renewable Energy in India (MW)

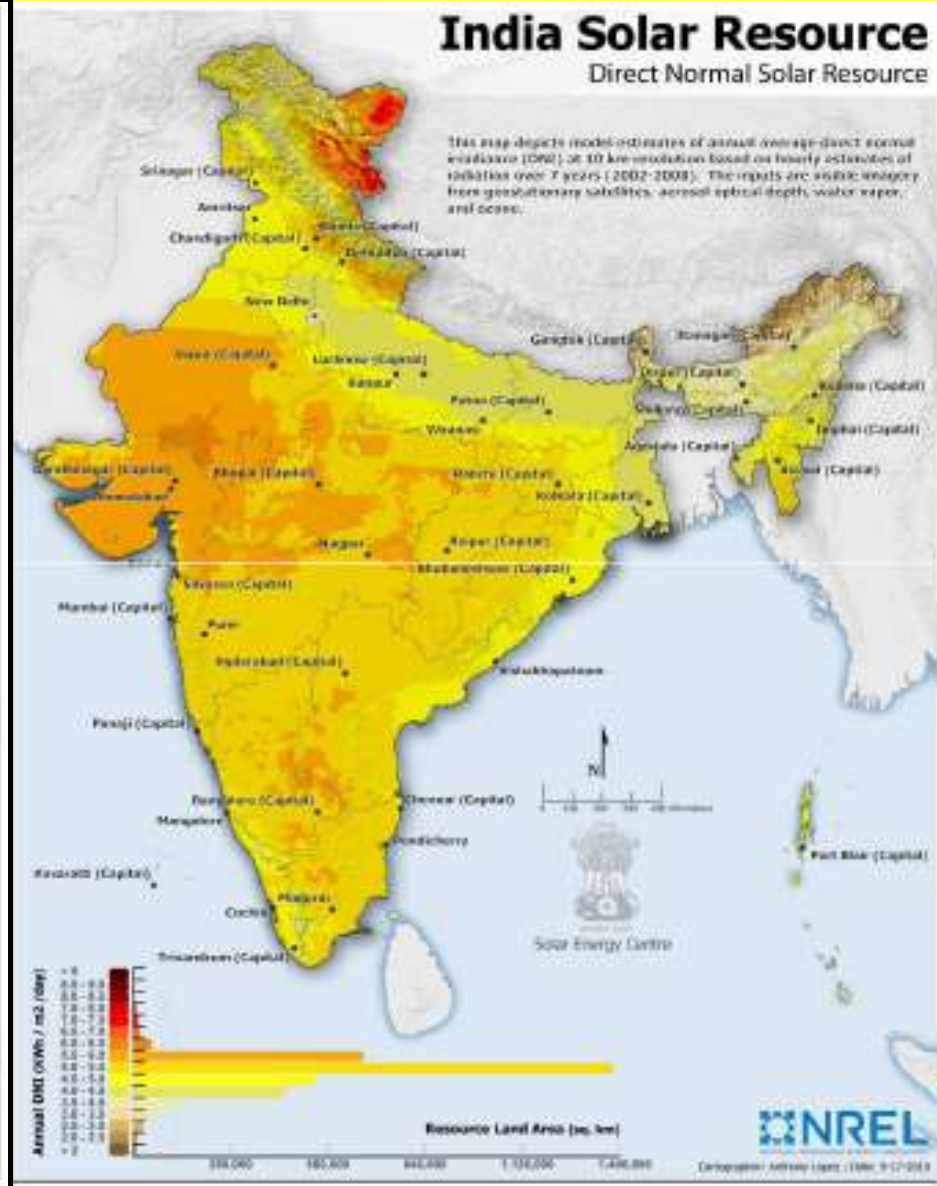
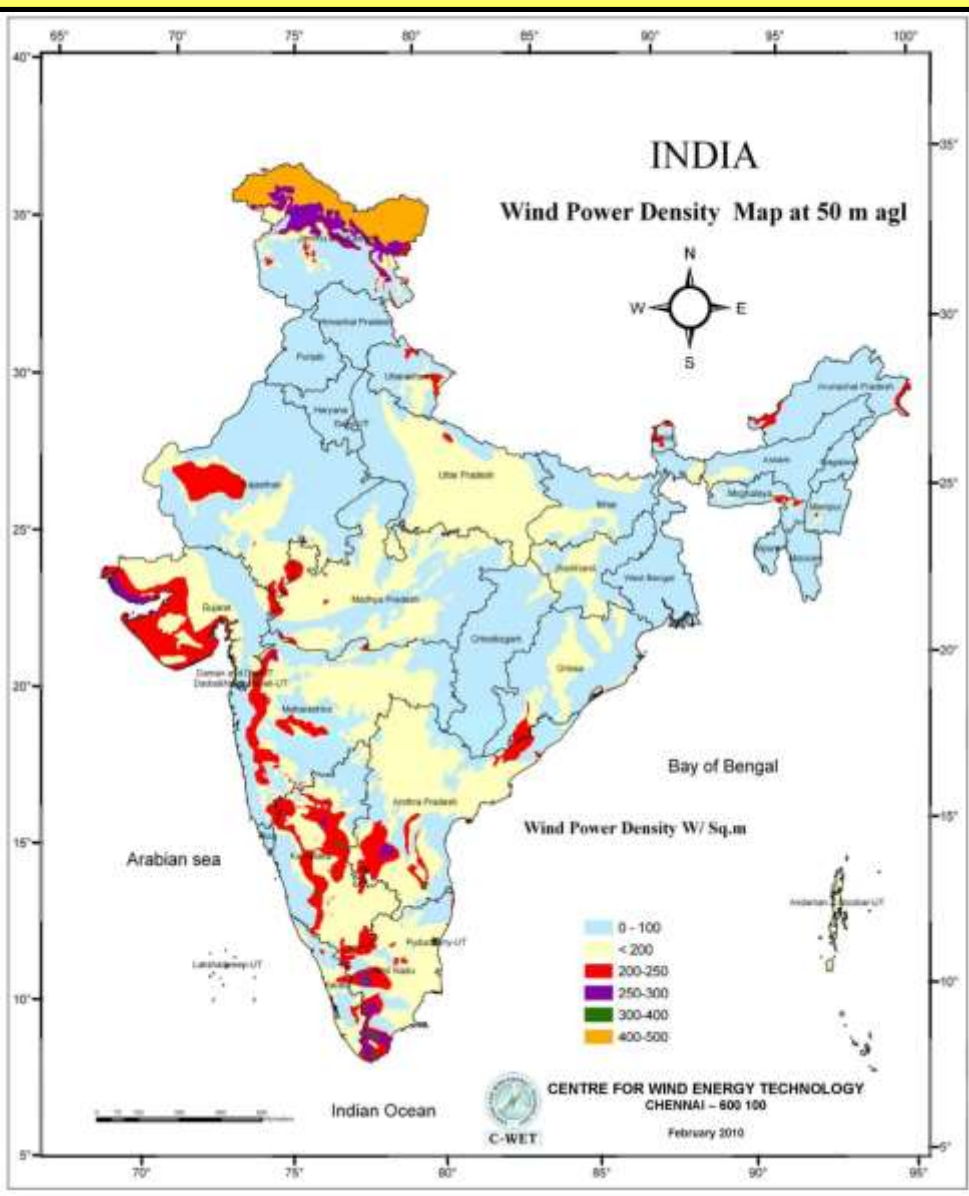
Source	Potential (MW)	Total Installed Capacity (MW)
Wind (On- shore)	102778	19565
SHP(<25MW)	15000	3686
Biomass	17000	1265
Bagasse-Cogen	5000	2337
Waste	2700	96
Solar	>100000	1759
TOTAL		28,709

**Total Installed Renewable Energy Capacity (MW)
up to Jun,13= 28,709**

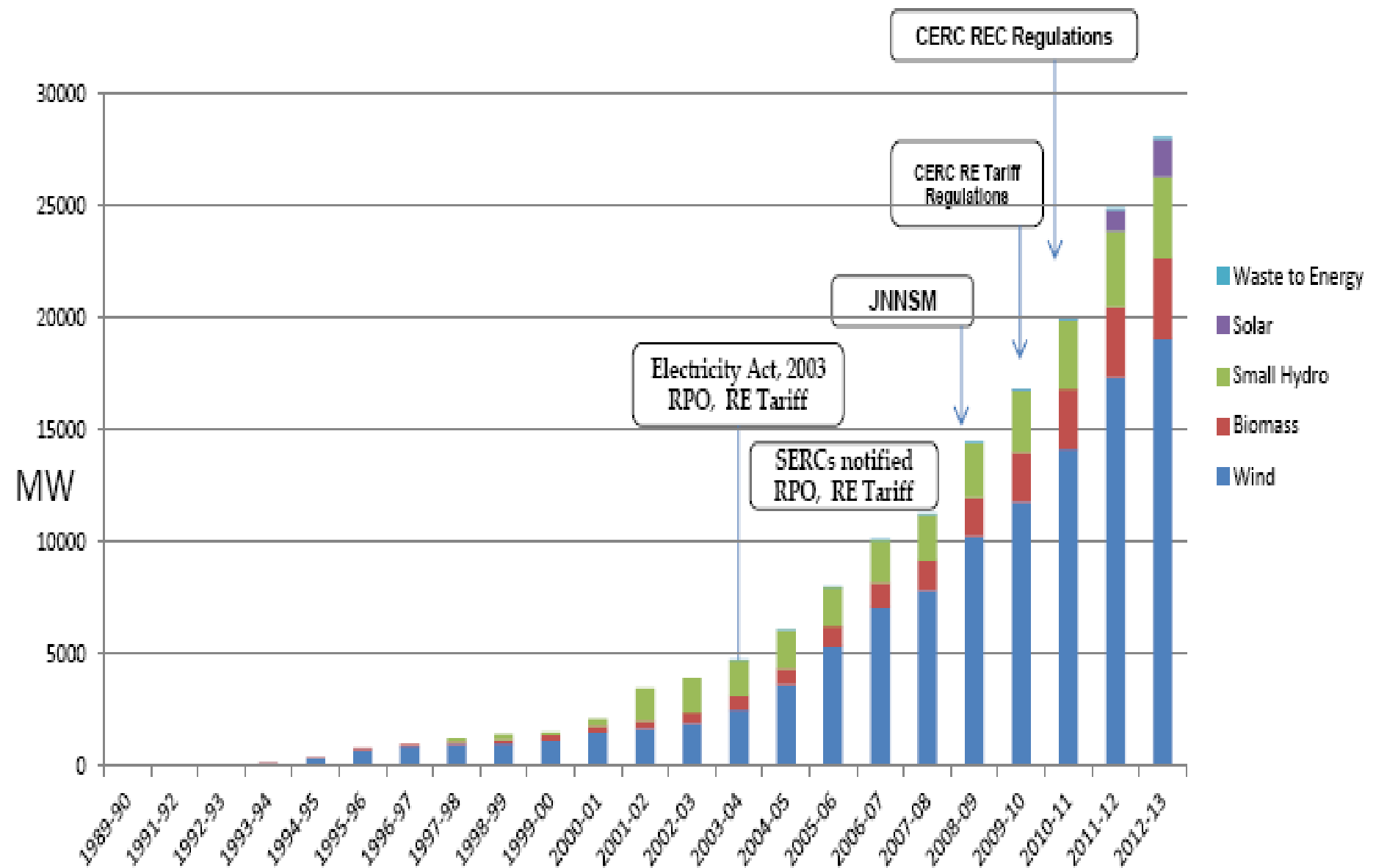


Sources	Target for 12 th plan (MW) *
Wind Power	15,000
Biomass Power	5,000
Small Hydro (up to 25 MW)	
Solar Power	10,000
TOTAL	30,000

Major RES Distribution in India

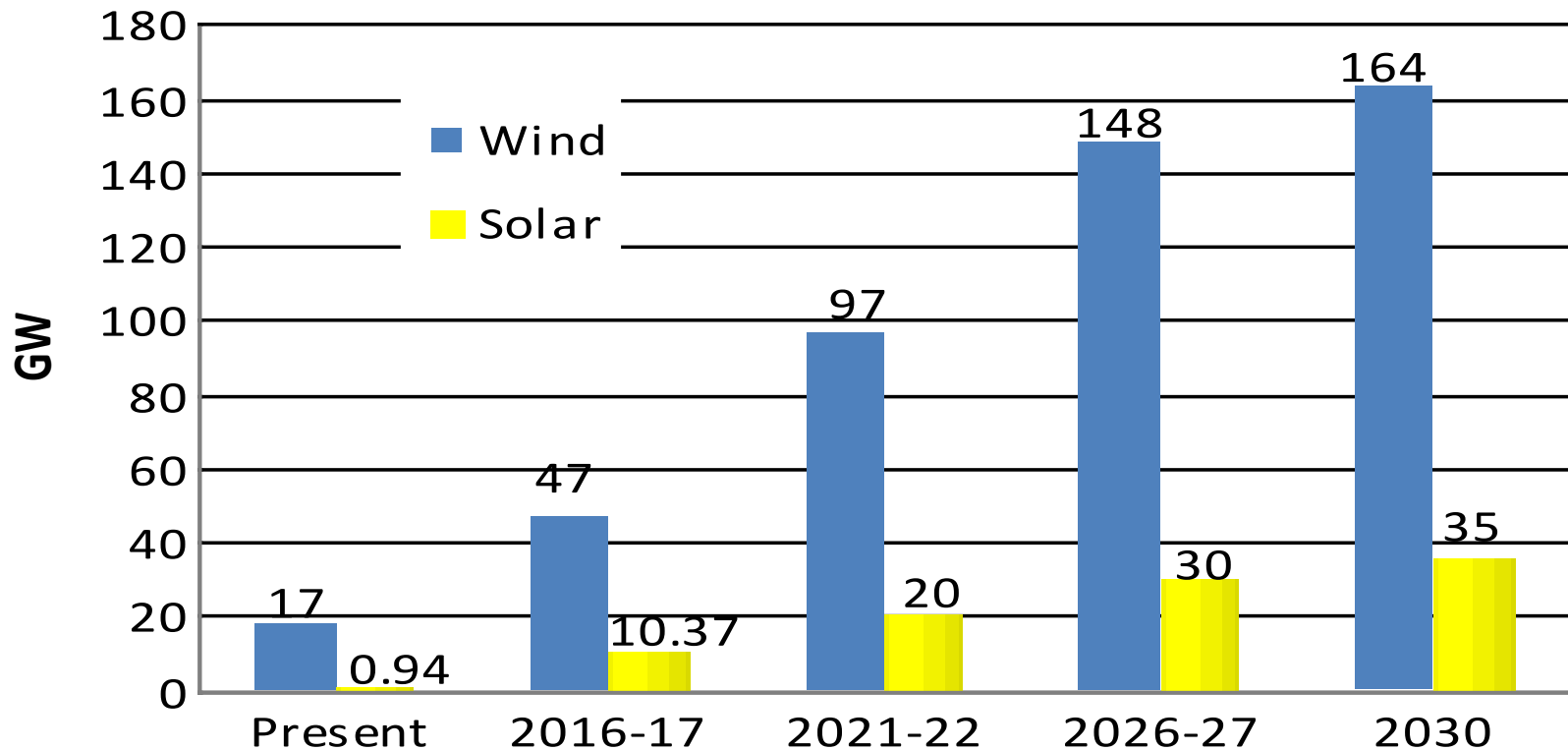


Evolution of Renewables over the years



Envisaged Wind & Solar Capacity addition by 2030

Resource	2012 (GW)	2016-17 (12 th plan) (GW)	2021-22 (13 th Plan) (GW)	2026-27 (14 th Plan) (GW)	2030 (mid 15 th plan) (GW)
Wind	17	47	97	148	164
Solar	0.92	9.45	20	30	35

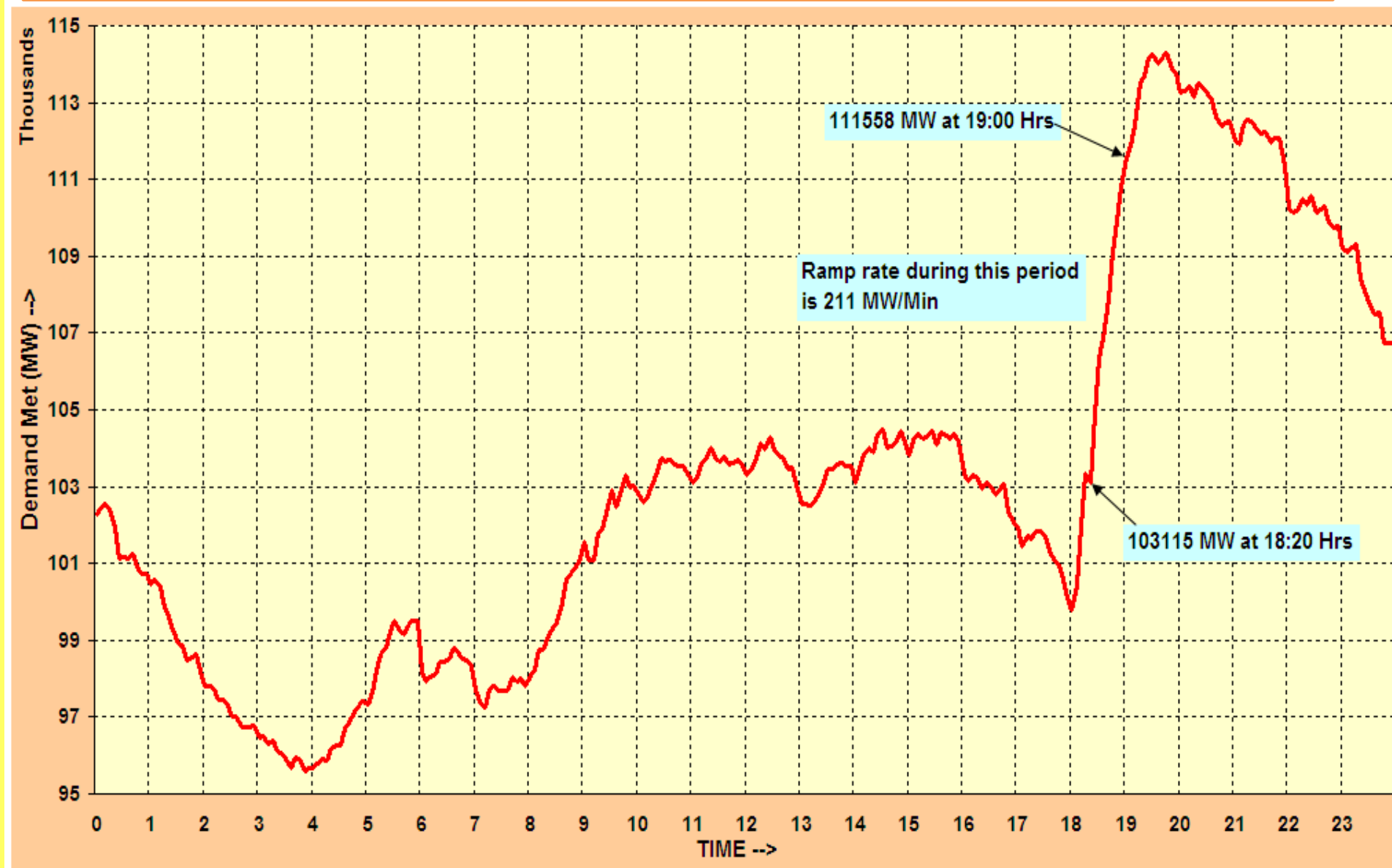


Increasing Renewable Penetration

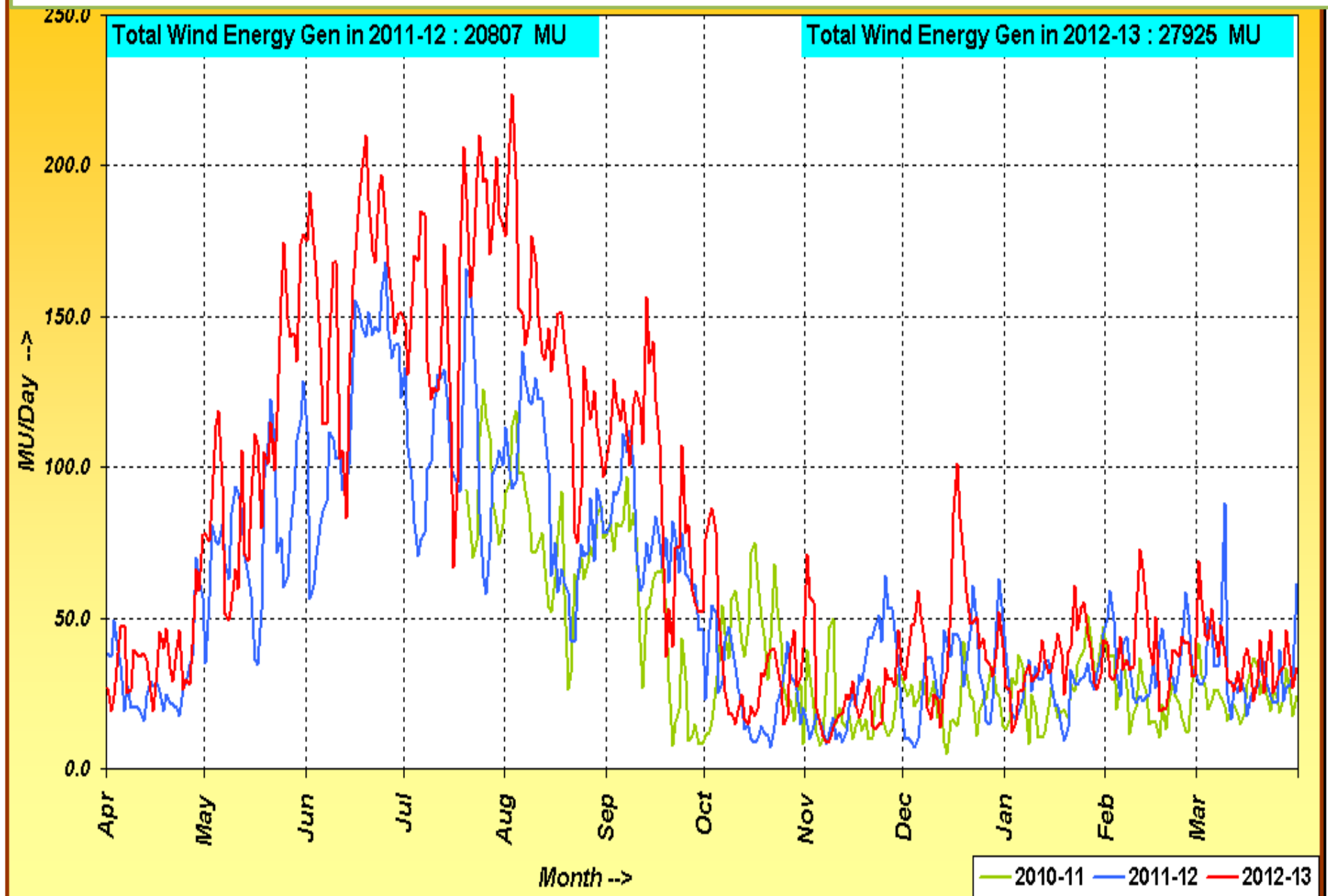
Scenario	Energy Penetration(%)	Capacity Penetration(%)
Present	6	12
2017	13	21
2030	21	35

Grid Integration of Renewable Generation: Wind & Solar

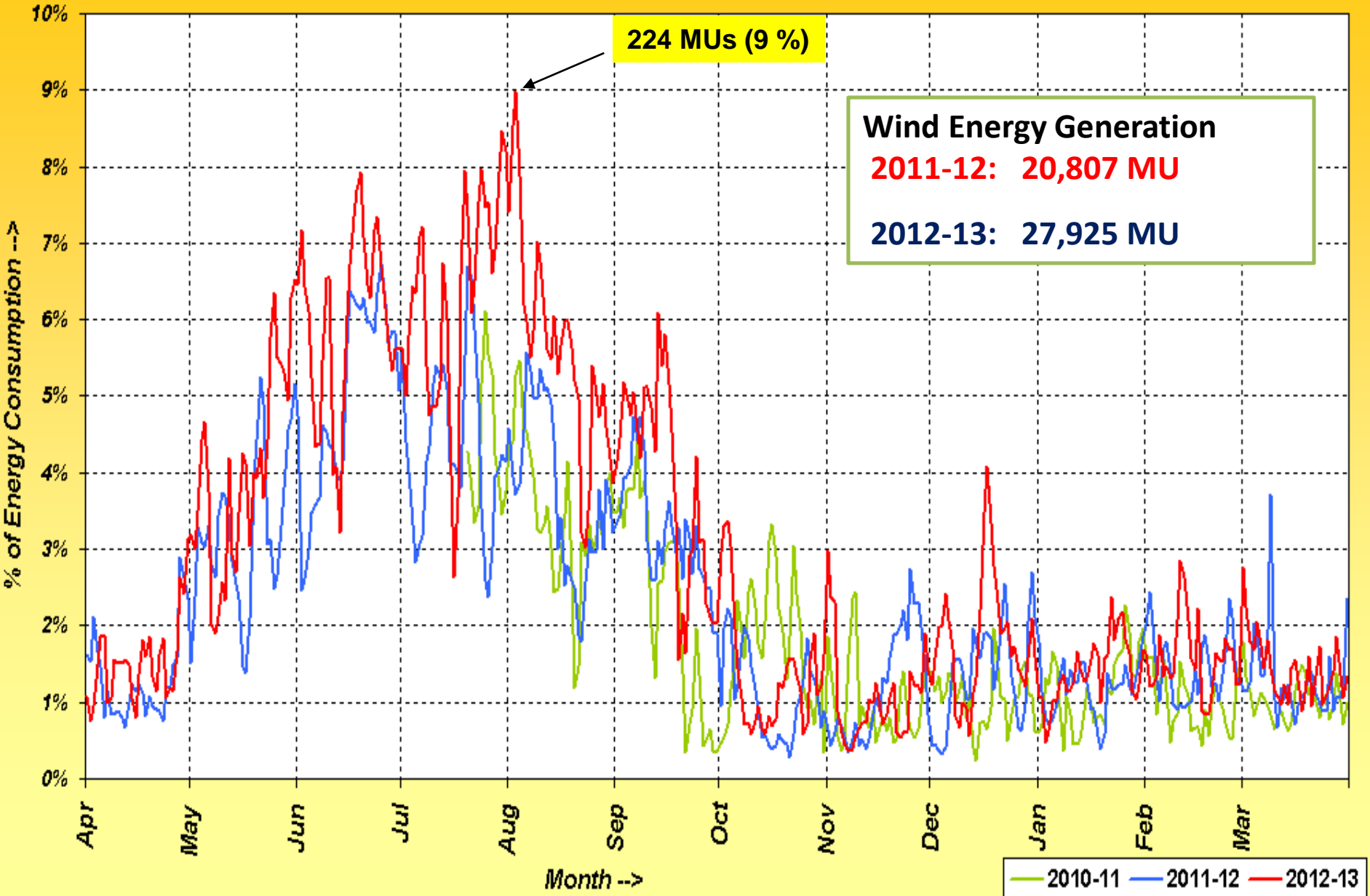
Typical All India daily load curve - Ramp rate during evening Peak



All India Wind Energy Generation on Daily Basis in MU



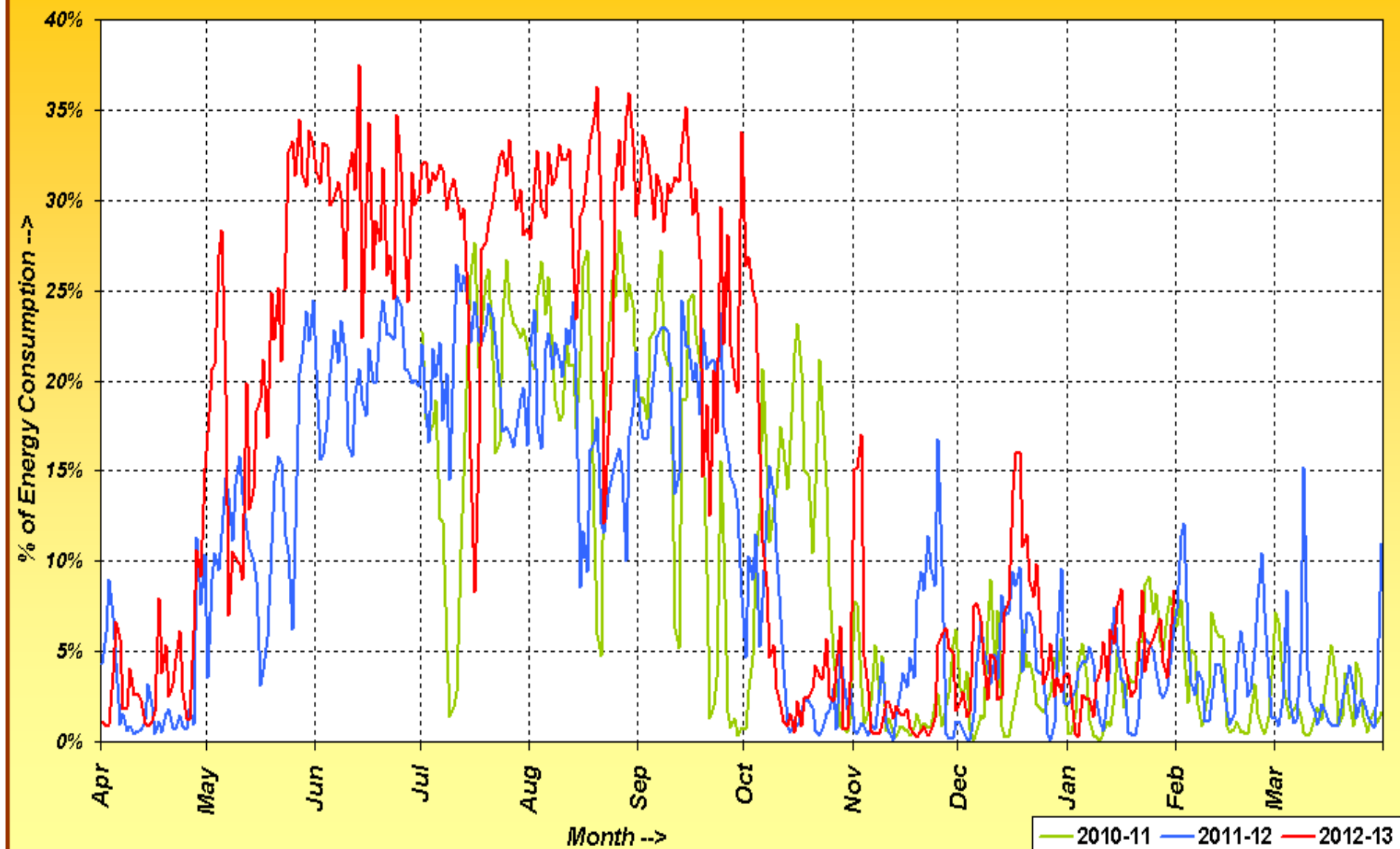
All India Wind Energy as a Percentage of Energy Consumption



Wind Yearly Plots ▼

Tamilnadu Wind Energy as a Percentage of Energy Consumption

Tamilnadu ▼



Issues in Large Scale Renewable Integration

- Intermittency
- Variability and ramp rates
- Wind Power not coincident with peak load
- Uncertainties never match- Load Generation Balance
- Reactive power management and fault ride through capability
- Plants connected at remote/concentrated locations with weak transmission network
- Renewable plants providing lesser grid support during system disturbances/exigencies

Mitigating Measures for Large Scale Renewable Integration

- Flexible generation, Ancillary Services for supply-balancing
- Technical Standard Requirements (Grid code, Connectivity standards, Real time monitoring etc.)
- Demand Side management, Demand Response and Storage for load balancing
- Forecasting of Renewable generation & Forecasting of Demand
- PMUs/WAMS on pooling stations and interconnection with centralized control centre for real time information, monitoring and control
- Policy and Regulatory advocacy for power-balance market and pricing mechanism
- Renewable Energy Management Centers (REMC)

Provisions Under Indian Electricity Grid Code (IEGC)

- Planning: IEGC mandates the Central Transmission Utility(CTU) to carry out planning process for transmission projects associated with generation projects, regional and inter regional system strengthening schemes fitting into the perspective plan developed by CEA. (For renewable capacity, green corridors have been developed).
- Operation: Subject to grid security considerations, system operators to evacuate solar and wind power and treat as a must run station. IEGC puts emphasis on data acquisition facilities.
- Renewable Regulatory Fund (RRF Mechanism): The RRF mechanism is a complementary commercial mechanism which aims towards achieving better forecasting tools for wind and solar power generation. Under implementation.

Provisions Under Indian Electricity Grid Code (IEGC)

- Ancillary Services: CERC Regulations specify providing ancillary services including but not limited to “load generation balancing” during low grid frequency. The modalities are presently under discussion with stakeholders.

Way Forward

- At 6% renewable energy penetration, presently the Indian electricity grid is well secured from the renewable integration.
- We are getting geared up to meet the challenges, once the renewable energy penetration crosses the double digit mark.
- Systematic scheduling, based on accurate forecasting holds the key.
- We are looking for potential collaborations for development of accurate forecasting models, specially for wind.
- Development of environment friendly and cost effective storage solutions are another area, we are willing to collaborate in.

A composite image featuring a large white wind turbine in the background and a row of blue solar panels in the foreground. The sun is shining brightly behind the panels, creating a lens flare effect. The sky is blue with some white clouds.

Thank You