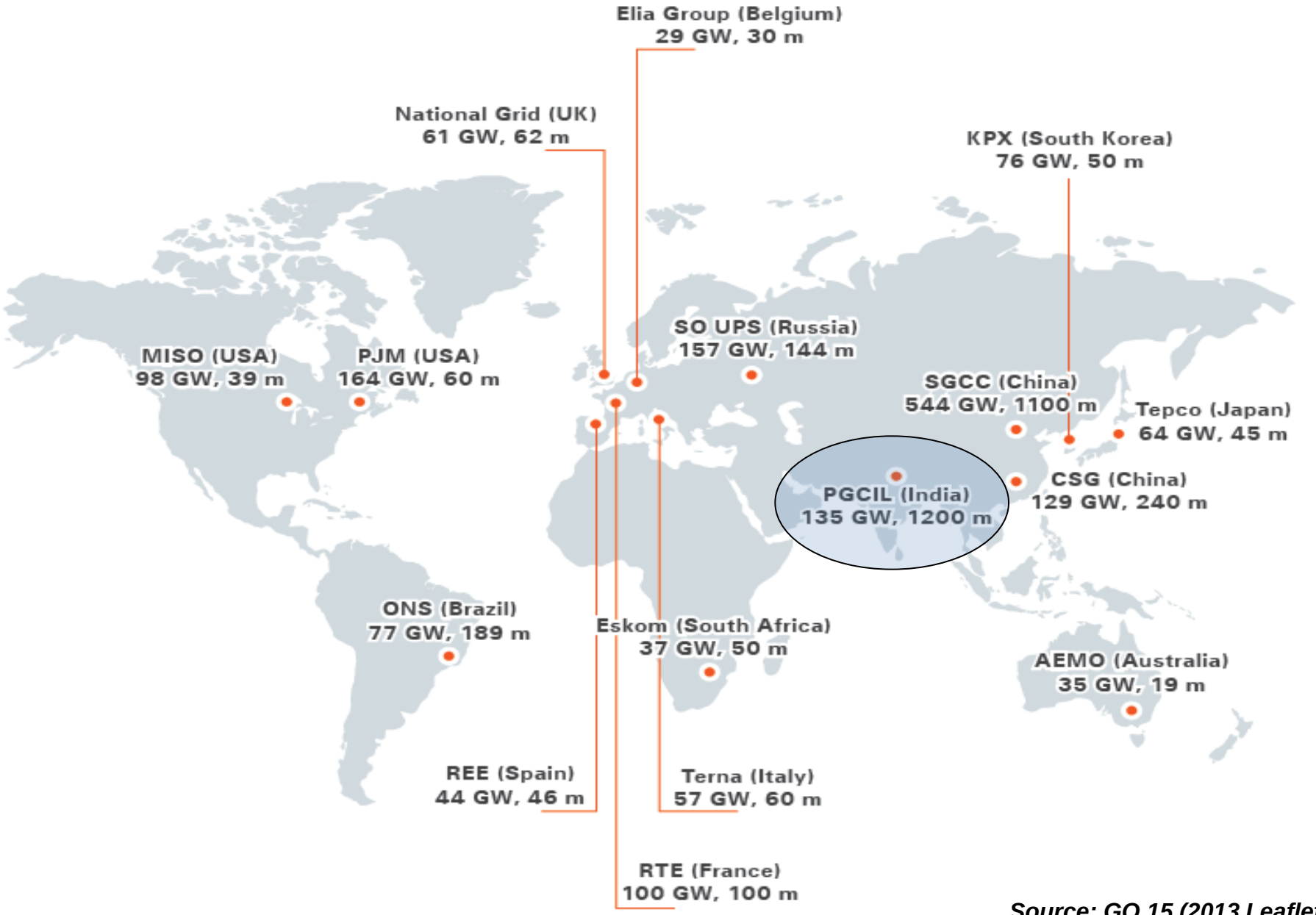
Grid Integration of Renewables

K.V.S. Baba

General Manager

National Load Despatch Centre

Some of the Large Power Grids in the World



Source: GO 15 (2013 Leaflet)

Some Typical Numbers …

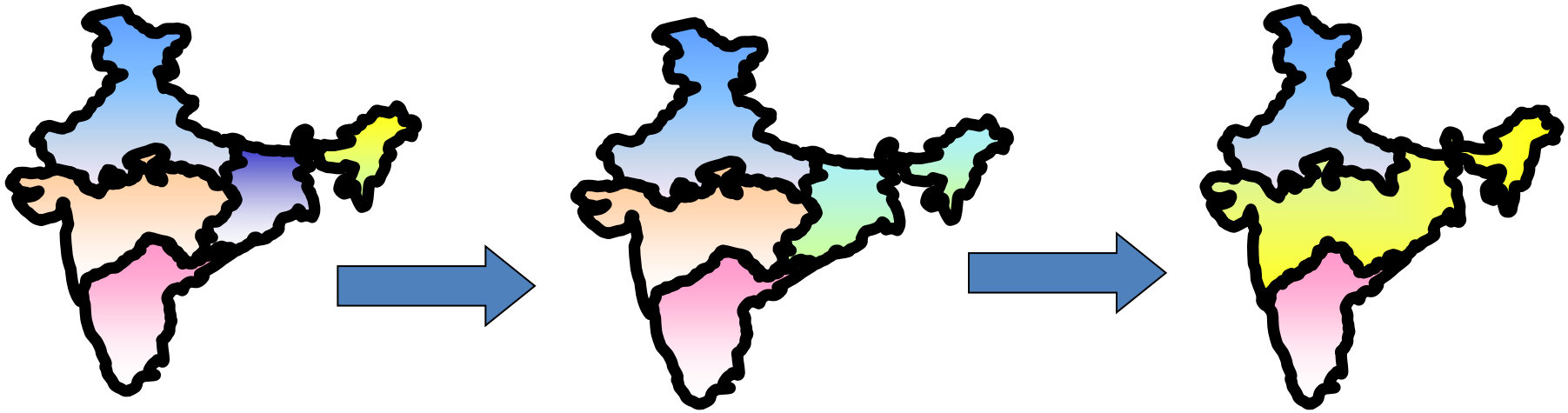
- All India Installed Capacity : ~ 232 GW
- Fuel Mix : Hydro 17%, Thermal 70%, RES 13%
- Peak Demand Met : ~ 125 GW
- Energy : ~ 2800 MU/day
- Wind Generation : ~ 55 MU/day
- 400kV & above Trans. Line : ~ 1050 Nos.
- No. of Generating Units : ~ 1750 Nos.
- Short Term Open Access : ~ 240 MU/day

Evolution of the Grid

Five Regional Grids
Five Frequencies
Pre – October 1991

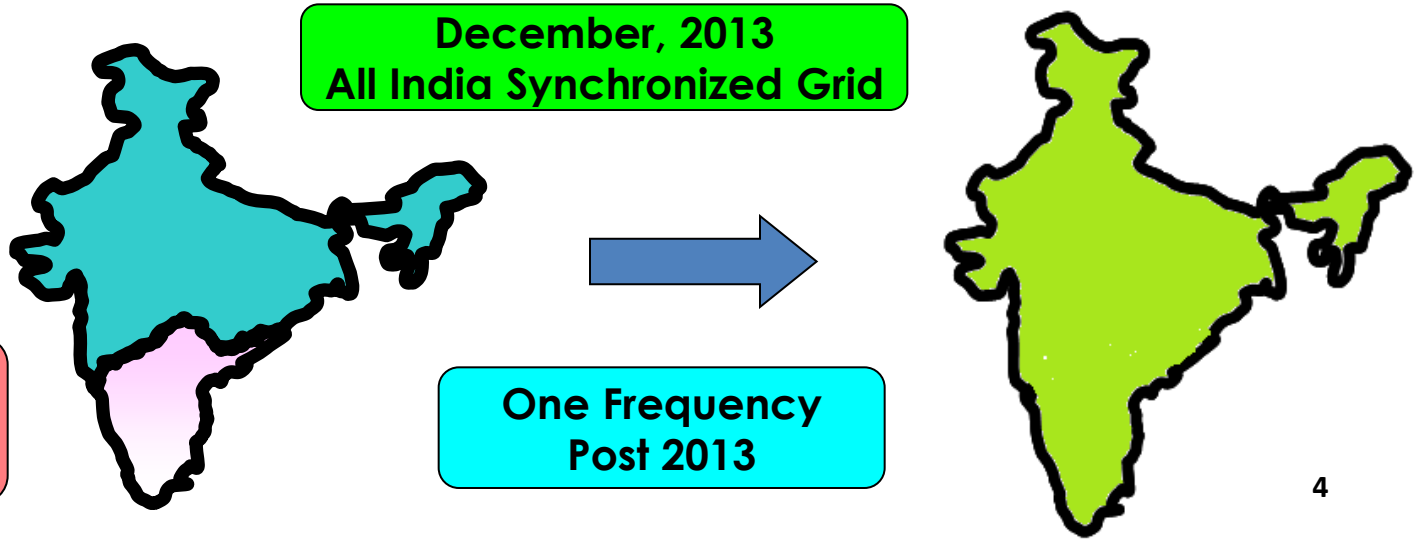
October 1991
East and Northeast
synchronized

March 2003
West synchronized
With East & Northeast



August 2006
North synchronized
With Central Grid

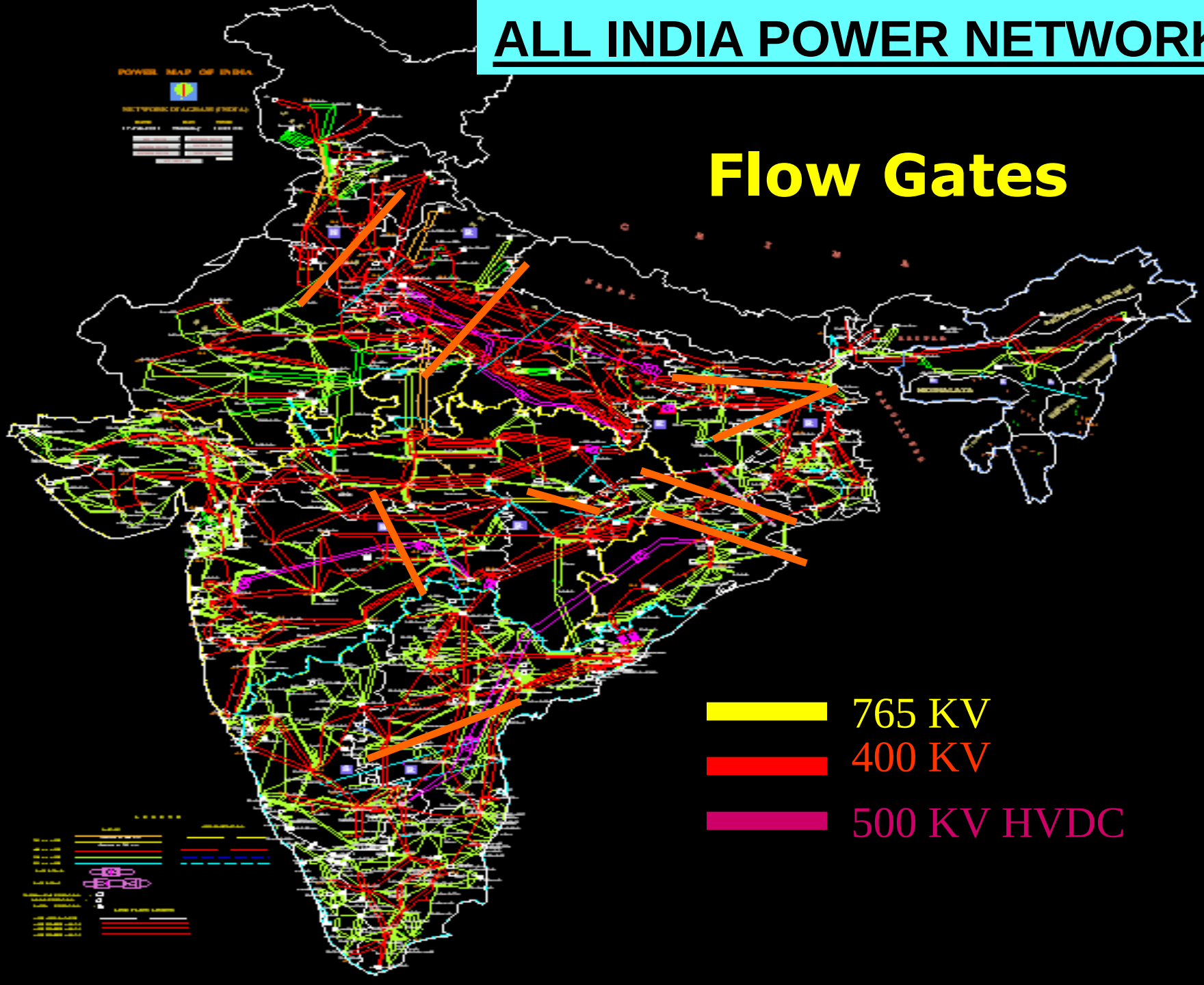
December, 2013
All India Synchronized Grid



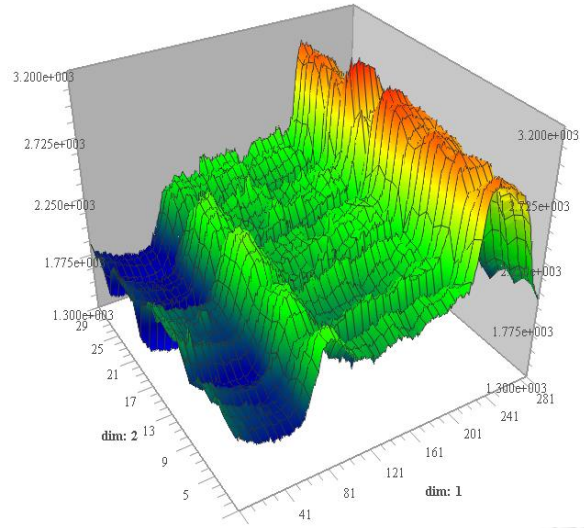
Five Regional Grids
Two Frequencies
Post August 2006

One Frequency
Post 2013

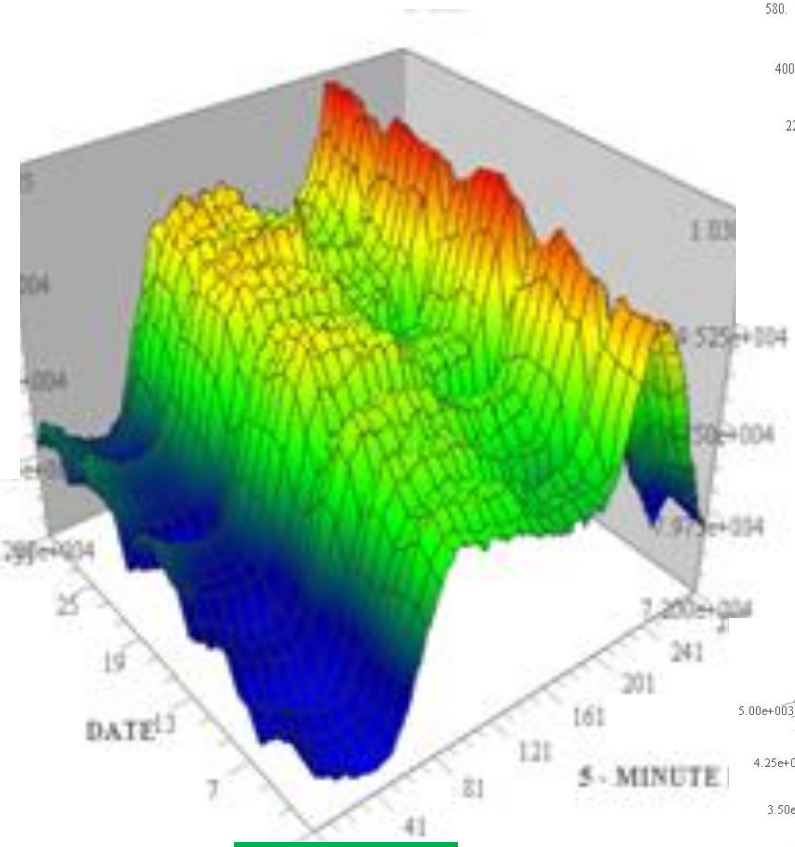
ALL INDIA POWER NETWORK



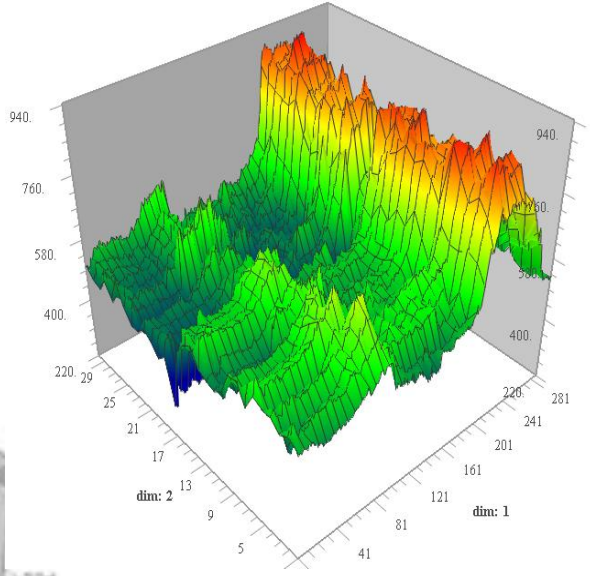
Variation in Demand



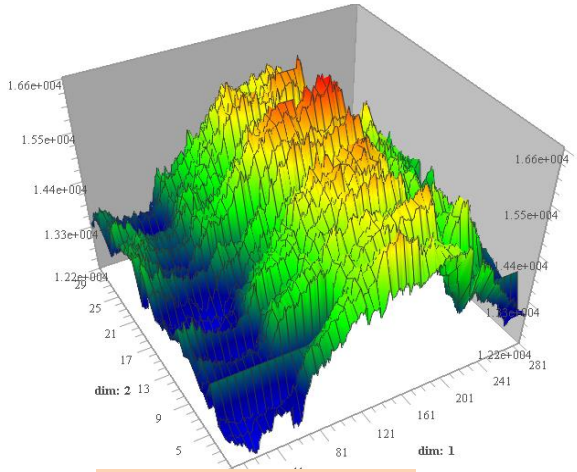
Kerala



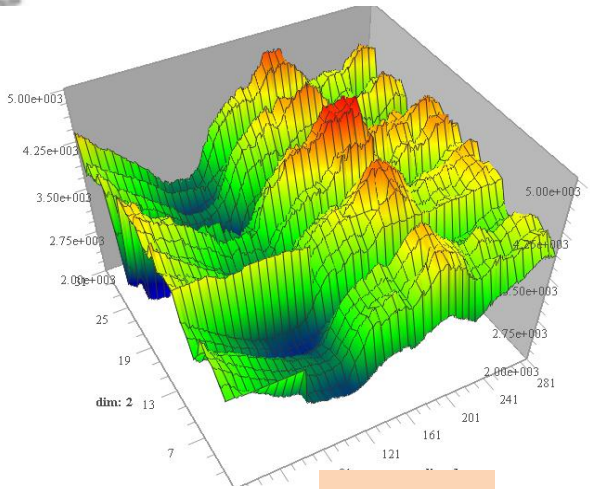
All India



Assam

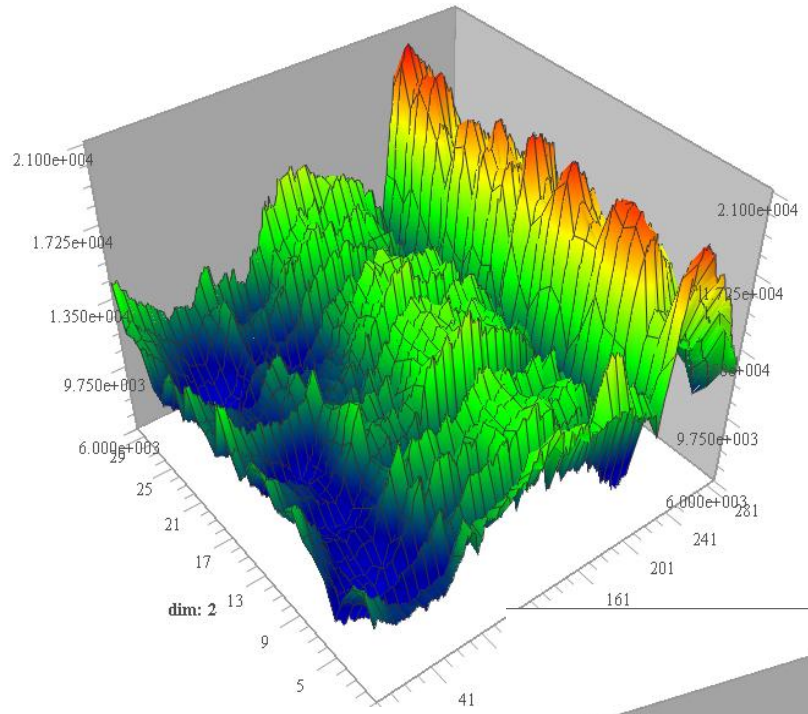


Maharashtra

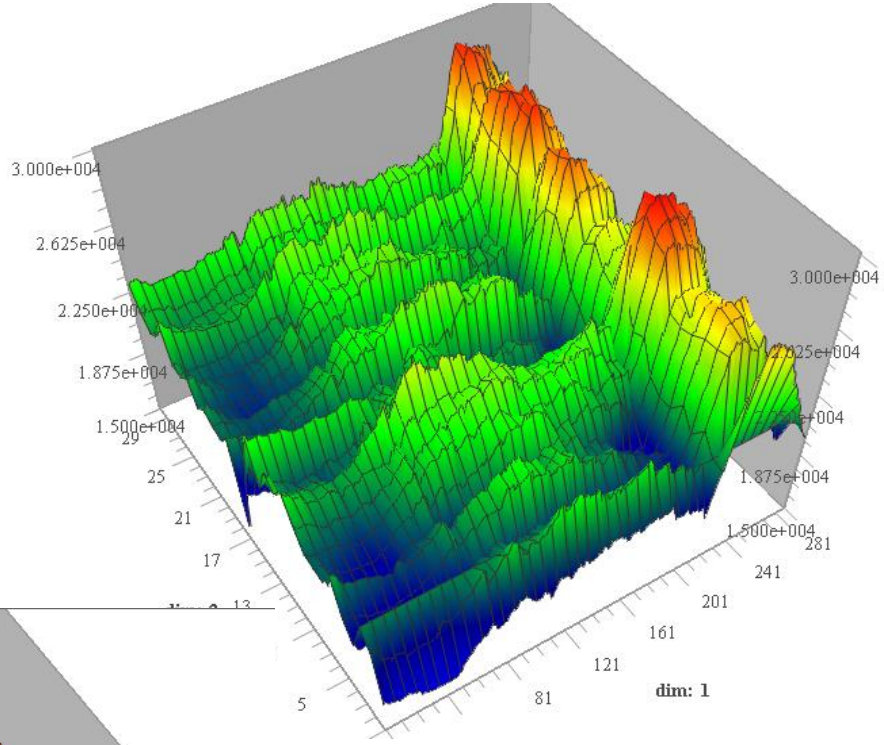


Delhi

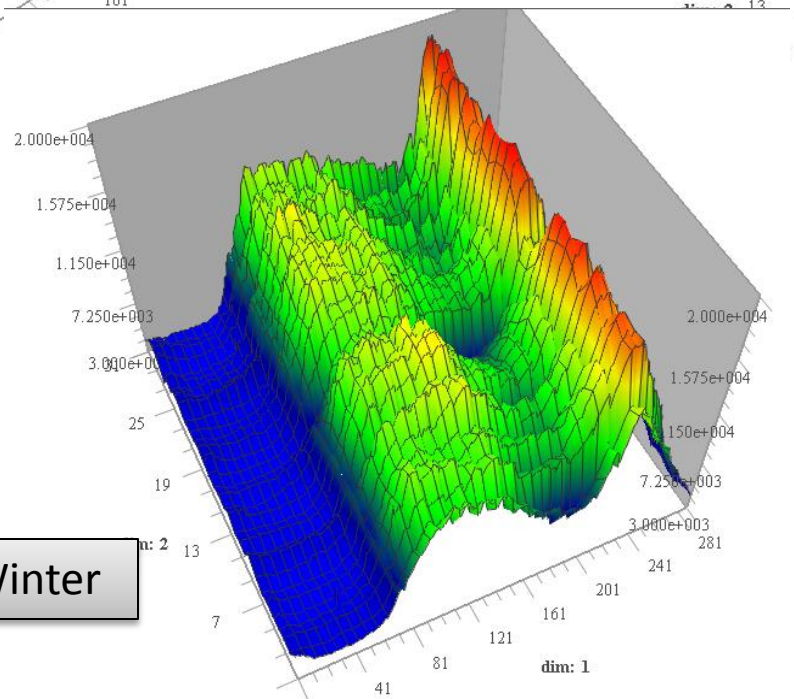
Variation in Hydro Generation



Summer

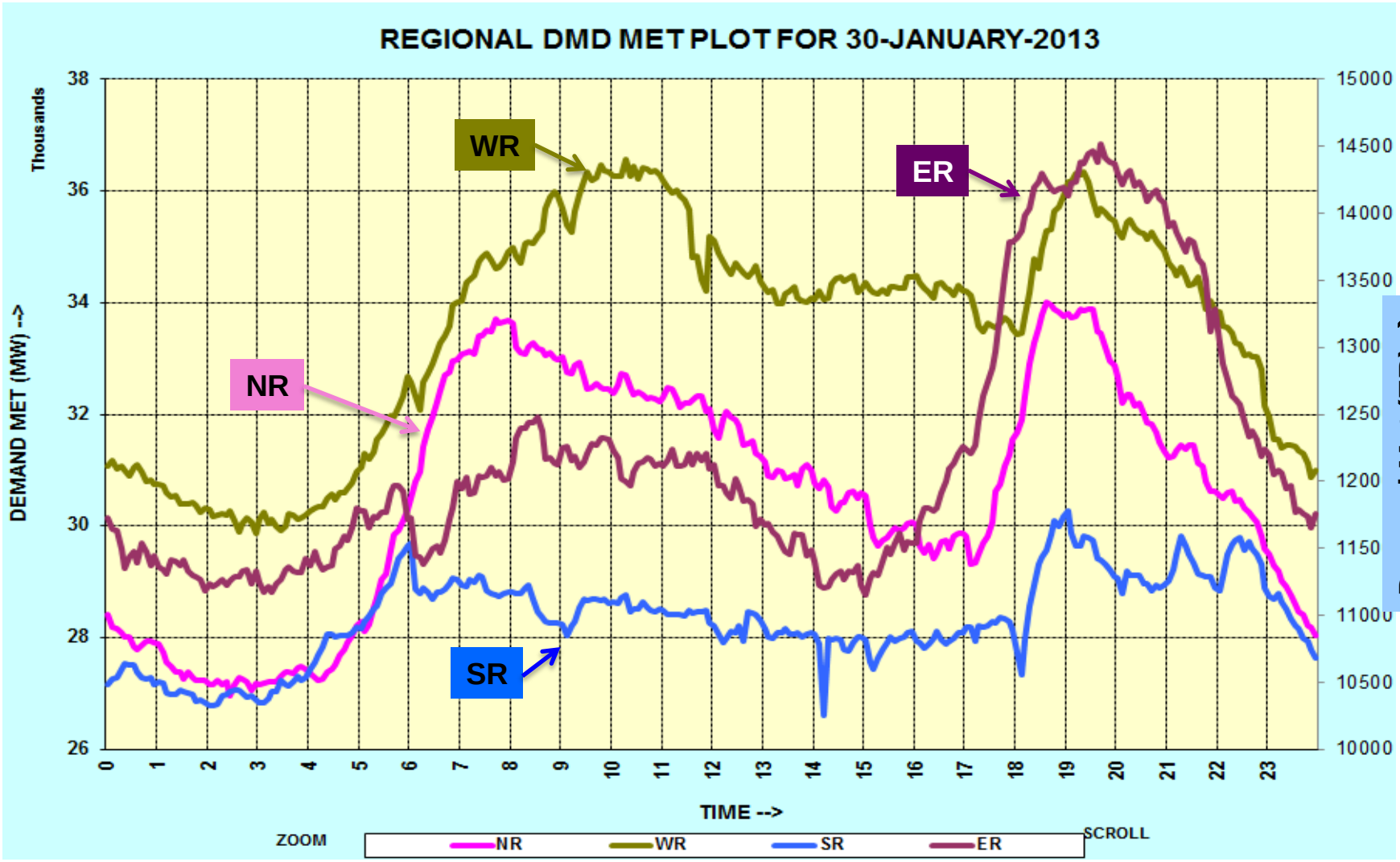


Monsoon



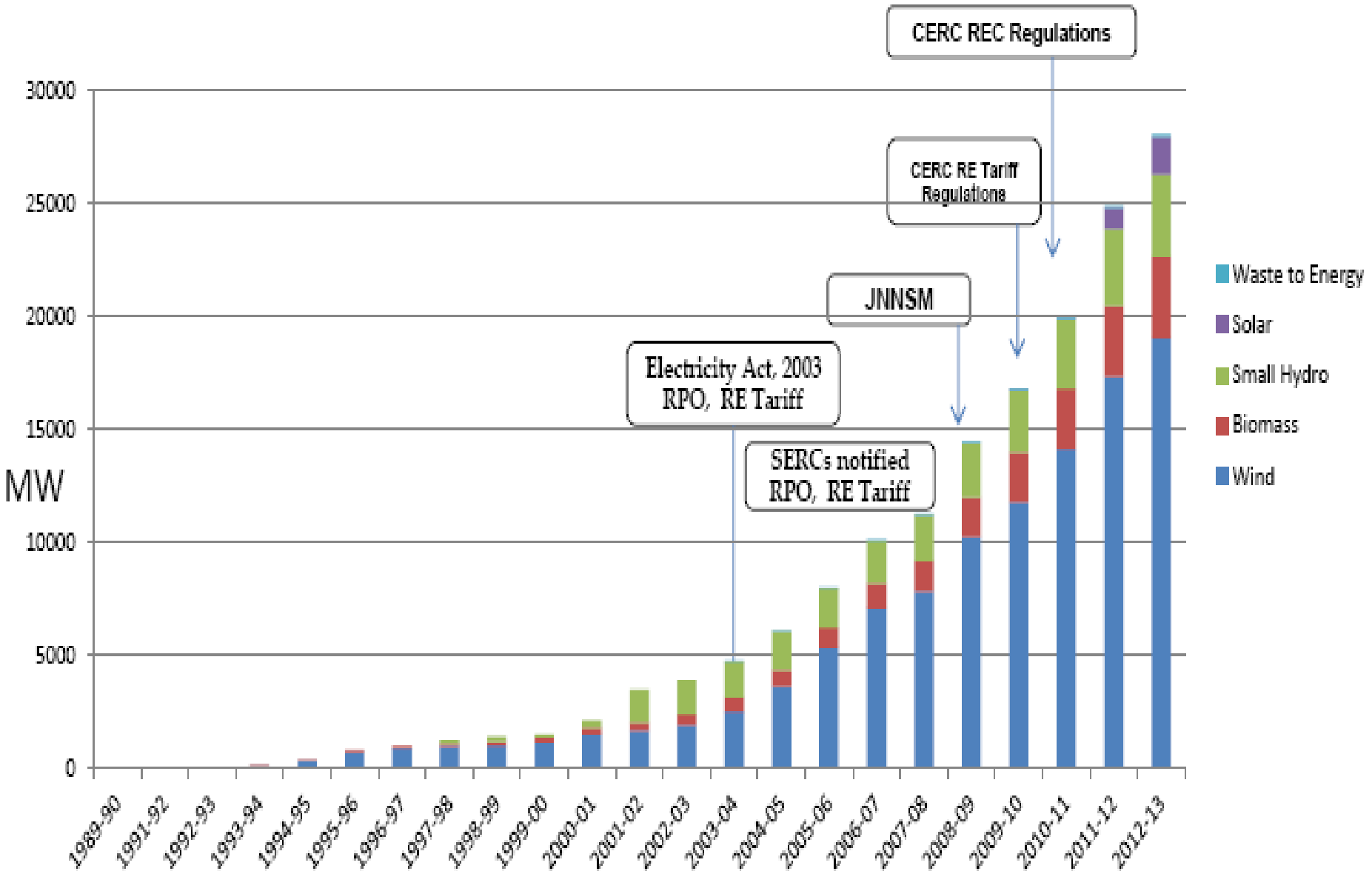
Winter

Regional Geographical Diversity

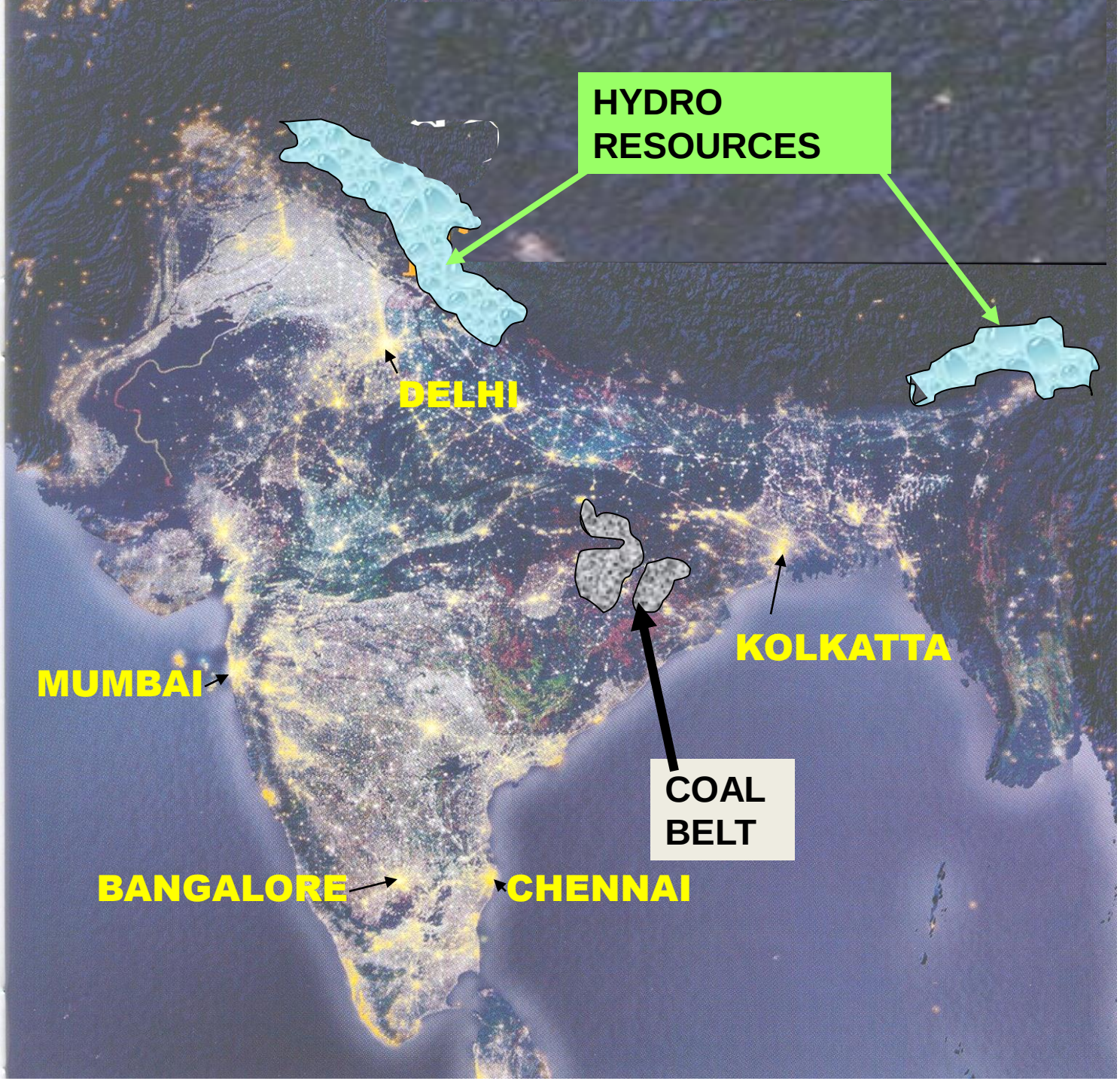


Diversity on account of geographical location, seasons, time of day, load, etc.

Evolution of Renewables over the years

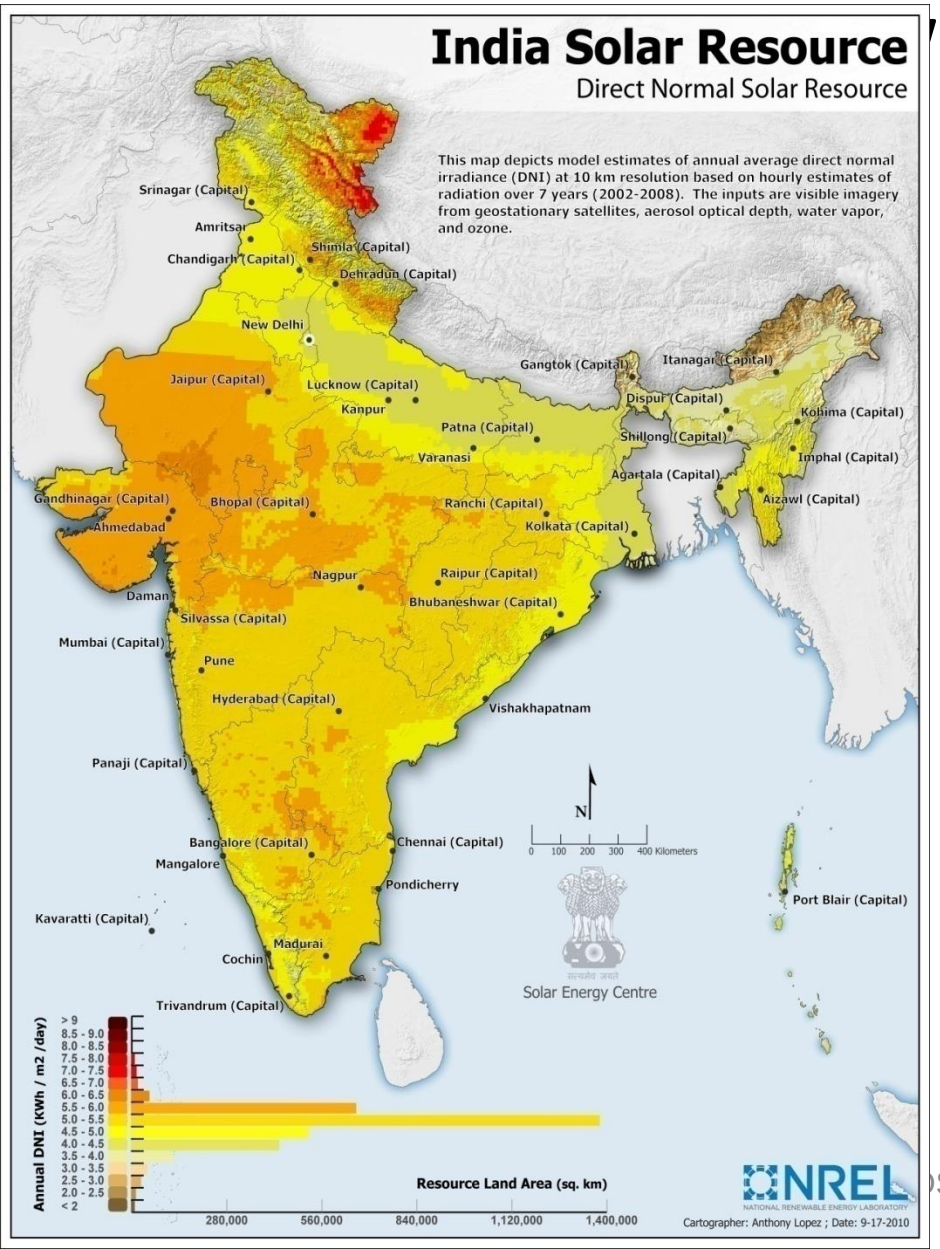


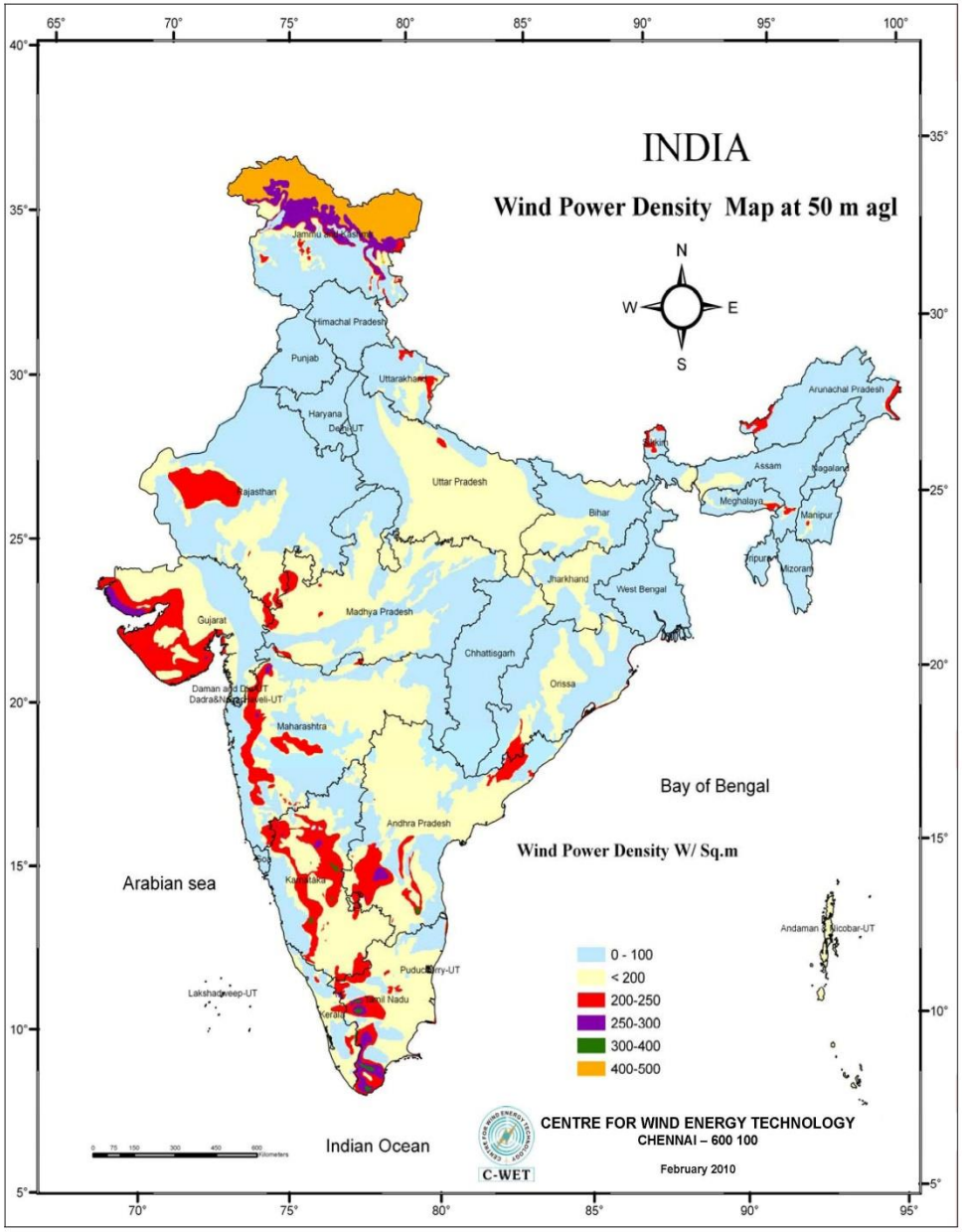
Renewable Energy Scenario in India



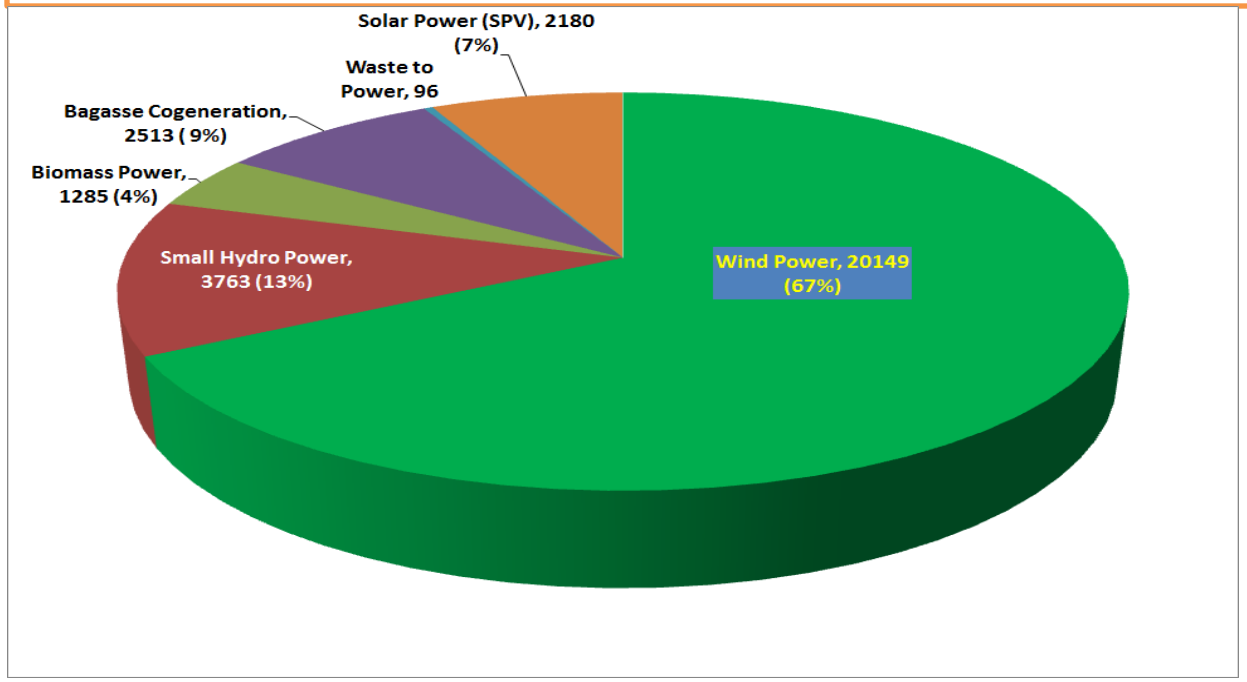
AREAS SHOWN ARE APPROXIMATE AND INDICATIVE

Renewable Energy In India – Solar &



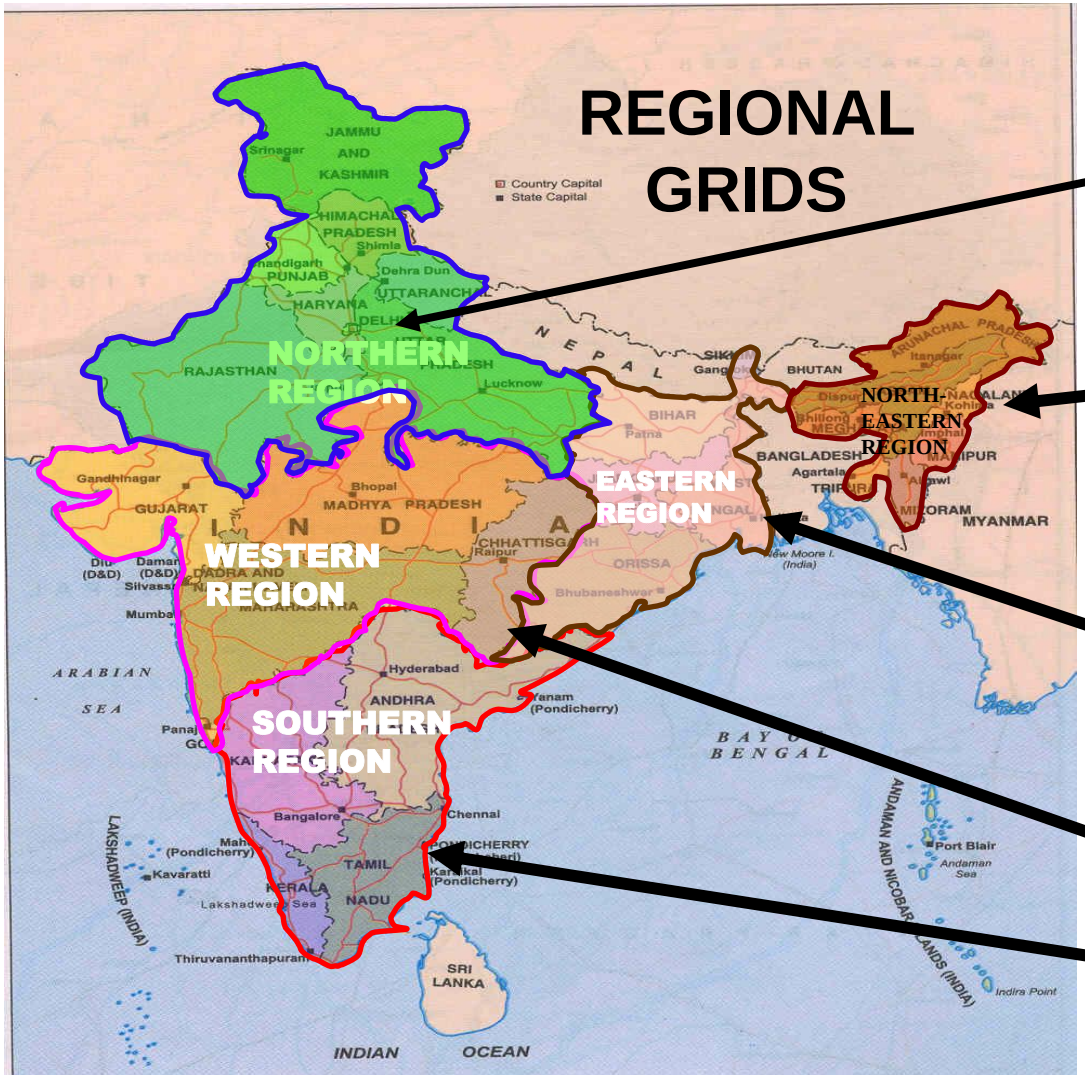


Renewable Installed Capacity (in MW)



Resources	Grid-Interactive Capacity (MW) as on 31.12.2013
Wind Power	20149
Small Hydro Power	3763
Biomass Power & Gasification	1285
Bagasse Cogeneration	2513
Waste to Power	99
Solar Power (SPV)	2180
Total	29989

Peculiarities of Regional Grids in India



Deficit Region

Snow fed - run-of -the -river hydro

Highly weather sensitive load

Adverse weather conditions: Fog & Dust Storm

Very low load

High hydro potential

Evacuation problems

Low load

High coal reserves

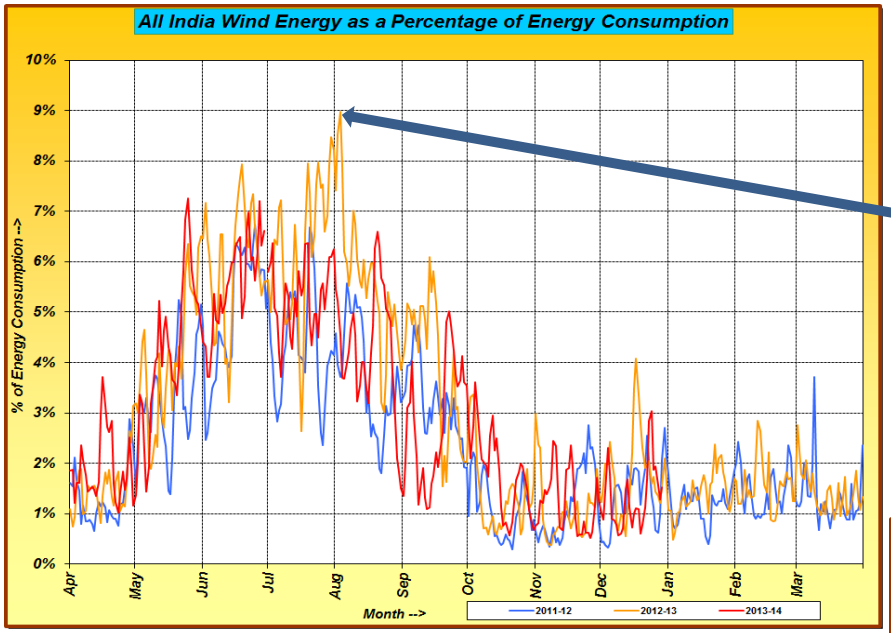
Pit head base load plants

Industrial load and agricultural load

High load (40% agricultural load)

Monsoon dependent hydro

All India Wind Penetration (in Energy terms)

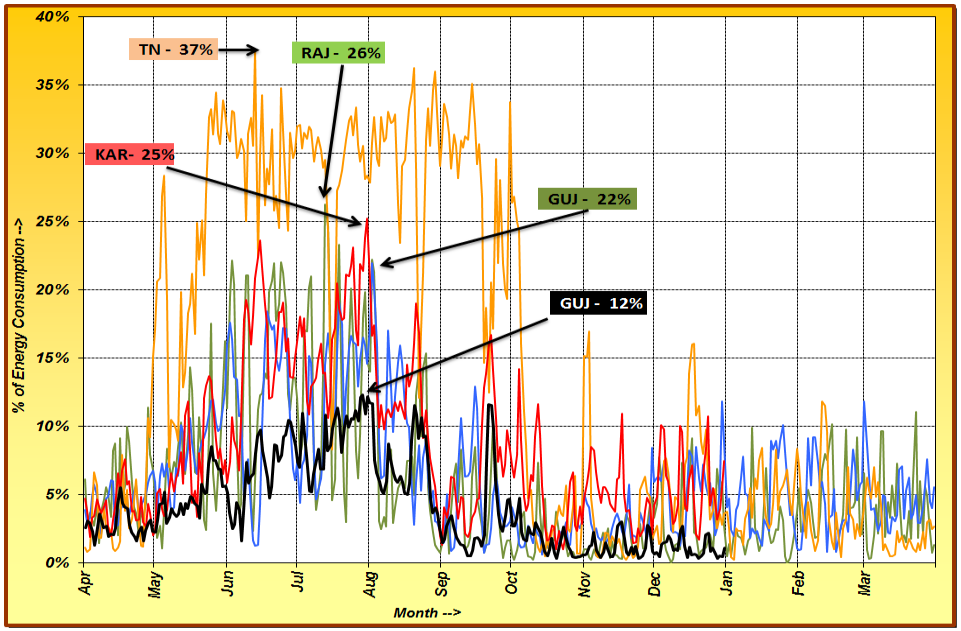


→ High Wind generation during June to August.

→ All India level penetration – 9% (max achieved)

→ State-wise penetration level achieved (appx):

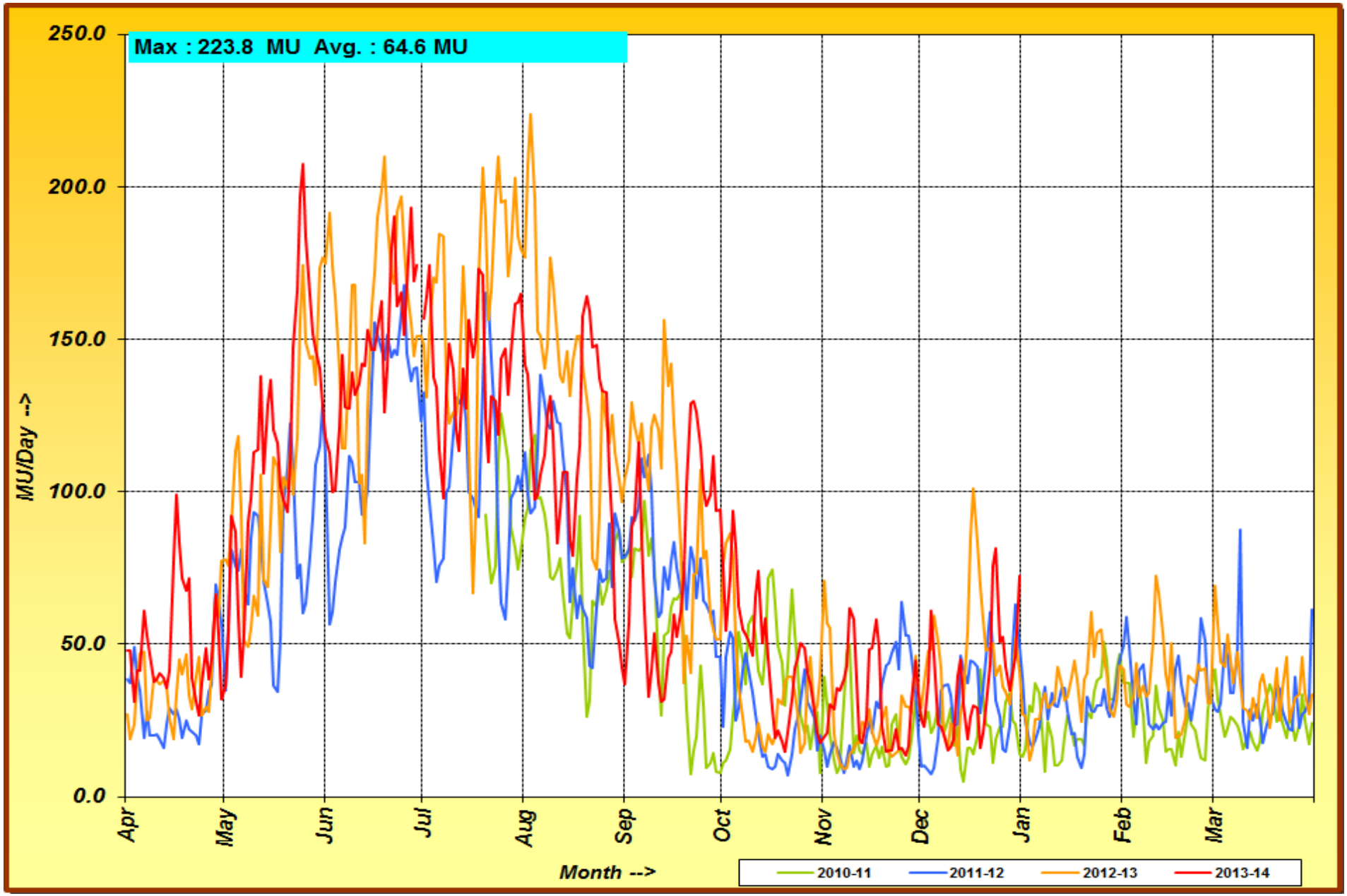
1. Tamil Nadu – 37%
2. Rajasthan – 26%
3. Karnataka – 25%
4. Gujarat – 22%
5. Maharashtra – 12%



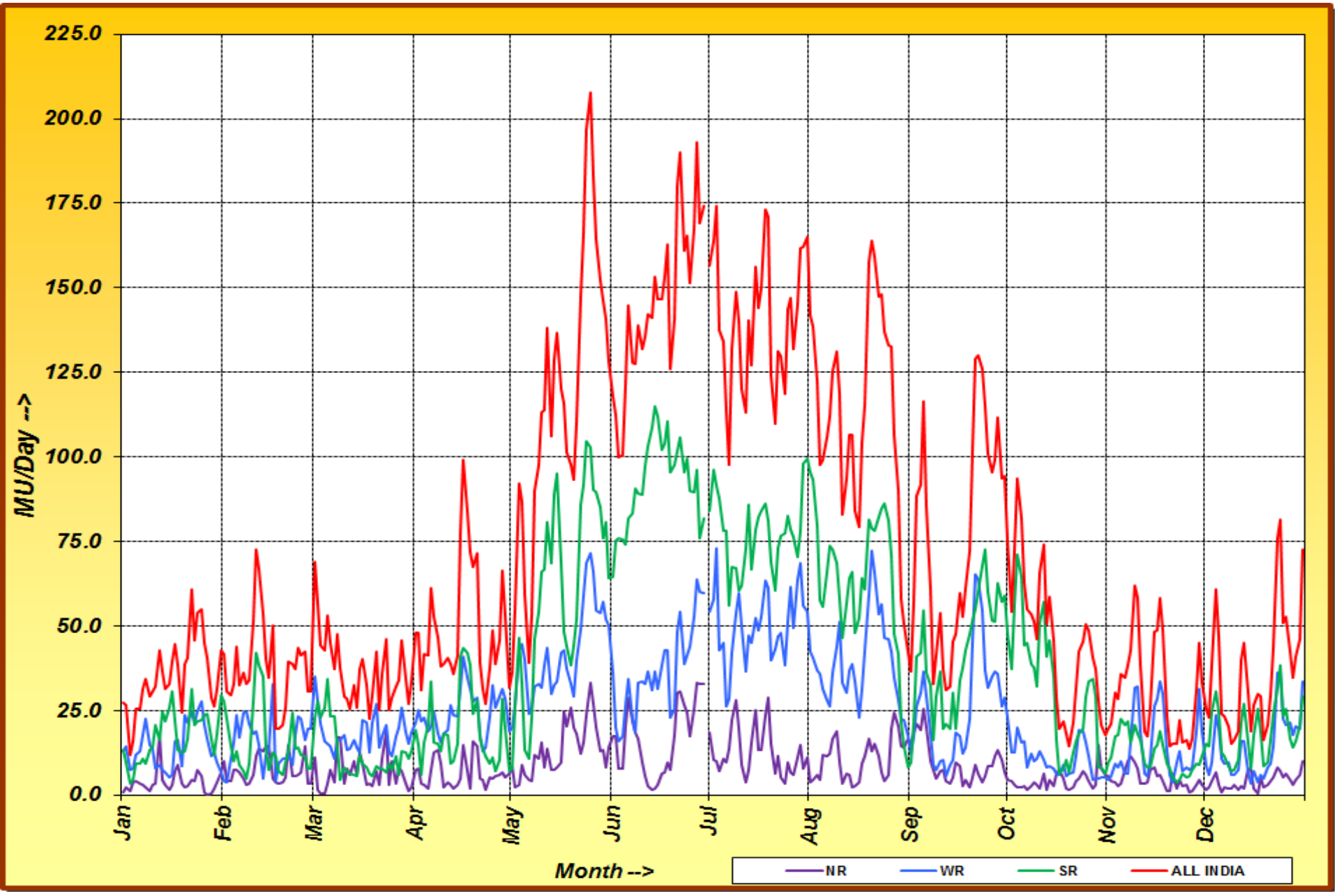
Proposed Renewable capacity addition programme

Resource	12th Plan Projection for RE Addition	Total Projected Capacity by end of 12th Plan(2017)	13th Plan Projection for RE Addition	Total Projected Capacity by end of 13th Plan (2022)
Wind Power	11200	27300	11200	38500
Small Hydro Power	1600	5000	1600	6600
Biomass	500	1525	1000	2525
Bagasse Cogen	1400	3216	700	3916
Waste to Energy	200	324	500	824
Solar Power	3800	4000	16000	20000
Total	***18700***	***41400***	***31000***	***72400***

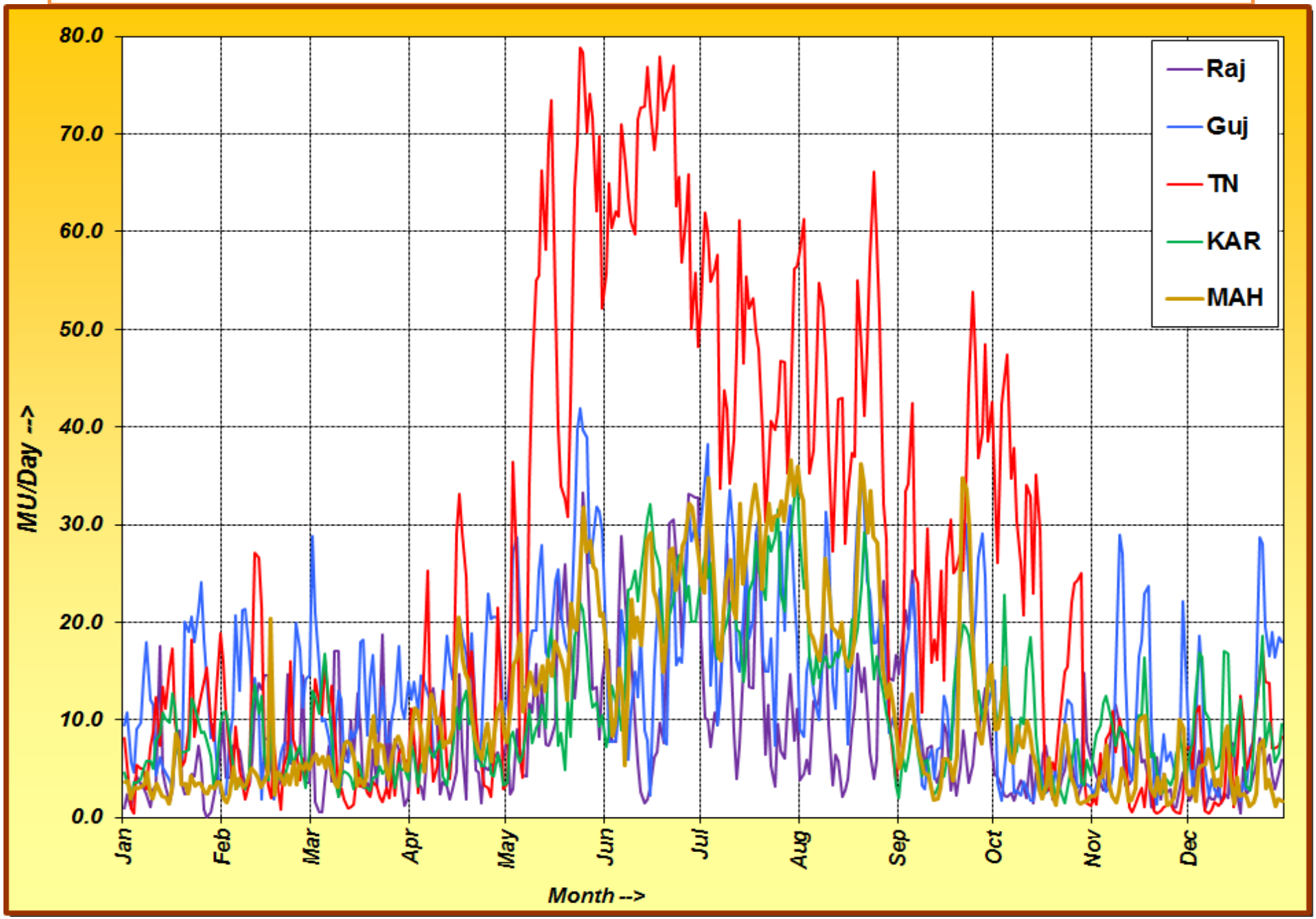
ALL INDIA WIND GENERATION (in MU) - JULY' 2010 ONWARDS

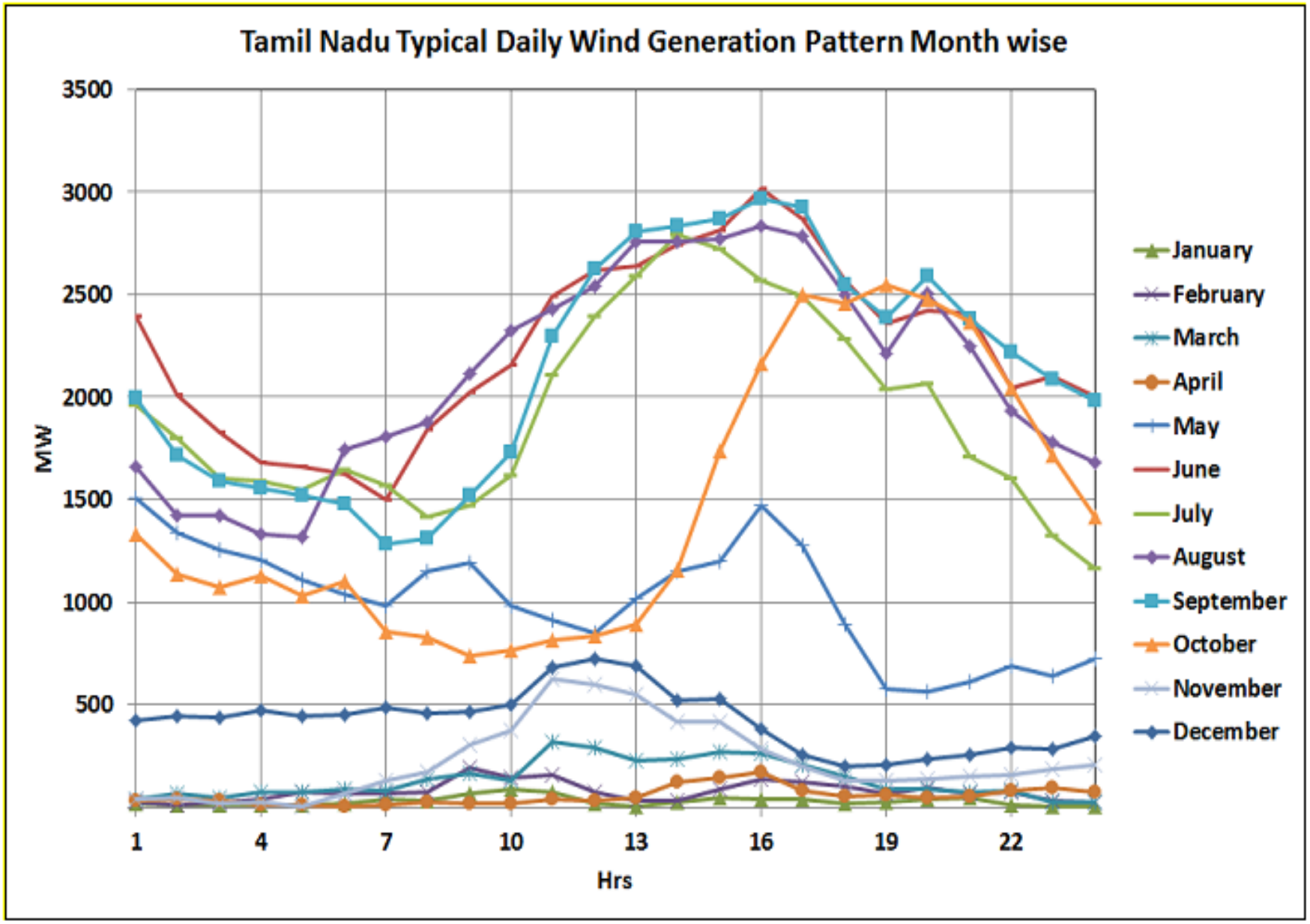


Region wise annual wind generation pattern for RE Rich Regions during 2013

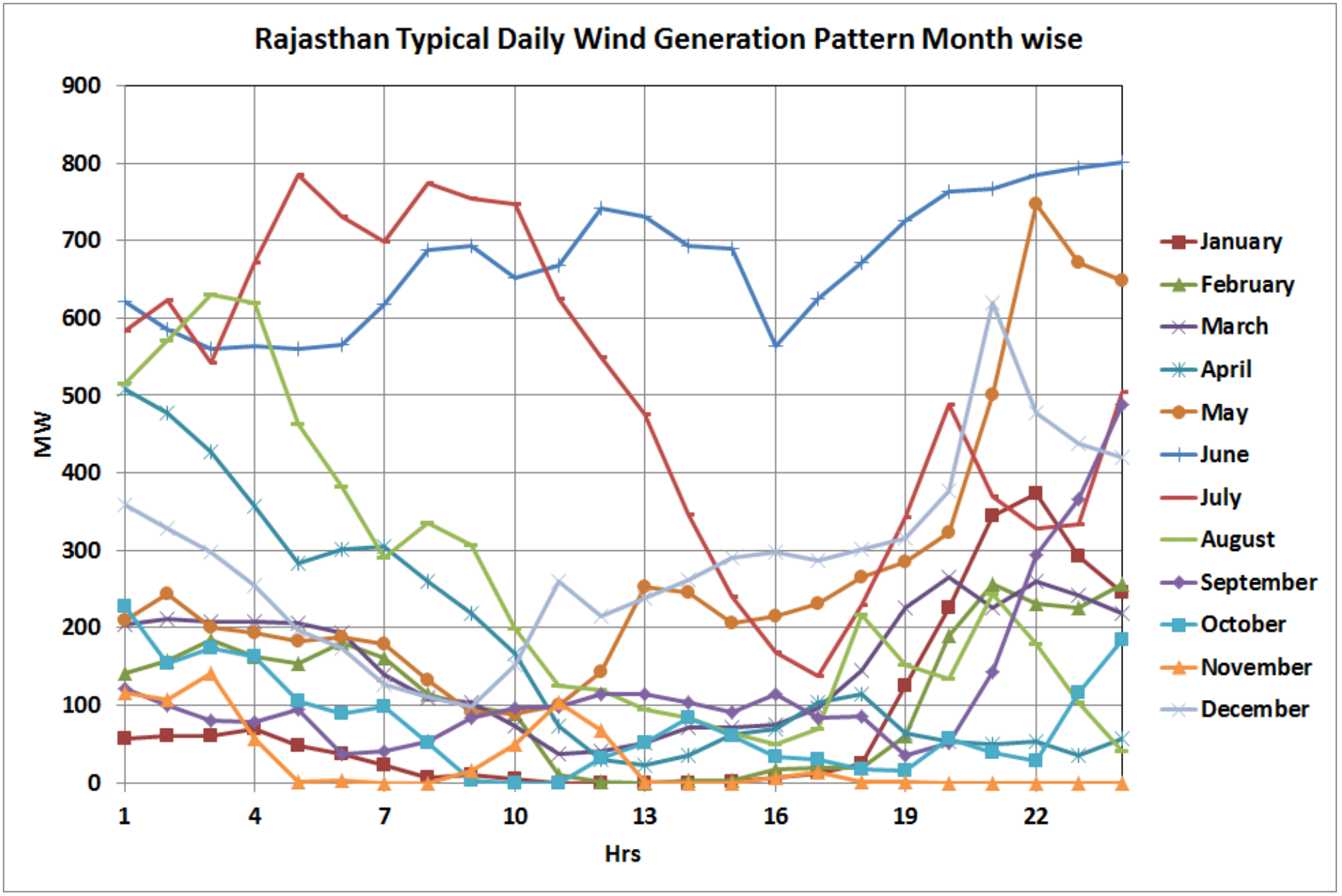


Wind generation pattern for RE rich States-2013

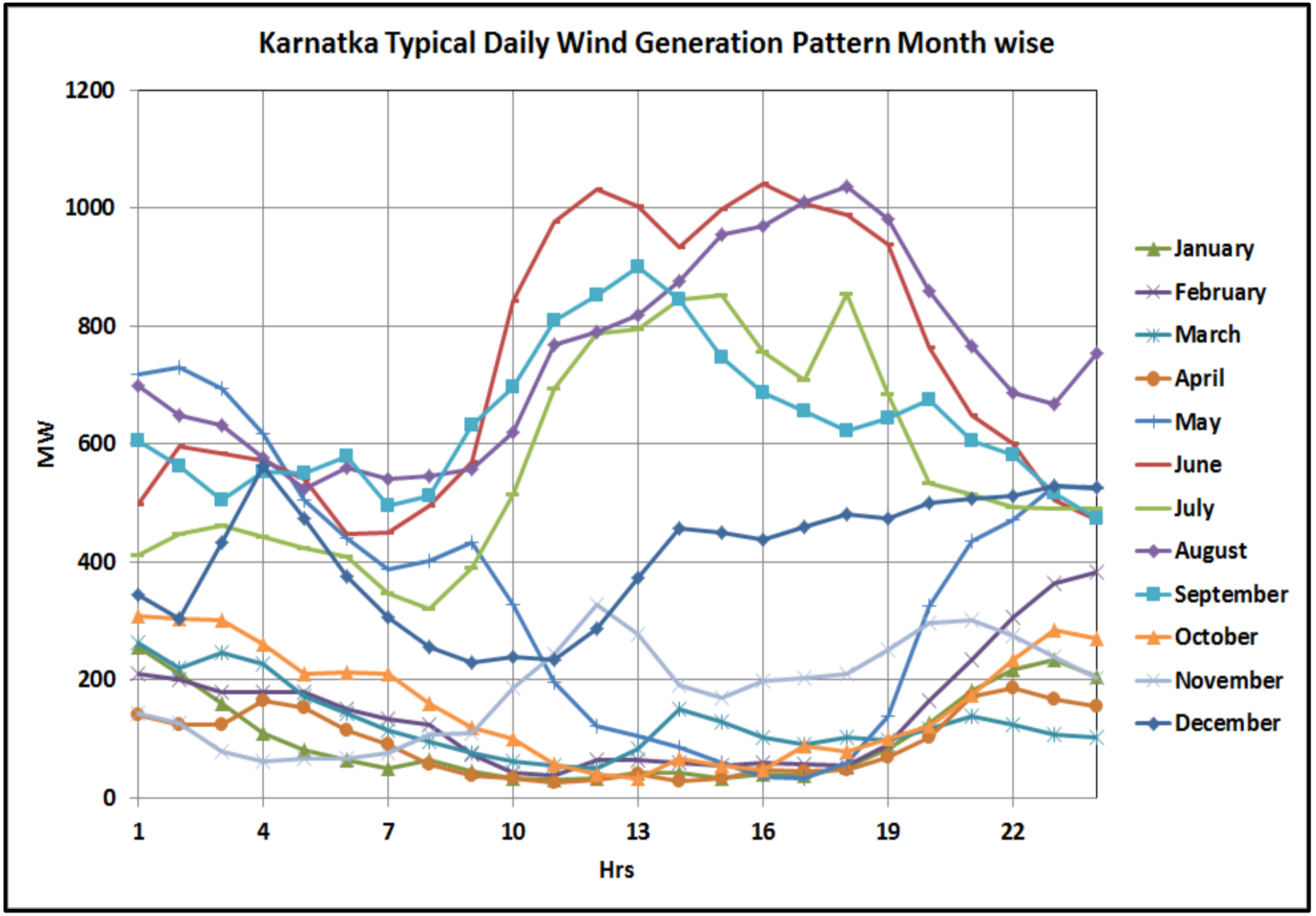


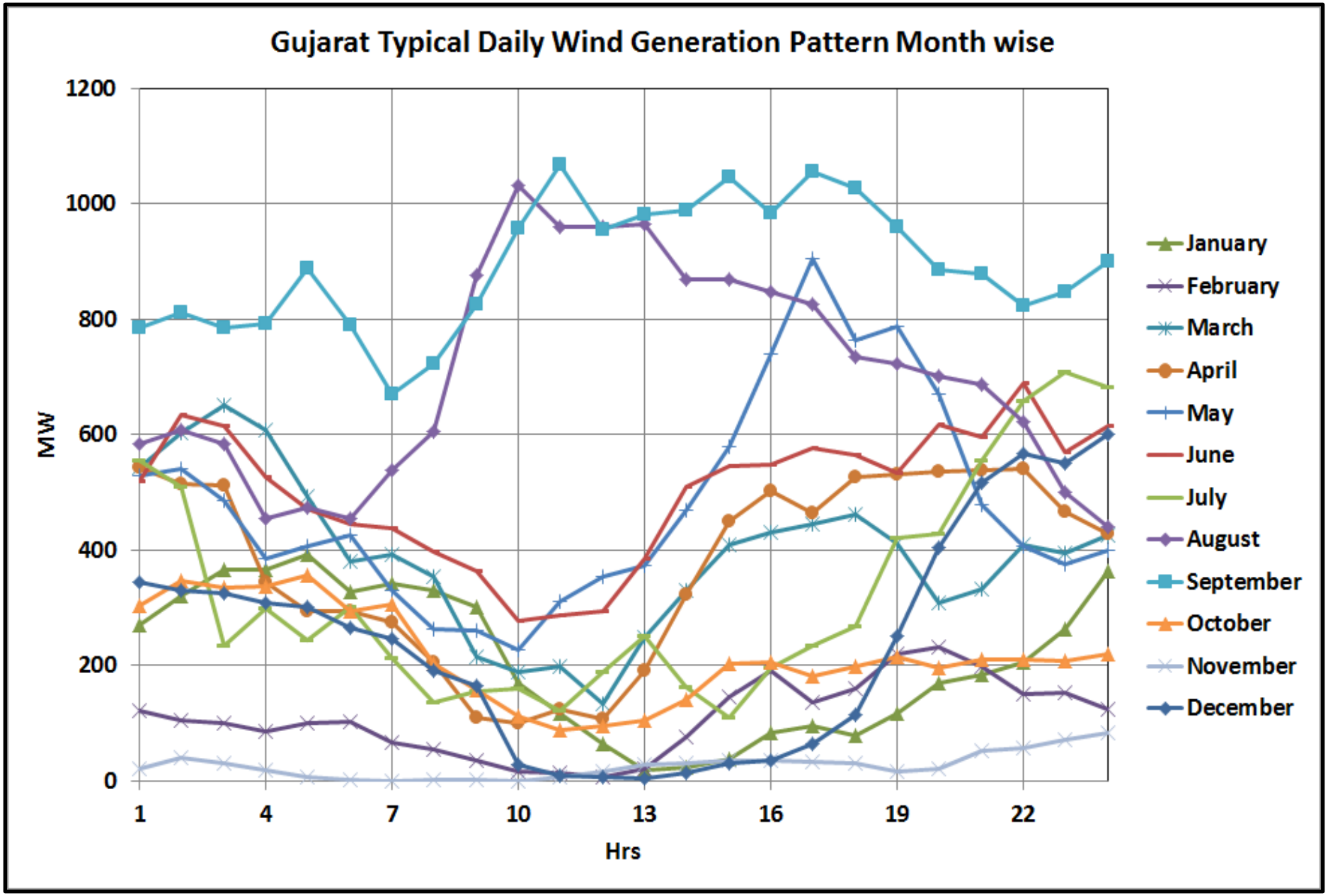


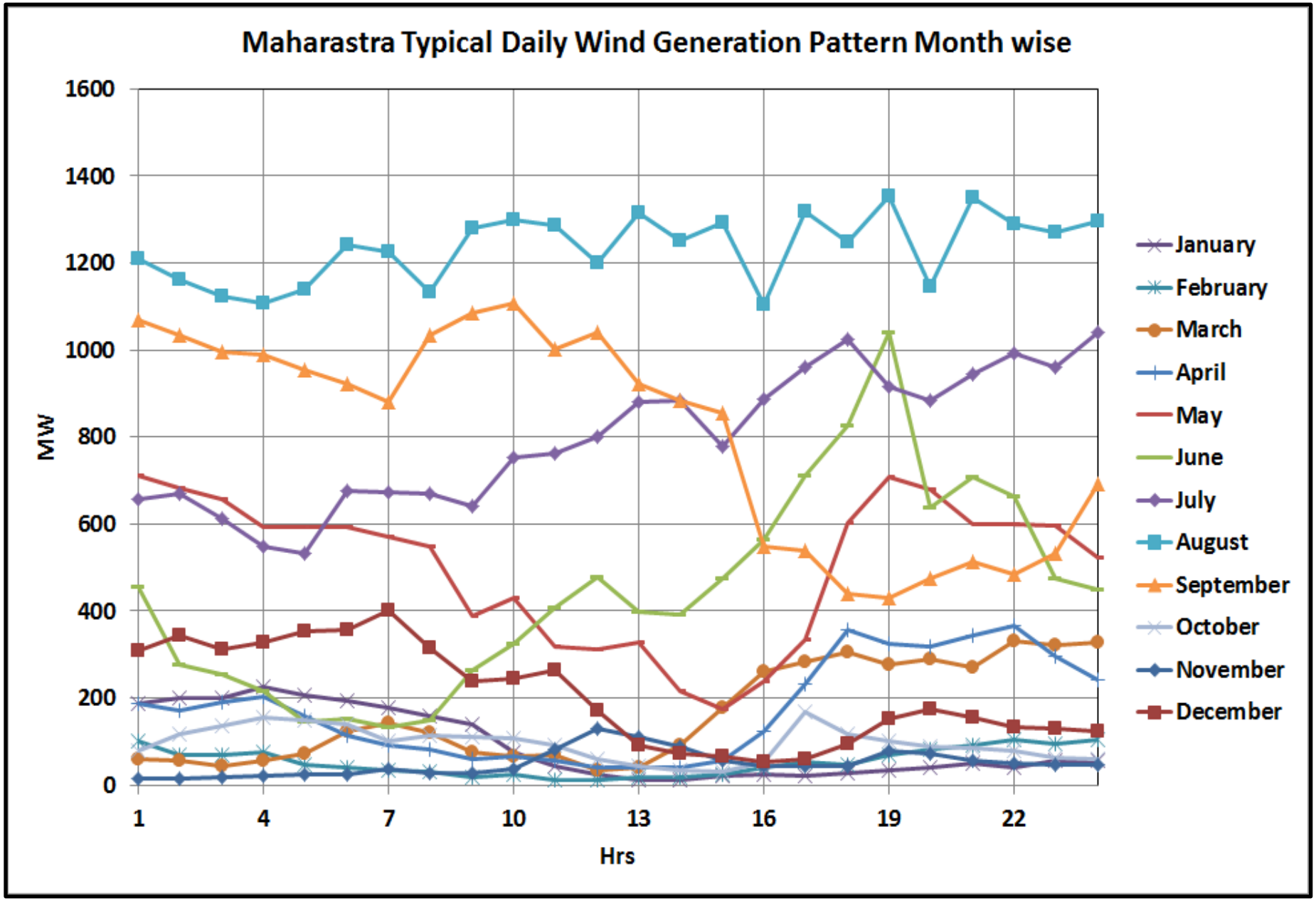
Tamil Nadu typical daily Wind Generation Pattern Month wise (Source-TAN SLDC)



Rajasthan typical daily Wind Generation Pattern Month wise *(Source-Raj SLDC)*


Karnatka Typical Daily Wind Generation Pattern Month wise
MW
1200
1000
800
600
400
200
0
1
4
7
10
13
16
19
22
Hrs
January
February
March
April
May
June
July
August
September
October
November
December


Gujarat Typical Daily Wind Generation Pattern Month wise
1200
1000
800
600
400
200
0
MW
1
4
7
10
13
16
19
22
Hrs
January
February
March
April
May
June
July
August
September
October
November
December


Maharastra Typical Daily Wind Generation Pattern Month wise
MW
Hrs
0
200
400
600
800
1000
1200
1400
1600
1
4
7
10
13
16
19
22
January
February
March
April
May
June
July
August
September
October
November
December

Specific IEGC Provisions for Renewables

- **Clause 3.4(b)-(vi)**
  CTU shall carry out the planning process including ***Renewable capacity addition plan issued by MNRE***

- **Clause 5.2 (u)**
  - Must-run stations in normal conditions
  - curtail its reactive power injection /drawl
  - Data Acquisition System facility shall be provided for transfer of information to concerned SLDC and RLDC.

Clause 6.1(d)

RRF Mechanism

- ✓ *Wind farms with collective capacity of 10 MW and above,*
- ✓ *Solar generating plants with capacity of 5 MW and above*
- connected at >=33 KV level
- ✓ wind generators to forecast upto an accuracy of 70%

Clause 6.5 (23)

- Revisions upto a max 8 times in day (1 for each 3 hr time slot)
- Revisions after a 6 time block notice

Integration issues

Integration issues

- Planning criterion for RE
- Variability and Intermittency
- Scheduling
- SCADA / telemetry
- Network related Problems and Congestion
- Protection
- Commercial mechanism implementation

Planning criterion for Wind Power Integration

Planning Transmission system for RE

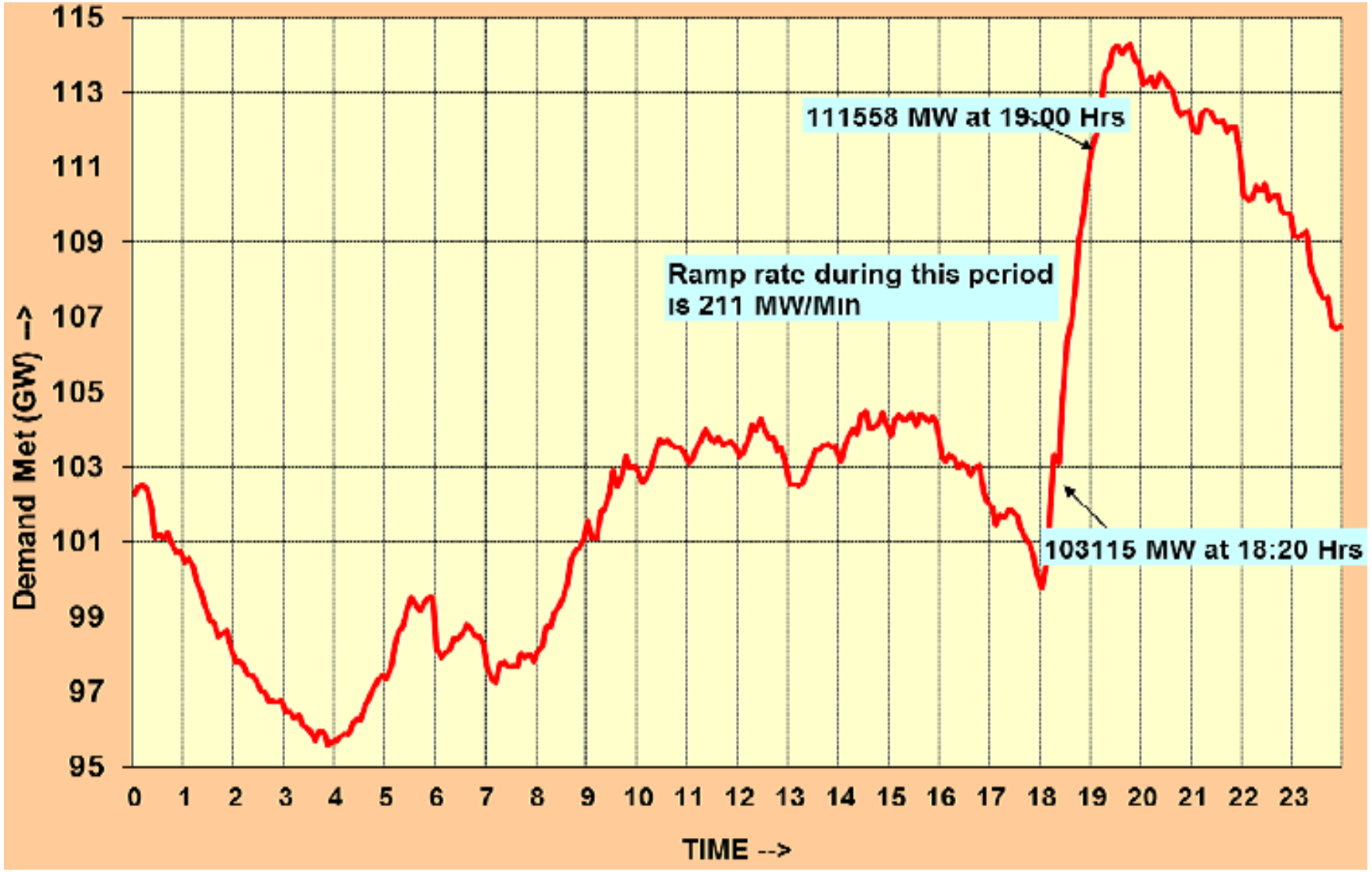
- System Studies
- Trade off between network optimal utilization and redundancy
- Network development and O&M
- Dynamic Line Rating- to be duly factored while designing evacuation systems.
- Diversity Factor- to be duly factored while designing evacuation systems.
- Wind/Solar farms are known to be providing lesser grid support during system disturbances/exigencies than the conventional.

Variability and Intermittency

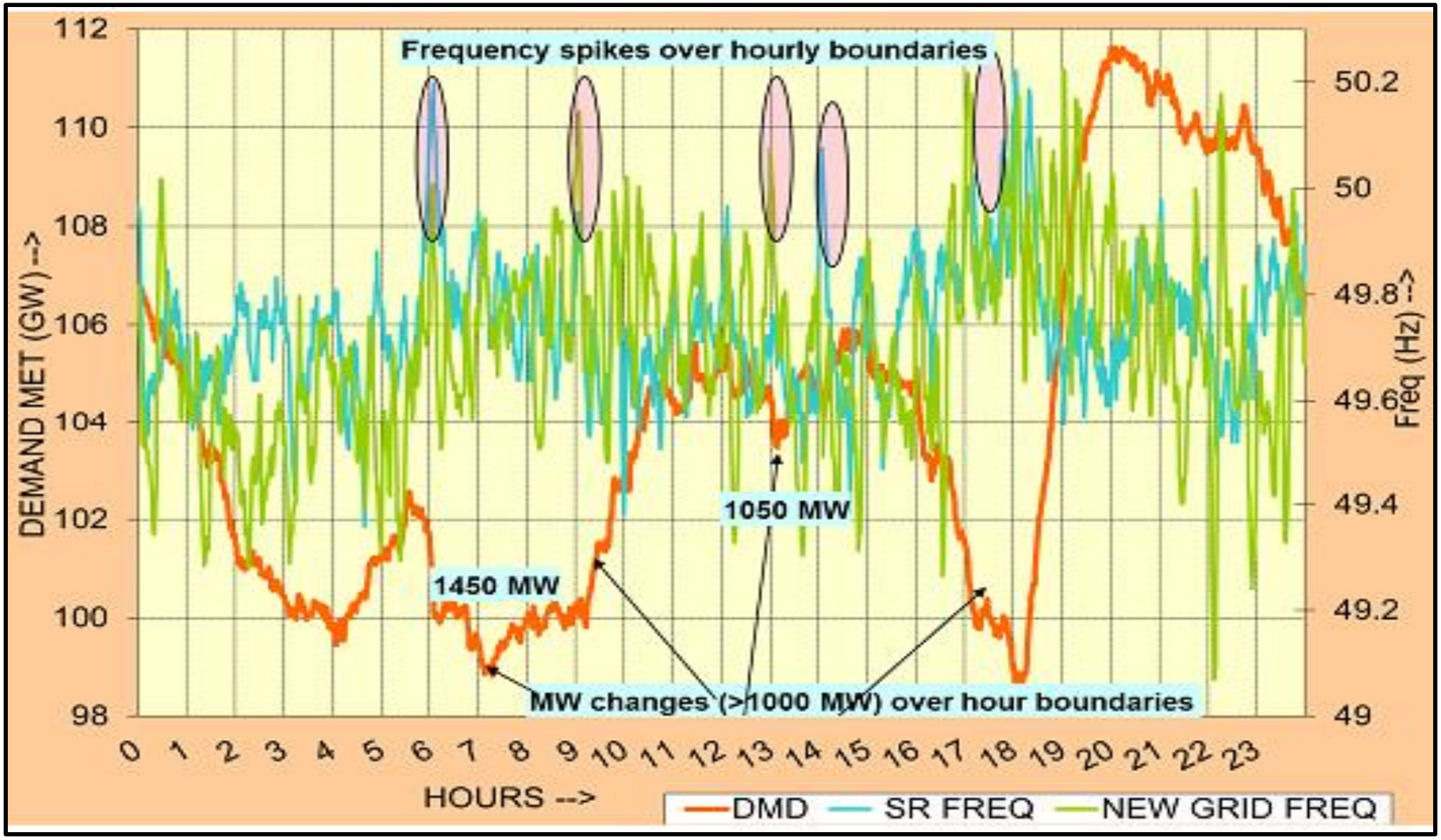
Sudden large variation in Load/ generation

- High Ramp rate of load- evening peak hours
- Sharp change in load, particularly at the hour boundaries mainly due to agricultural load changes with consequent frequent spikes
- Frequency fluctuations:
  - **due to generation or load loss**
  - **poor Frequency Response Characteristics (FRC) of individual sub-systems**
- Impact of Wind Generation variability on Host state –UI implication

Typical All India daily load curve - High Ramp rate of load



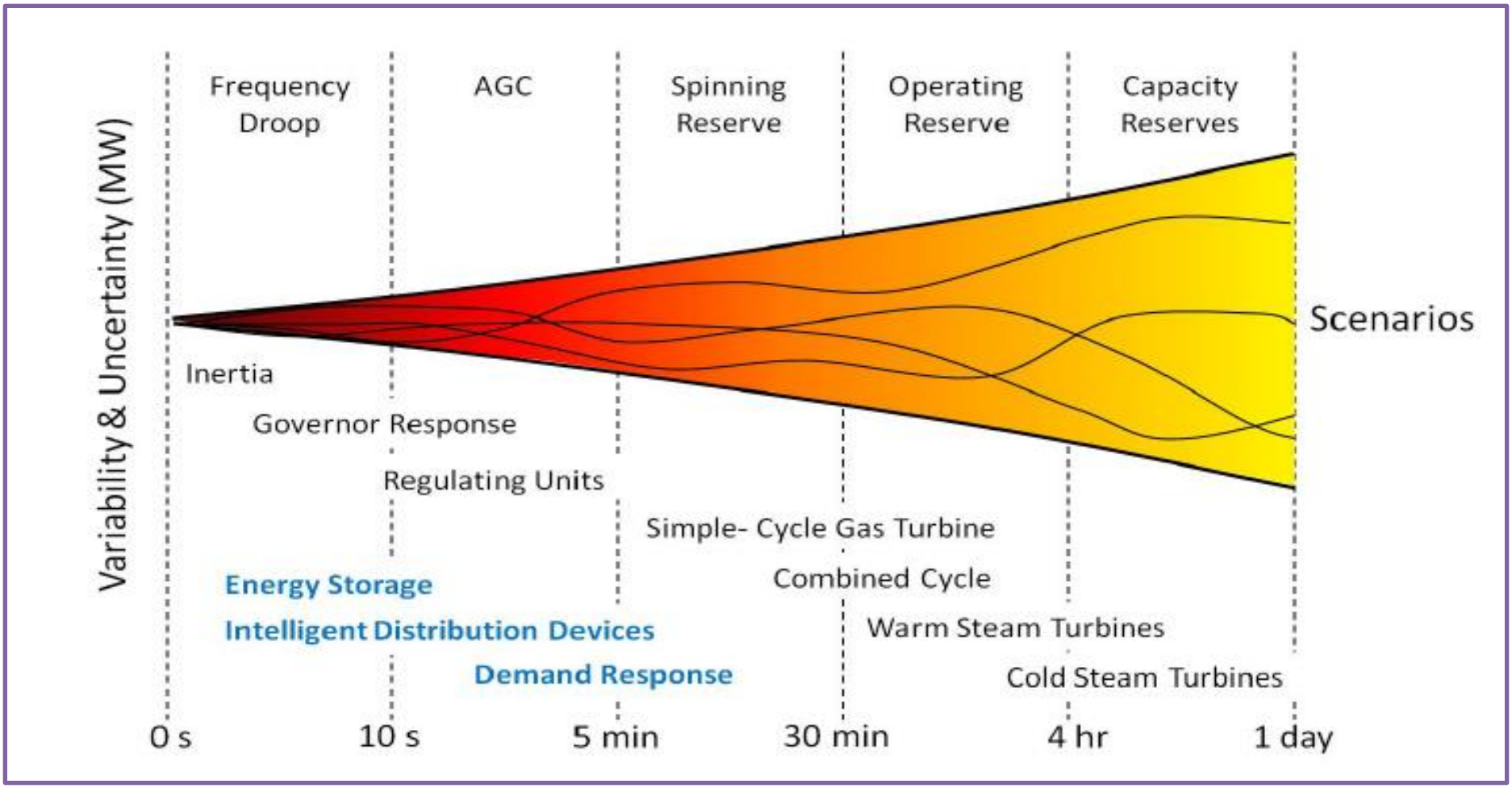
Sharp change in agricultural load- Hourly spikes at hour boundaries



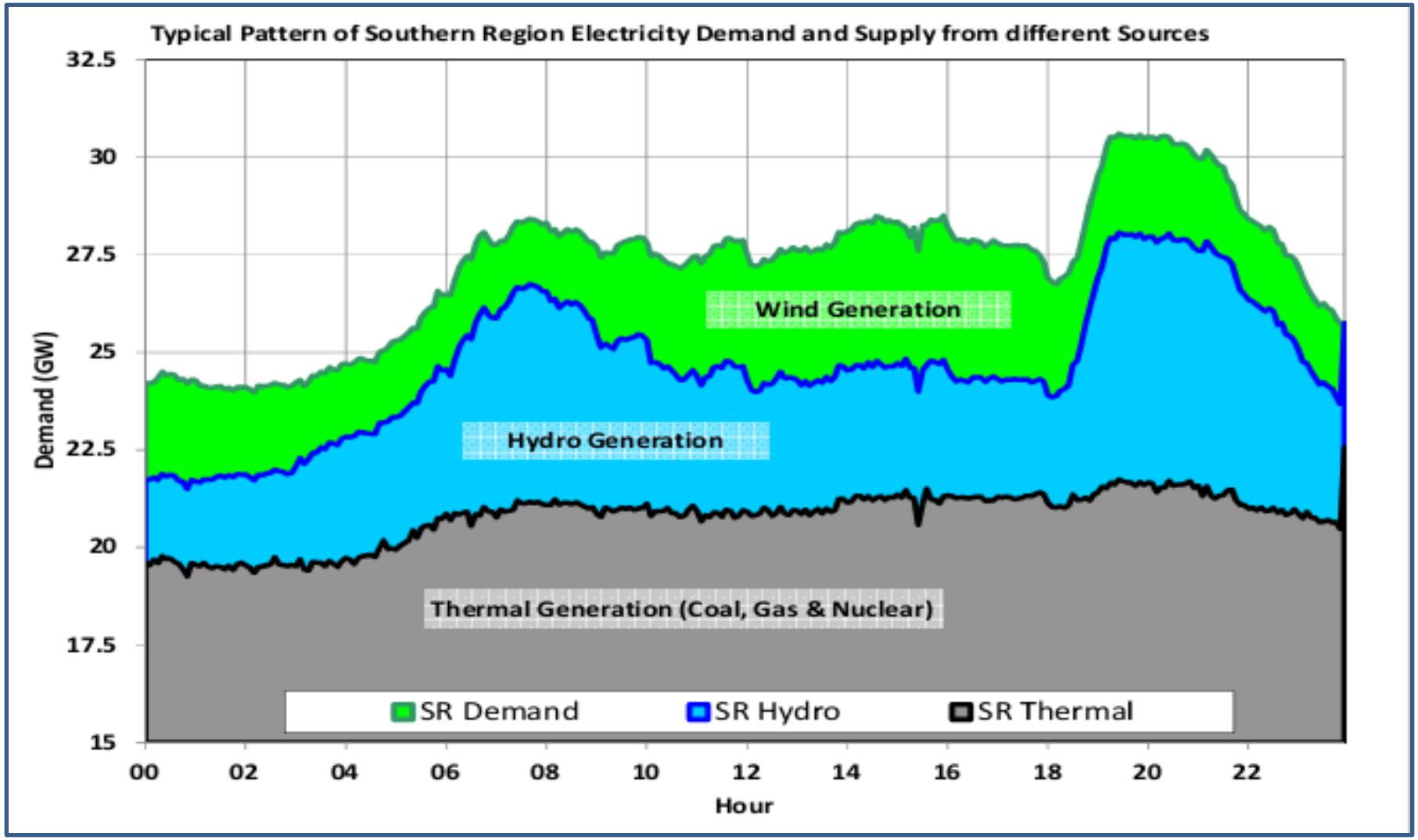
Impact of large contingencies - large fluctuations in frequency

Sno.	Event	NEW Grid FRC (MW/Hz)	SR Grid FRC (MW/Hz)	All India FRC (MW/Hz) when SR is synchronized
1	Talcher Kolar trip on 31.01.2012 @ 2149 hrs	2575	1597	4172
2	Talcher Kolar trip on 29.02.2012 @ 0310 hrs	2125	1373	3498
3	Bhadrawati HVDC Trip on 08.03.2012 @ 1622 hrs	1990	2042	4032
4	Bhadrawati HVDC Trip on 14.03.2012 @ 2122 hrs	1214	1177	2391
5	Talcher-Kolar Bipole Tripping on 22.04.2012 @ 14:32 hrs	2336	1071	3407
6	Talcher-Kolar pole-I Tripping on 01.052012 @ 17:17 hrs	3233	1729	4962

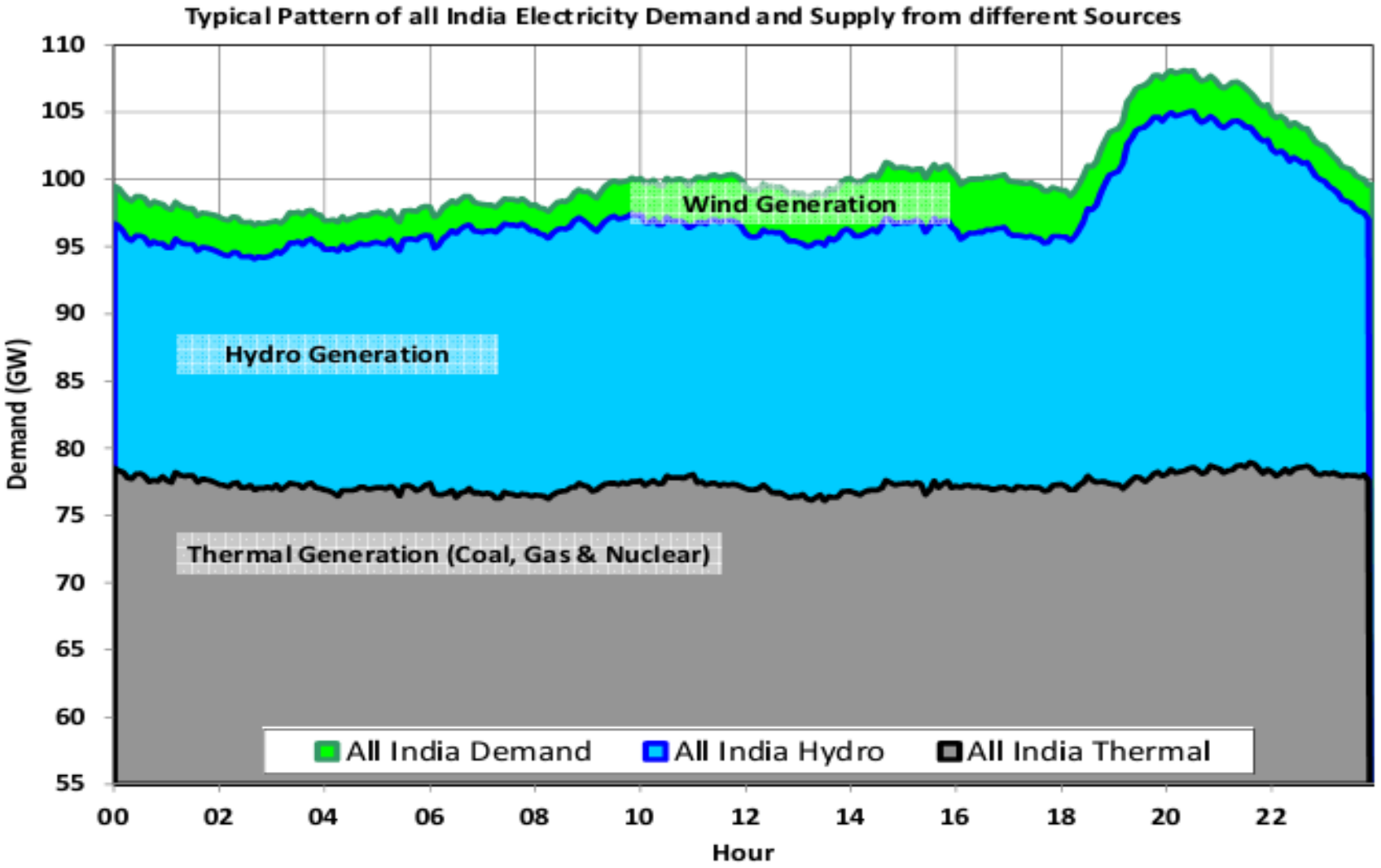
Growth of variability and uncertainty with time and associated resources & reserves available to maintain power-balance



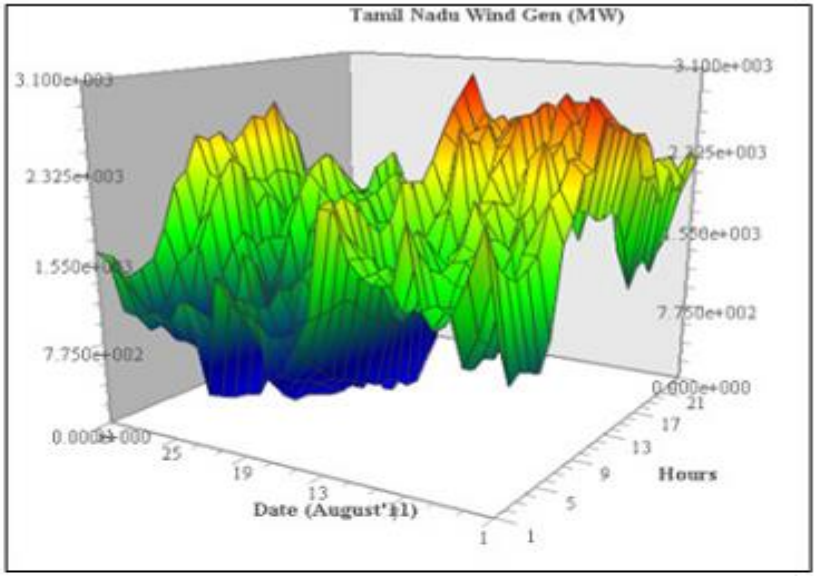
Management of Intermittency & Variability in Wind generation- Southern Region (July 2011)

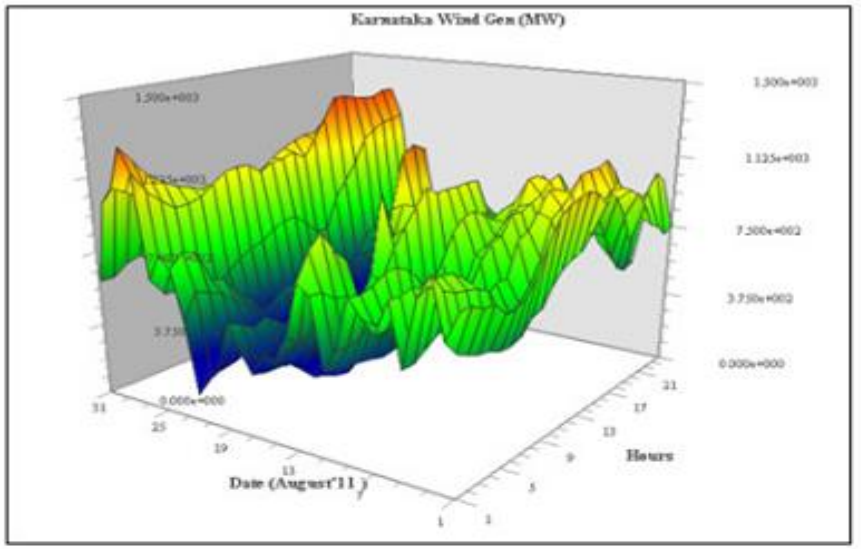


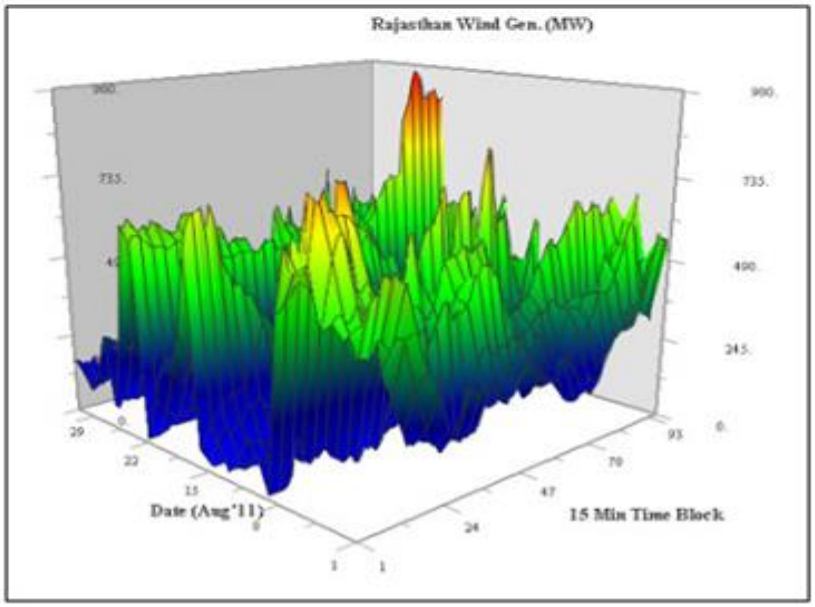
Management of Intermittency & Variability in Wind generation- All India (July 2011)

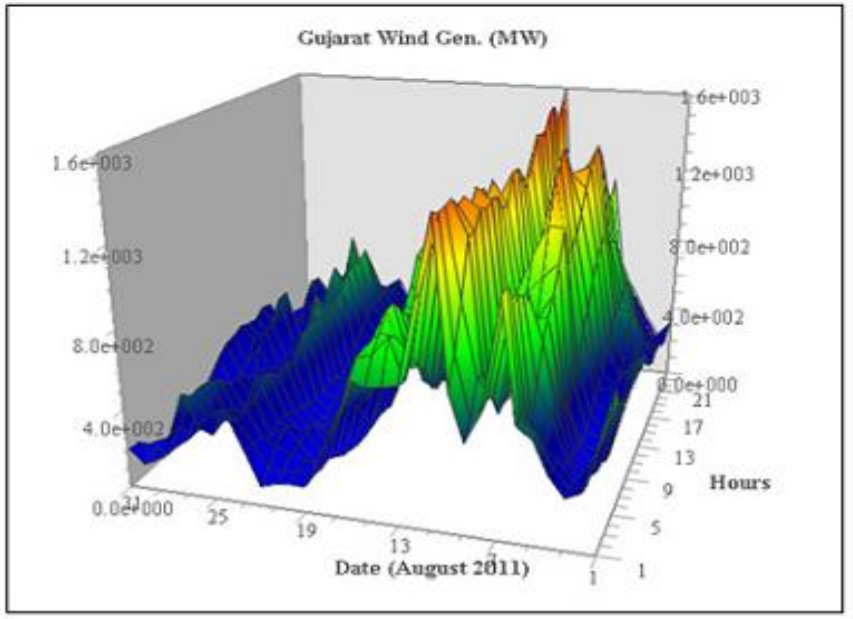


Variability of Wind Generation in States







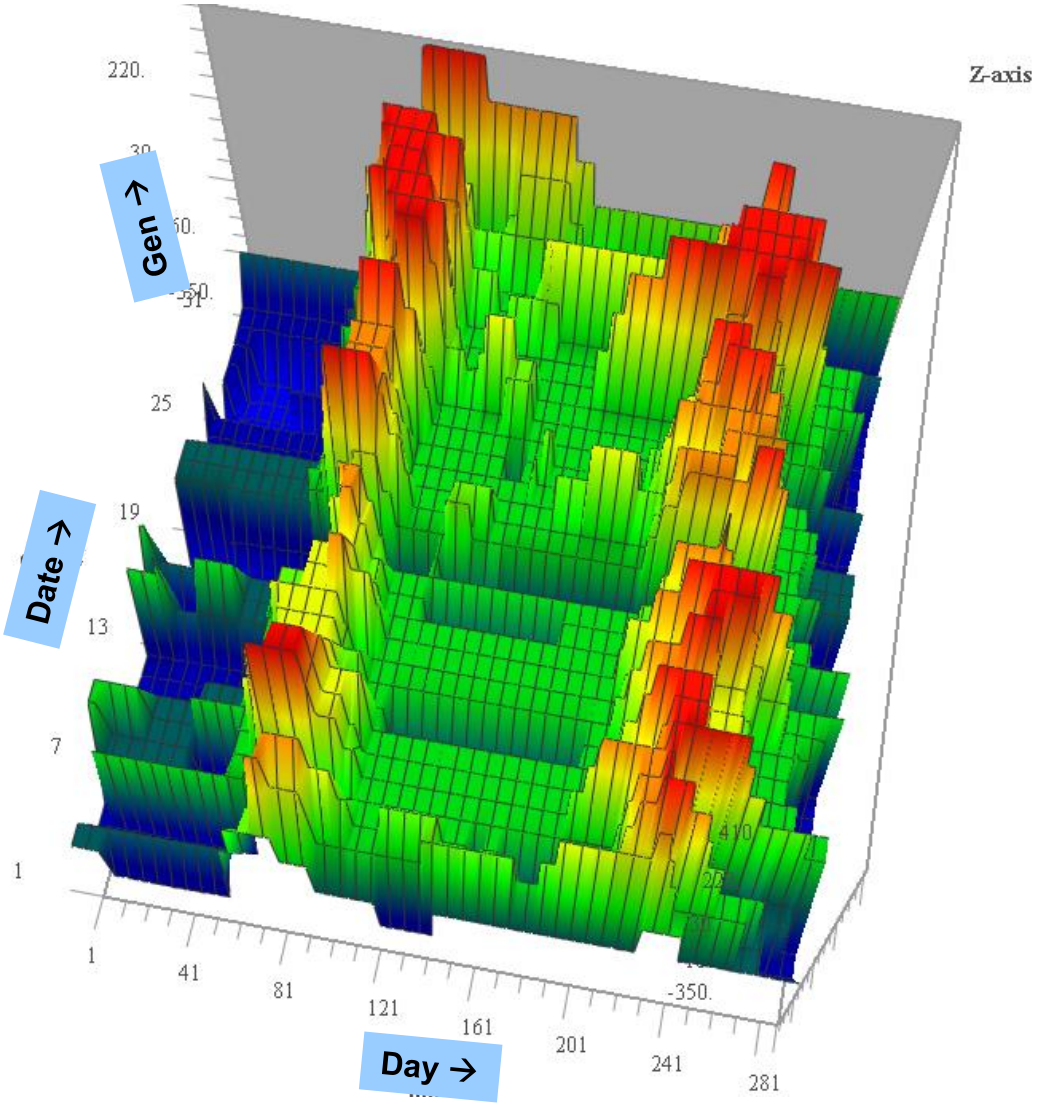


DEALING WITH WIND VARIABILITY

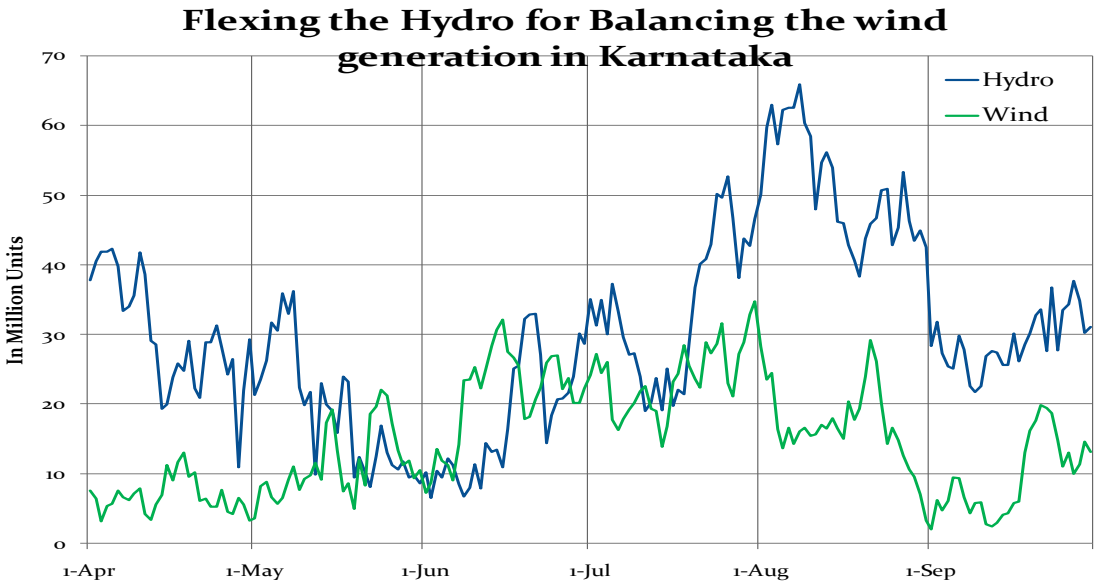
- Flexible Generation and Generation Reserves
  - ✓Primary reserve/ Frequency response reserve
  - ✓Secondary reserve - Spinning & non spinning reserves
  - ✓Tertiary reserve
  - ✓Hydropower Plant with Reservoir
  - ✓Pumped Storage Power Plant
- Flexibility for market participants
- Scheduling of Thermal & Wind power as per forecast and revisions thereof
- “smart” demand-response management to shift flexible loads to a time when more renewable energy is available
- Inter-State and Inter-regional transfer of power to harvest diversity

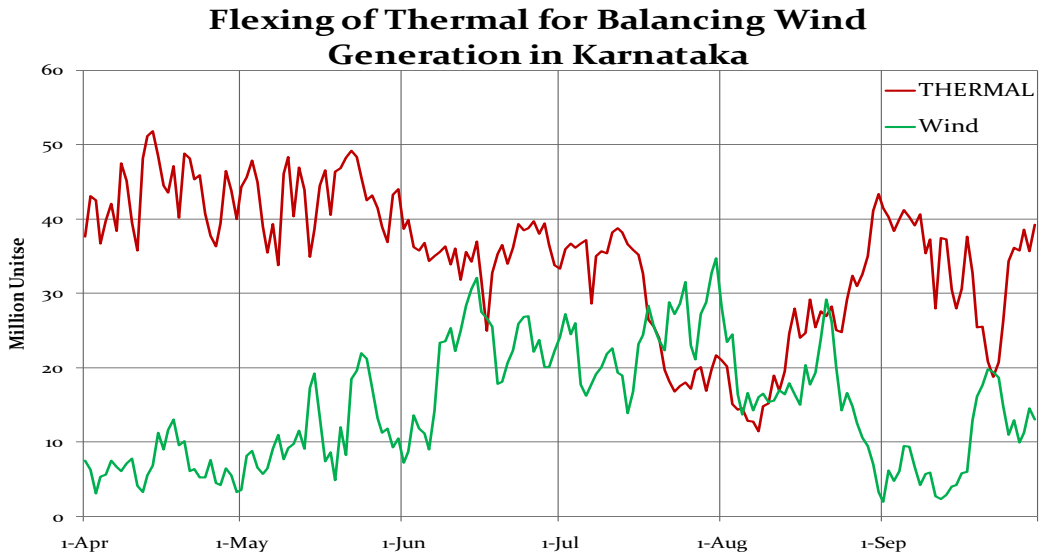
Pumped Storage Plants

- Pump Storage Plants:
  - **Purulia (4x225 MW)**
  - **Srisailam (6x150 MW)**
  - **Kadamparia (4x100 MW)**
- Pumping Mode:
  - **Purulia**
    - **Fixed timing**
    - **Typically between 00 to 06 hours**
    - **Irrespective of frequency**
  - **Kadamparia**
    - **Frequency dependent**
    - **Generally during 00 to 06 hours**
  - **Srisailam**
    - **Seasonal**
- Generator mode during day/peak hours.
  - **Kadamparia**
    - **During Morning Peak (06 to 09 hrs)**
    - **During Evening Peak (16 to 21 hrs)**



Balancing Renewable Generation





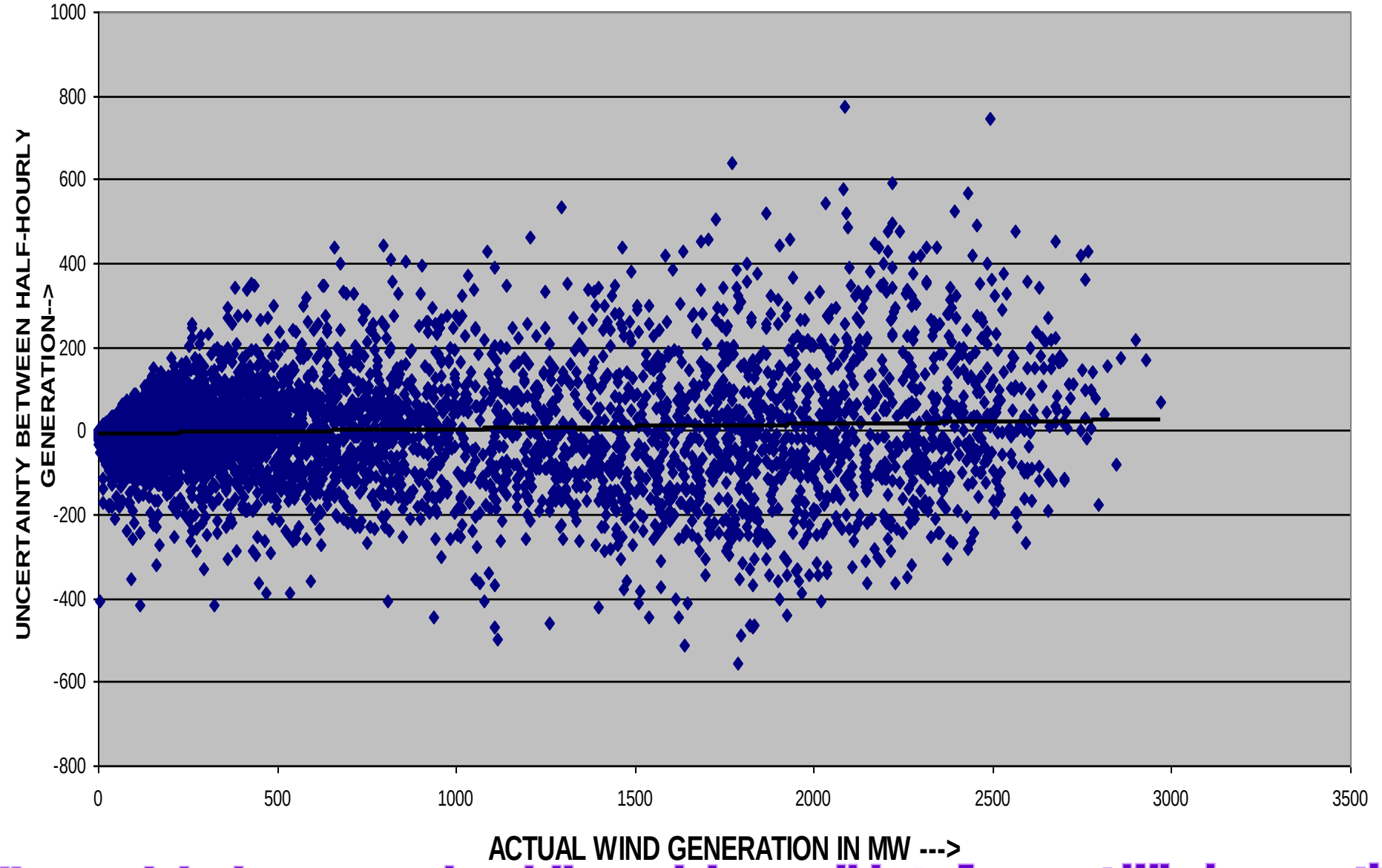
- **Challenges**
  - Variability, intermittency and ramping
  - Sudden onset or offset of wind generation
- **Remedies**
  - Generation balancing by the conventional energy sources.
  - Greater the penetration, greater the balancing requirement.
  - Forecasting of renewable generation (Solar and wind)
  - Ramp forecast is also essential.

Scheduling

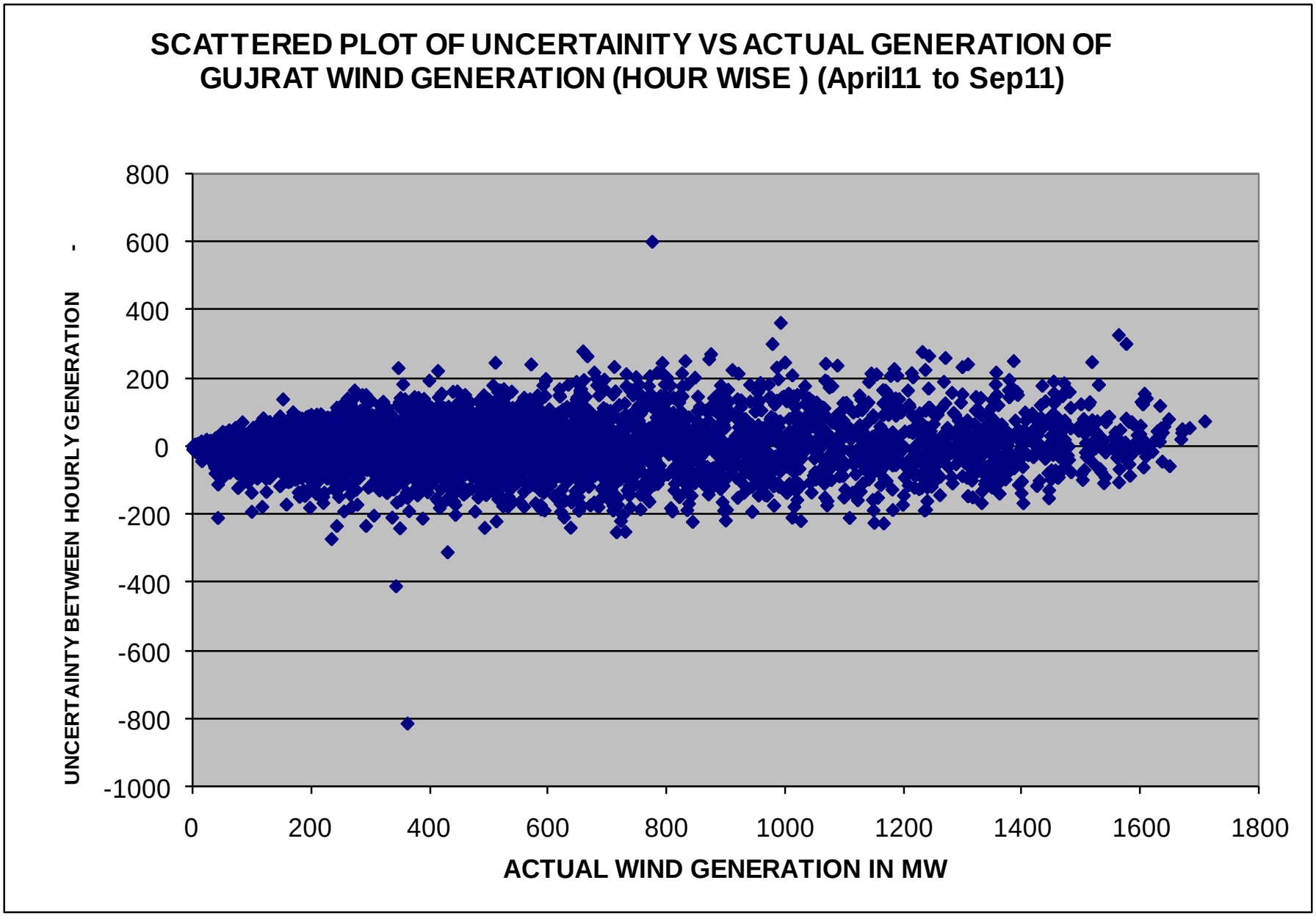
Need for Scheduling

- To maintain Load Generation balance
- Increasing penetration of Renewable power
- To handle the absence of spinning reserve
- To handle the effect of variability and intermittency
- Grid code provisions
- Revising to minimize UI
- Real Time monitoring (SCADA requirements)
- Implementation of RRF Mechanism

SCATTERED PLOT OF UNCERTAINTY Vs ACTUAL GENERATION OF TNEB WIND GENERATION (HOUR WISE) (Aug-10 to Mar-11)



Uncertainity in a narrow band, Hence it is possible to Forecast Wind generation


SCATTERED PLOT OF UNCERTAINITY VS ACTUAL GENERATION OF GUJRAT WIND GENERATION (HOUR WISE) (April11 to Sep11)
UNCERTAINTY BETWEEN HOURLY GENERATION -
800
600
400
200
0
-200
-400
-600
-800
-1000
0
200
400
600
800
1000
1200
1400
1600
1800
ACTUAL WIND GENERATION IN MW

SCADA / telemetry

SCADA and telemetry

- **Telemetering the data is a challenge - due to wide geo-graphical diversity**
- **Real time data from wind turbines to be metered and shall be transmitted to the local control centre of each wind farm**
- **The net injection of the wind farm to be measured at pooling station**
- **Deployment of synchrophasor technology i.e., PMUs/WAMS on pooling stations and interconnection with centralized control centre for real time information, monitoring and control.**
- **Real time monitoring system using Synchrophasor Technology**
- **As of now only partial data is being transmitted to RLDCs/SLDCs**
- **State-of-the-art in Centralized Forecasting centre and integration with SCADA through telemetry**

Telemetry is a must for scheduling and monitoring

Commercial mechanism implementation

Commercial mechanism

- Market mechanisms would further help large scale integration of renewable sources of energy:
  - ✓Suitable market design to handle reserves for power balancing
  - ✓Flexible Generators
  - ✓Ancillary Market
  - ✓Evening markets-through PXs
- Renewable Energy Certificate (REC) Mechanism
- Renewable purchase Obligation(RPO) – promotes the market mechanisms

Options for RE generators

REC Option

Electricity

Sale of Electricity at Market Price in open market

Sell to DisComs at Price ≤ Pooled Cost of Power Purchase*

Green Attributes

REC
[Solar & Non-Solar]

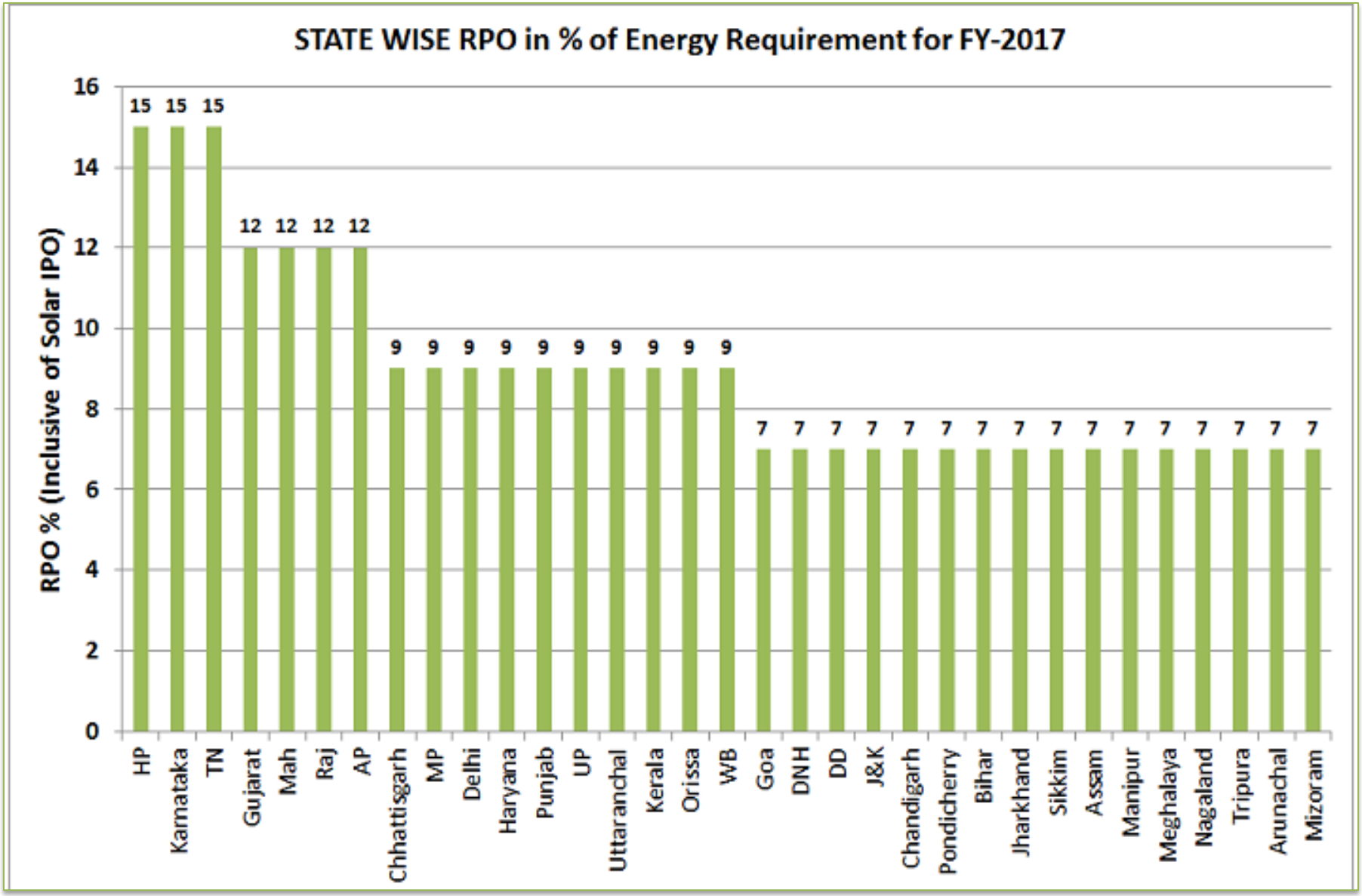
Sale of RECs at Power Exchange

Preferential Tariff
[State Regulated Tariff]

Sale of electricity to Obligated Entities at State regulated tariff

*** - Weighted Average Pooled Price at which distribution licensee has purchased electricity (including cost of self generation, long-term and short term purchase) in the previous year, but excluding the cost of RE power purchase**

Projected RPO targets



(Source – FOR report-Mar'12)

REC Mechanism

REC Portal Home Page | https://www.recregistryindia.nic.in

भारतीय अक्षय ऊर्जा प्रमाणपत्र पंजीकरण
RENEWABLE ENERGY CERTIFICATE REGISTRY OF INDIA

Welcome Guest

मुख्य पृष्ठ / Home | आरईसी के बारे में / About REC | संबंधित दस्तावेज़ / Reference Documents | कार्यप्रणाली / Procedures | आरई जेनरेटर / RE Generators | राज्य एजेंसियां / State Agencies | रिपोर्ट / Reports
सहायता / Help | हमसे संपर्क करें / Contact Us | पंजीकरण/निर्गमन जांच सूची / Registration / Issuance Checklist | पंजीकरण/निर्गमन शुल्क / Registration / Issuance Fee | क्षमता अभिवृद्धि / Capacity Building
मुख्य बिन्दु / Highlights | मानचित्र / Map

r Issuance of RECs on 10th, 20th and last day of the month pursuant to Second Amendment to CERC REC Regulations dated 10 July 2013".View Details
Agencies for recommending projects for registration.View Details
nation for Stakeholders.View Details New!

What is REC?

The Electricity Act, 2003, the policies framed under the Act, as also the National Action Plan on Climate Change (NAPCC) provide for a roadmap for increasing the share of renewable in the total generation capacity in the country.However, Renewable Energy (RE) sources are not evenly spread across different parts of the country. Read More >>

Total Signed Up RE Generators Till Now - 2380

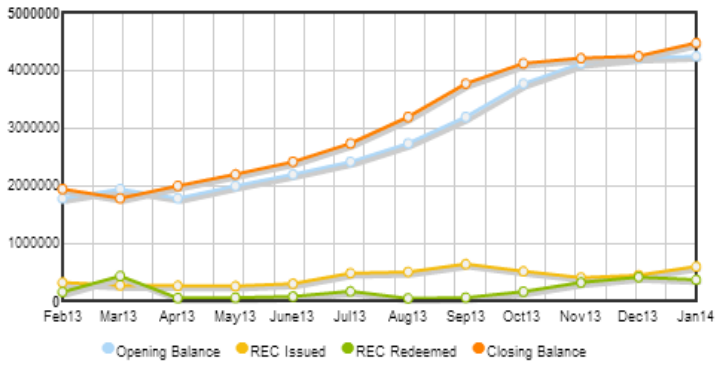
Steps for REC

1 of 4

The basic procedure for accreditation of the RE generation project shall cover following steps:

STEP 1: An application for availing accreditation shall be made by the generating company to the host State Agency, as defined under Clause 2(1) (n) of the CERC REC Regulations. ...Read More >>

REC Graph



REC Summary

Month, Year	Opening Balance	REC Issued	REC Redeemed	Closing Balance
Feb, 2013	1775130	316799	155186	1936743
Mar, 2013	1936743	271240	431054	1776929
Apr, 2013	1776929	261743	46676	1991996
May, 2013	1991996	253194	54671	2190519
June, 2013	2190519	295730	73965	2412284
Jul, 2013	2412284	480189	163431	2729042
Aug, 2013	2729042	501714	43248	3187508
Sep, 2013	3187508	635500	56543	3766465
Oct, 2013	3766465	511208	159897	4117776
Nov, 2013	4117776	404032	316282	4205526
Dec, 2013	4205526	445963	411744	4239745
Jan, 2014	4239745	594279	365358	4468666
Total:		9765993	5297327	

Log In
Password
Log In
Forget/Resend Password

Sign Up
New RE Generators

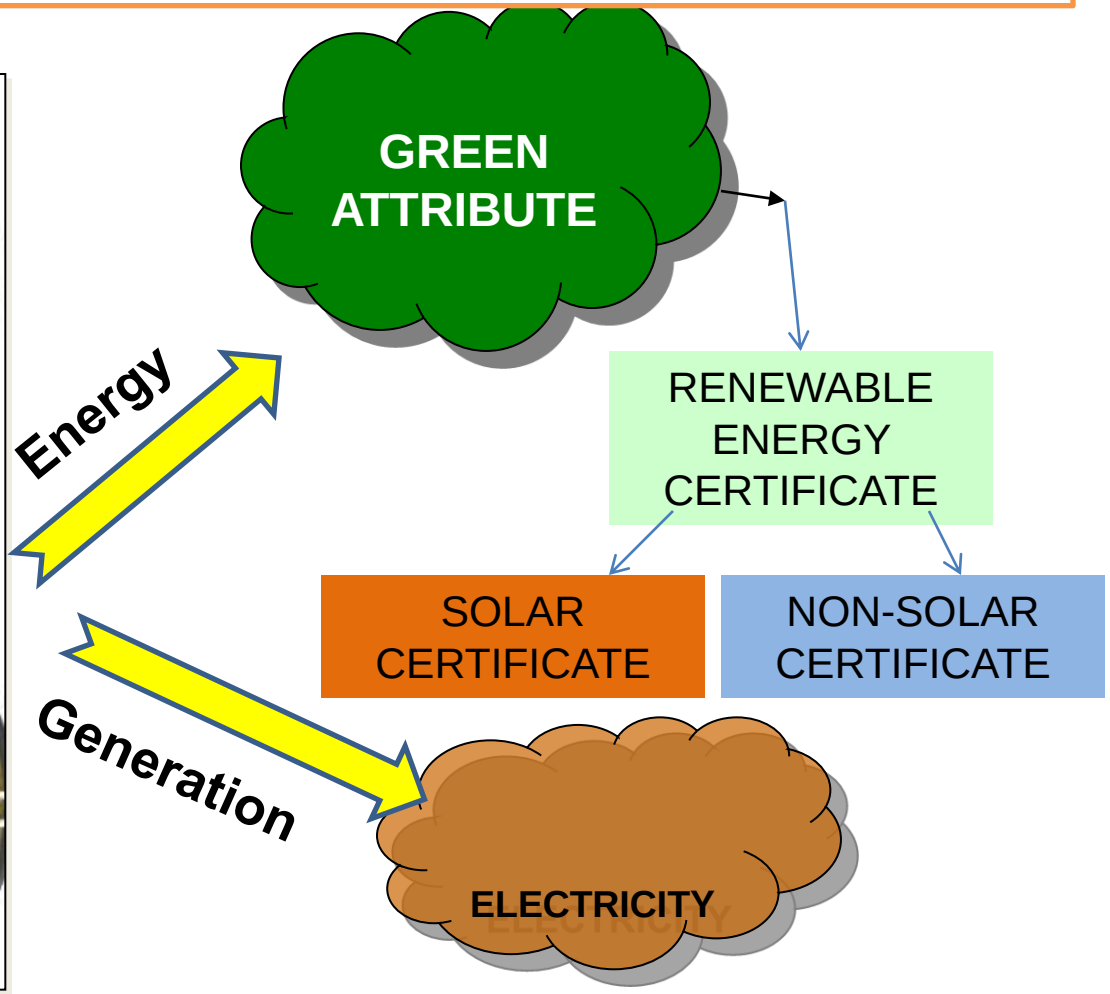
Related Links

- MNRE
- MoP
- CERC
- FOR
- Central Agency/NLDC
- SERCs
- State Agencies
- Power Exchange

Visitor Number - 5301337

PhotoGallery

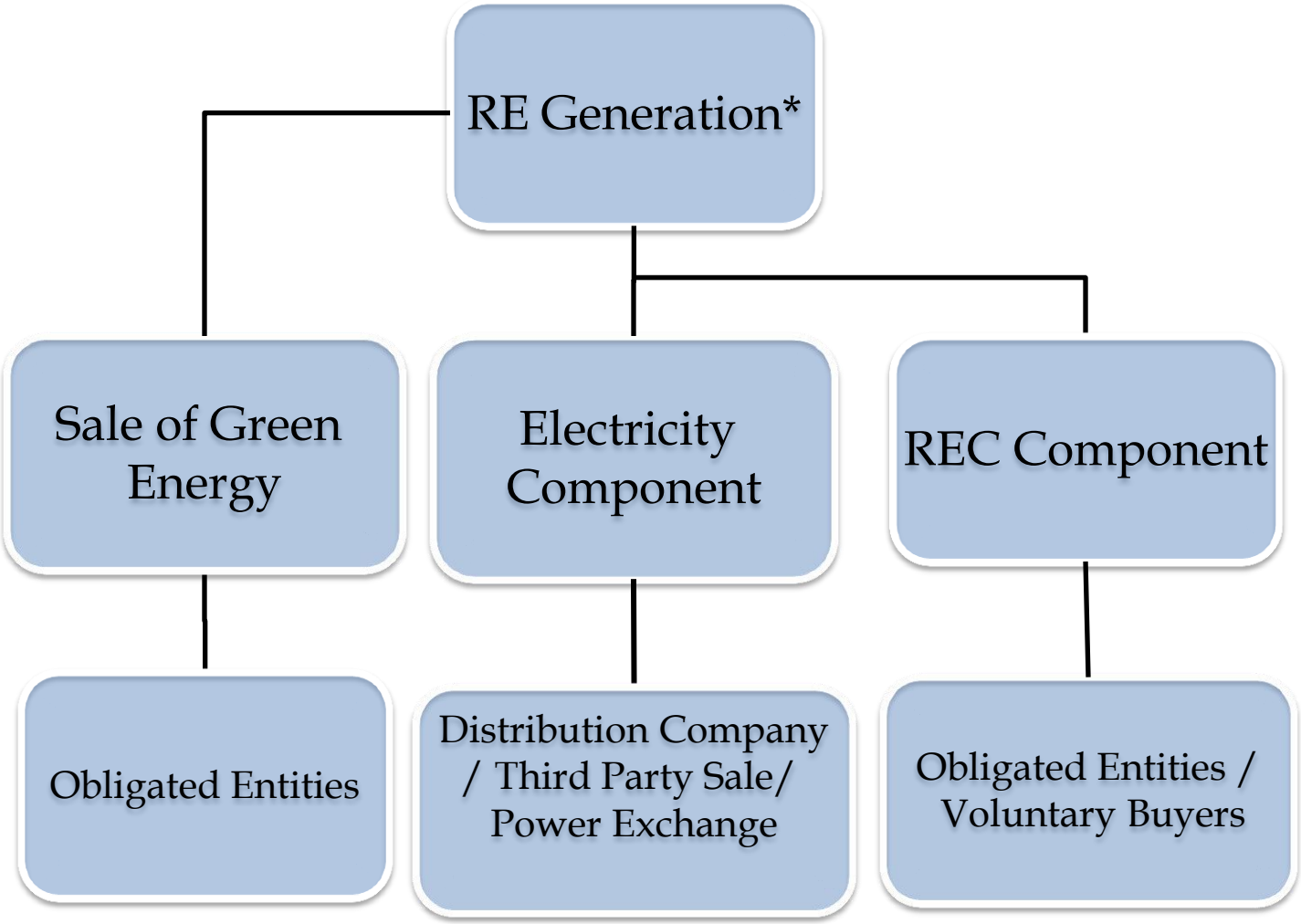
REC Concept



Key Highlights:-

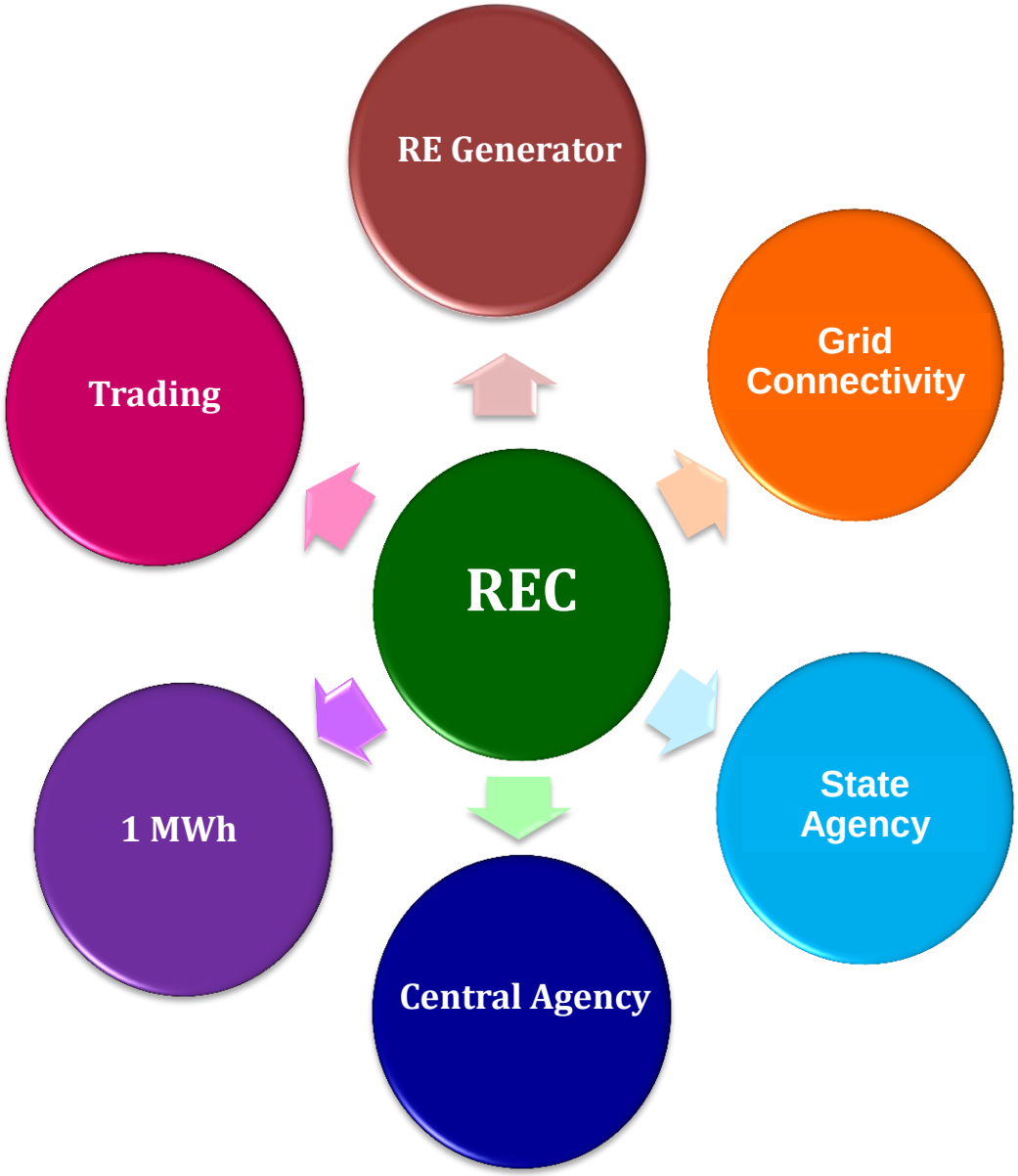
- Provides commercial mechanism for promoting renewable Energy
- Translates Government Policy to Action
- Brings in Investment in the Renewable Sector
- Platform for Environmentally concious Individuals and Corporates to Contribute

CERC REC Regulations -2010



* Self consumption by CPPs based upon renewable generation are eligible for RECs

Salient Features of REC Mechanism



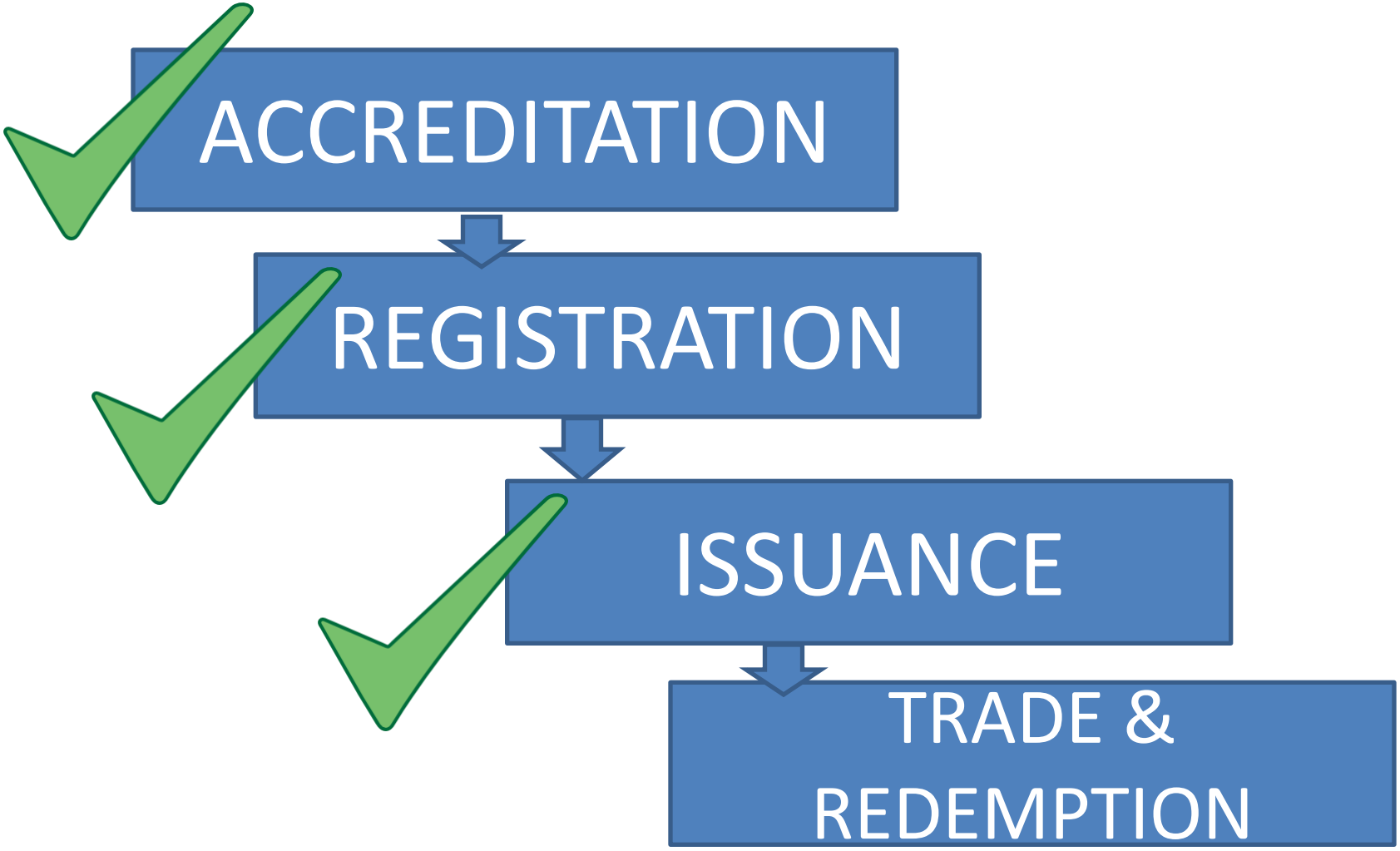
REGULATORY PROVISIONS

Renewable Energy Certificate Mechanism (REC): Eligibility

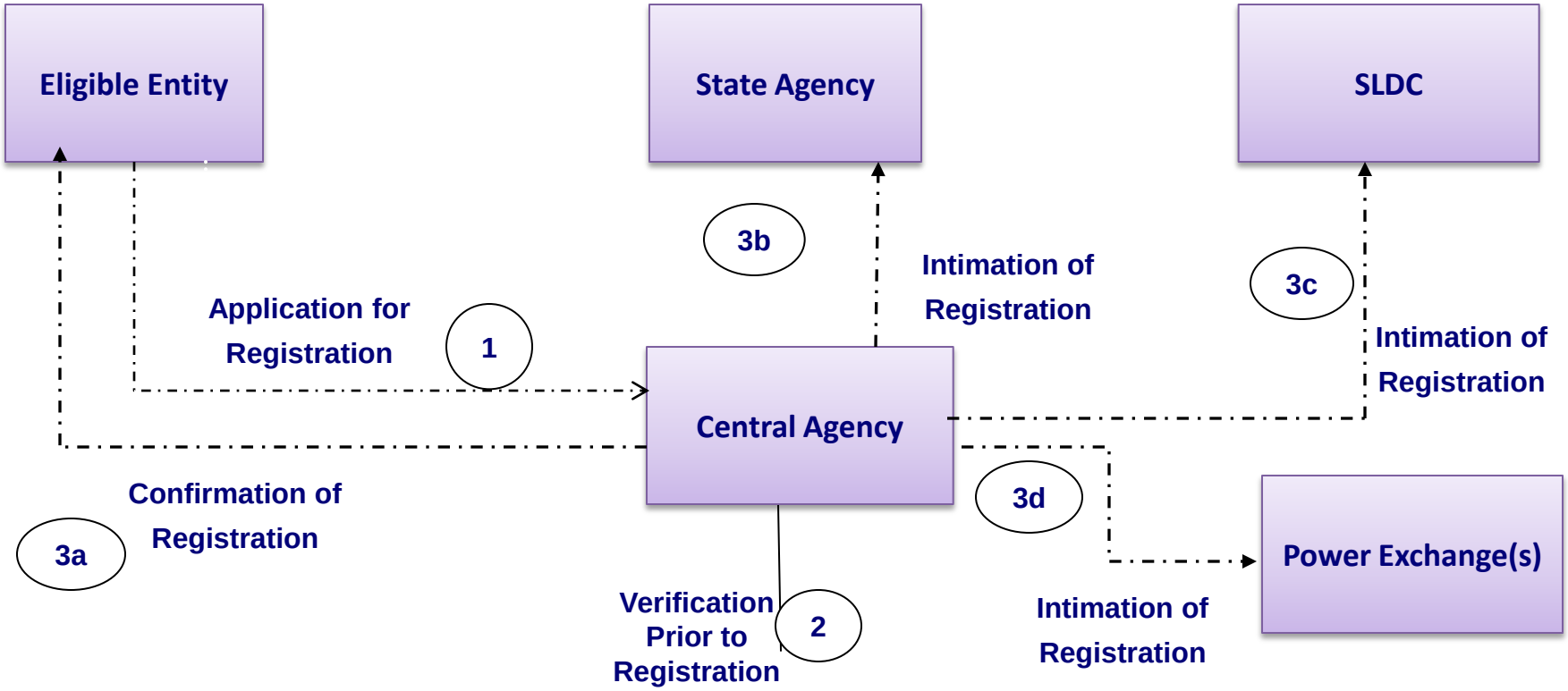
Grid Connected RE technology approved by MNRE

- **Self Consumption/ Captive use**
  - No Promotional Wheeling
  - No Promotional Banking
  - → **Eligible if both conditions mentioned above are met**
- **Third party sale/Open Access**
  - Sale at Mutually Agreed Price
  - → **Eligible**
- **PPA with Distribution Licensee**
  - PPA at Average Power Purchase Cost
    - → **Eligible**
  - PPA at rates as determined under section 62 and 63 of Act
    - → **Not Eligible**

REC Process



Schematic Description: Registration Procedure



Information to be furnished by the applicant

Owner Details, RE Generating Station details, Certificate of Accreditation

Commissioning Schedule, Details of Fee & Charges, Declaration

Latest Developments

- Eligibility criteria for issuance of Certificate for:
  - Renewable energy contracted through competitive bidding
  - Self consumption by a seasonal RE generator
  - Self consumption by a renewable energy based captive generating plant (CGP) and by a renewable energy generator other than a CGP
- Clarity on minimum capacity requirement for eligibility for Certificate
- Procurement of electricity at Average Pooled Purchase Cost (APPC) rate as determined by appropriate Commission
- Extension of time period for applying for issuance of Certificate
- Extension of shelf life of the Certificate
- Self-retention of RECs by RE Generators
- Clarity on issuance of RECs to an eligible entity from date of registration.

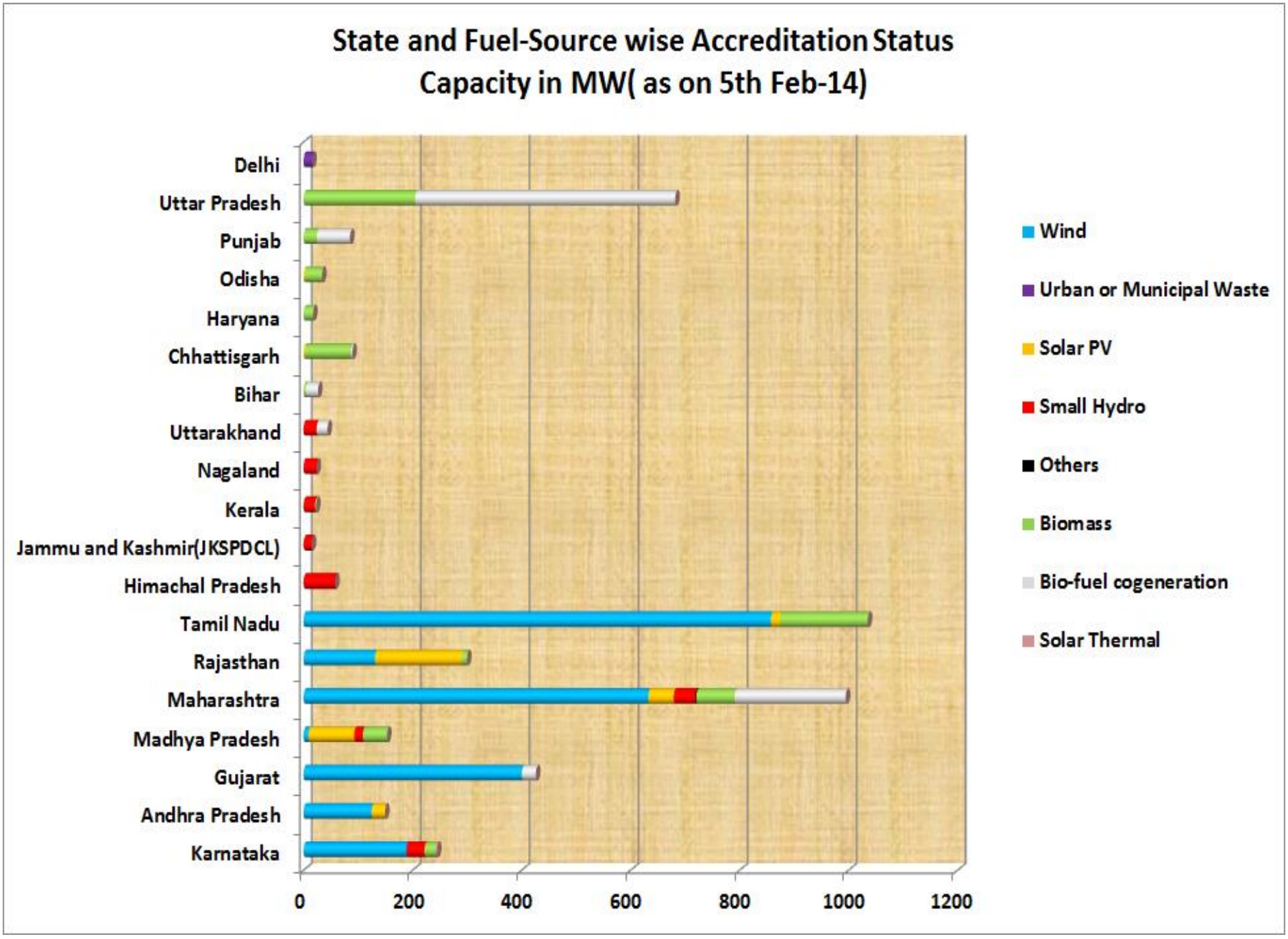
- **REC- Current Status**

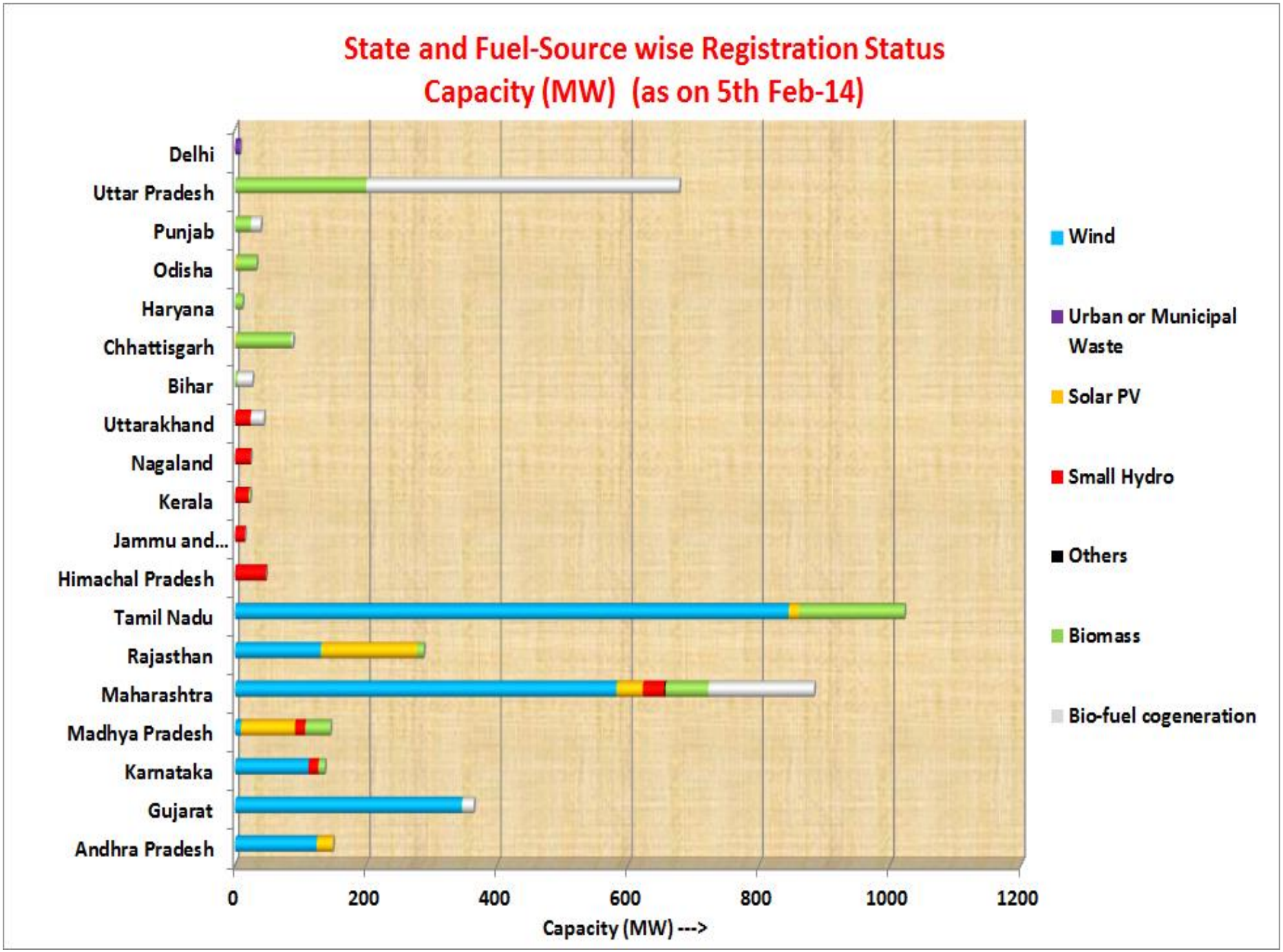
Status Update

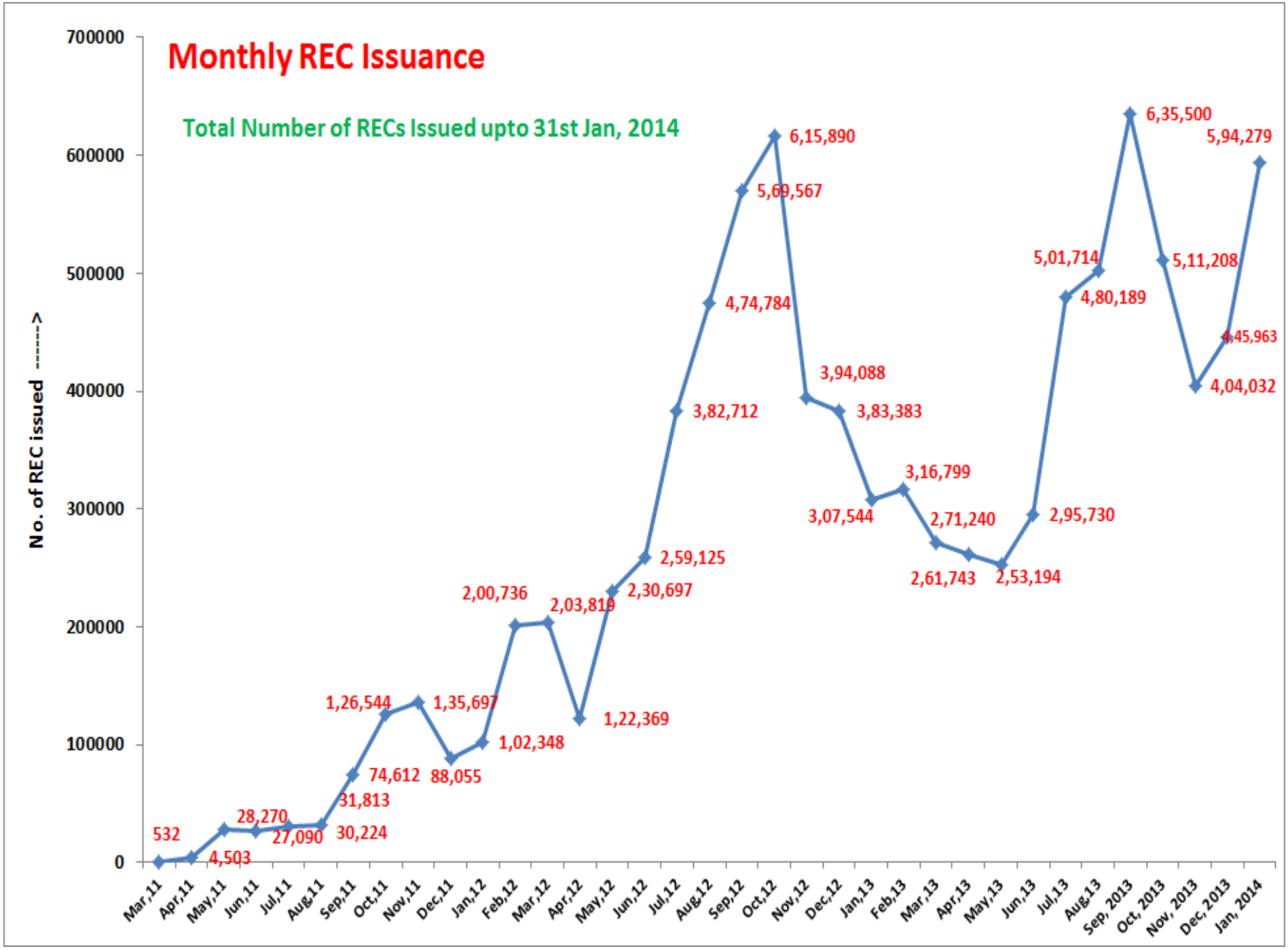
(up to 5th Feb,2014)

- **Registration:**
  - **868 Projects** with Capacity **4030 MW**
- **Accreditation:**
  - **950 Projects** with Capacity **4419 MW**
- **REC Inventory:**

	Solar	Non Solar	Total
RECs Issued	1,60,026	96,05,967	**97,65,993**
RECs Traded	61,366	52,35,961	**52,97,327**
Balance RECs	**98,660**	**43,70,006**	**44,68,666**


State and Fuel-Source wise Accreditation Status
Capacity in MW(as on 5th Feb-14)
Delhi
Uttar Pradesh
Punjab
Odisha
Haryana
Chhattisgarh
Bihar
Uttarakhand
Nagaland
Kerala
Jammu and Kashmir(JKSPDCL)
Himachal Pradesh
Tamil Nadu
Rajasthan
Maharashtra
Madhya Pradesh
Gujarat
Andhra Pradesh
Karnataka
0
200
400
600
800
1000
1200
Wind
Urban or Municipal Waste
Solar PV
Small Hydro
Others
Biomass
Bio-fuel cogeneration
Solar Thermal


State and Fuel-Source wise Registration Status
Capacity (MW) (as on 5th Feb-14)
Delhi
Uttar Pradesh
Punjab
Odisha
Haryana
Chhattisgarh
Bihar
Uttarakhand
Nagaland
Kerala
Jammu and...
Himachal Pradesh
Tamil Nadu
Rajasthan
Maharashtra
Madhya Pradesh
Karnataka
Gujarat
Andhra Pradesh
0
200
400
600
800
1000
1200
Capacity (MW) --->
Wind
Urban or Municipal Waste
Solar PV
Small Hydro
Others
Biomass
Bio-fuel cogeneration


Monthly REC Issuance
Total Number of RECs Issued upto 31st Jan, 2014
No. of REC issued ------>
700000
600000
500000
400000
300000
200000
100000
0
532
4,503
28,270
27,090
30,224
31,813
74,612
1,26,544
88,055
1,35,697
1,02,348
2,00,736
2,03,819
1,22,369
2,30,697
2,59,125
3,82,712
4,74,784
5,69,567
6,15,890
3,94,088
3,83,383
3,07,544
3,16,799
2,71,240
2,61,743
2,53,194
2,95,730
4,80,189
5,01,714
6,35,500
5,11,208
4,04,032
4,45,963
5,94,279
Mar,11
Apr,11
May,11
Jun,11
Jul,11
Aug,11
Sep,11
Oct,11
Nov,11
Dec,11
Jan,12
Feb,12
Mar,12
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Jun,12
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Jan,13
Feb,13
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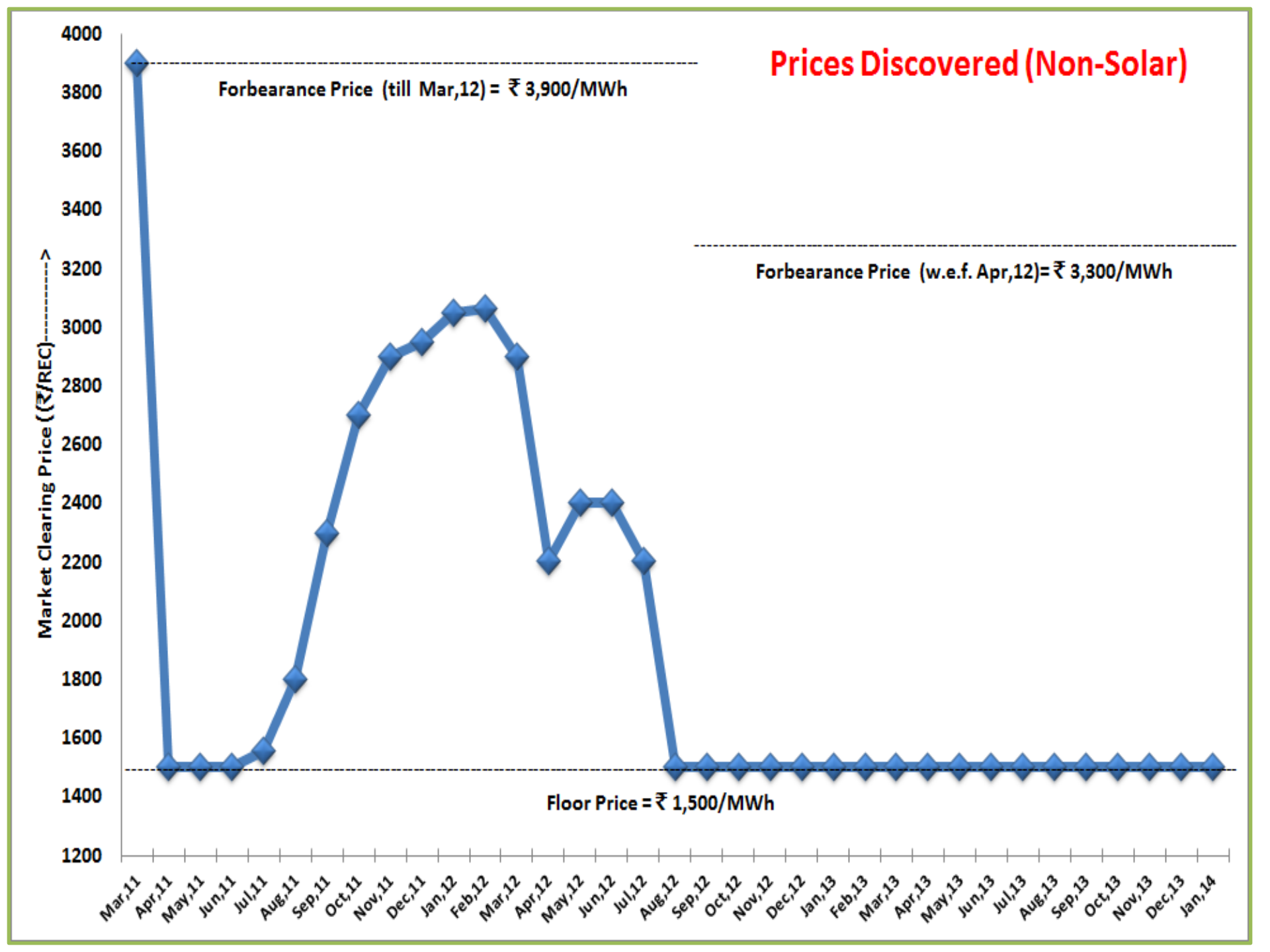
Apr,13
May,13
Jun,13
Jul,13
Aug,13
Sep, 2013
Oct, 2013
Nov, 2013
Dec, 2013
Jan, 2014


Prices Discovered (Non-Solar)
Forbearance Price (till Mar,12) = ₹ 3,900/MWh
Forbearance Price (w.e.f. Apr,12)= ₹ 3,300/MWh
Floor Price = ₹ 1,500/MWh
Market Clearing Price ((₹/REC)---------->
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
Mar,11
Apr,11
May,11
Jun,11
Jul,11
Aug,11
Sep,11
Oct,11
Nov,11
Dec,11
Jan,12
Feb,12
Mar,12
Apr,12
May,12
Jun,12
Jul,12
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Nov,12
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Mar,13
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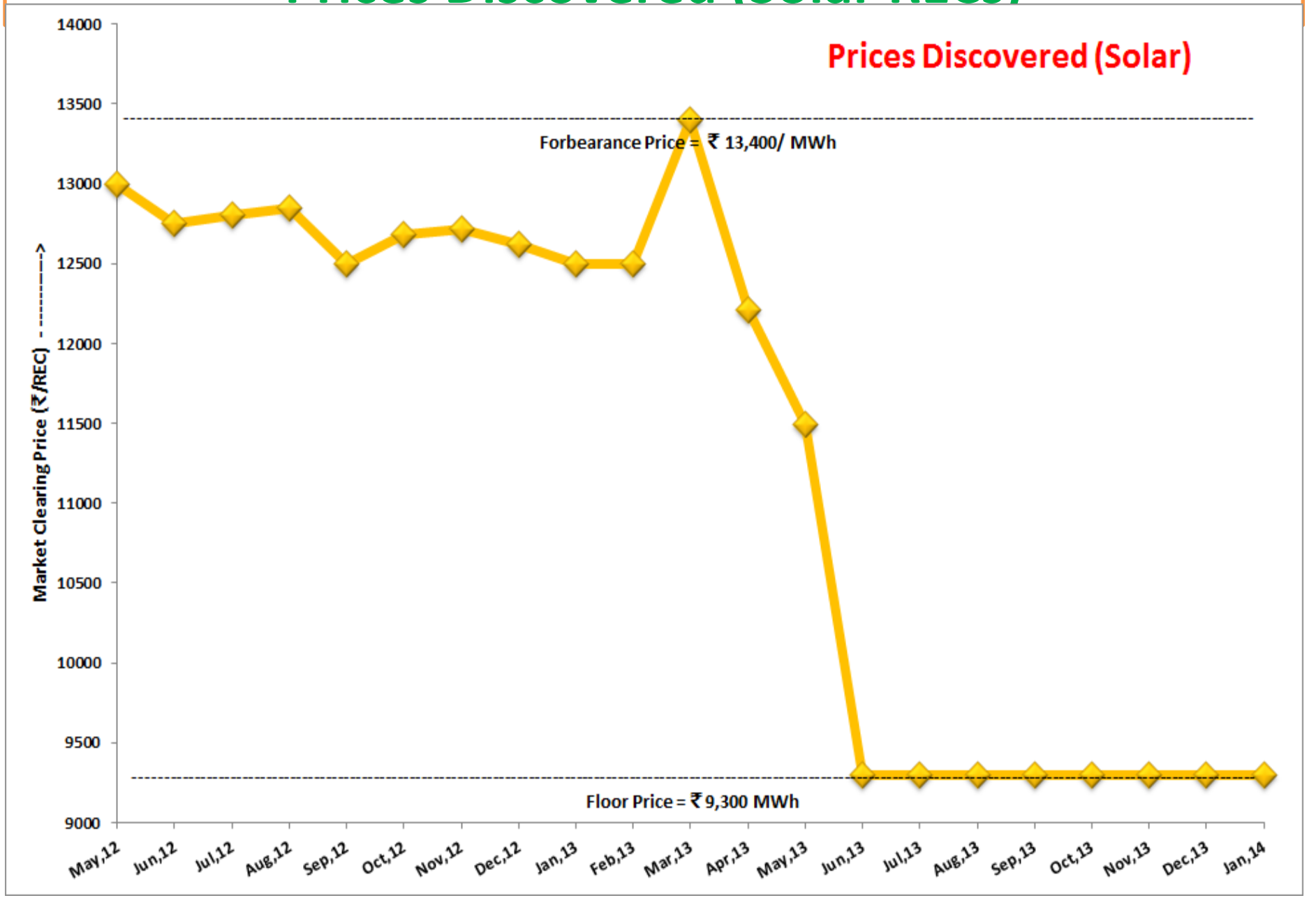
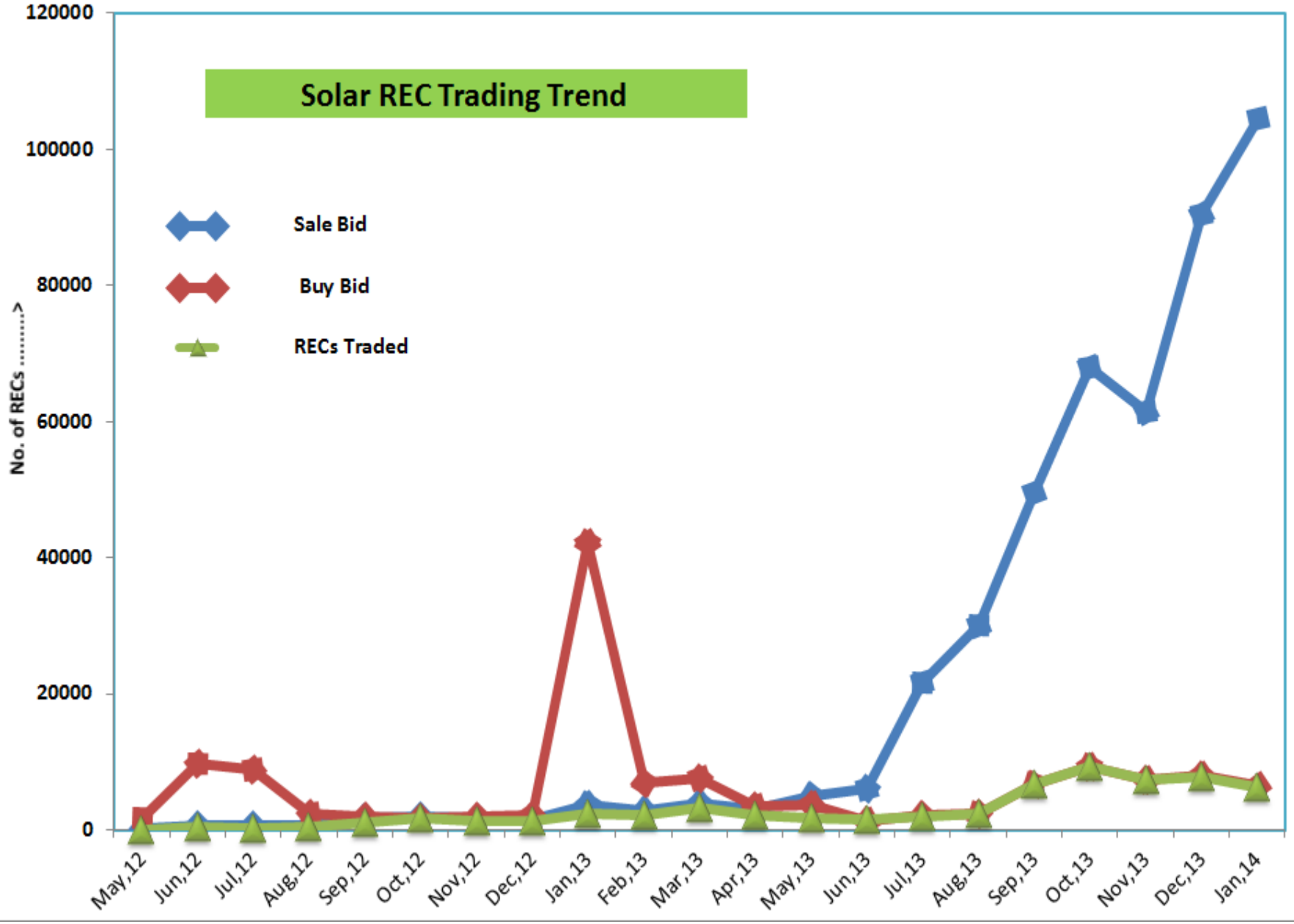
Oct,13
Nov,13
Dec,13
Jan,14

Prices Discovered (Solar RECs)



* Prices discovered at IEX

Market Trend Solar RECs

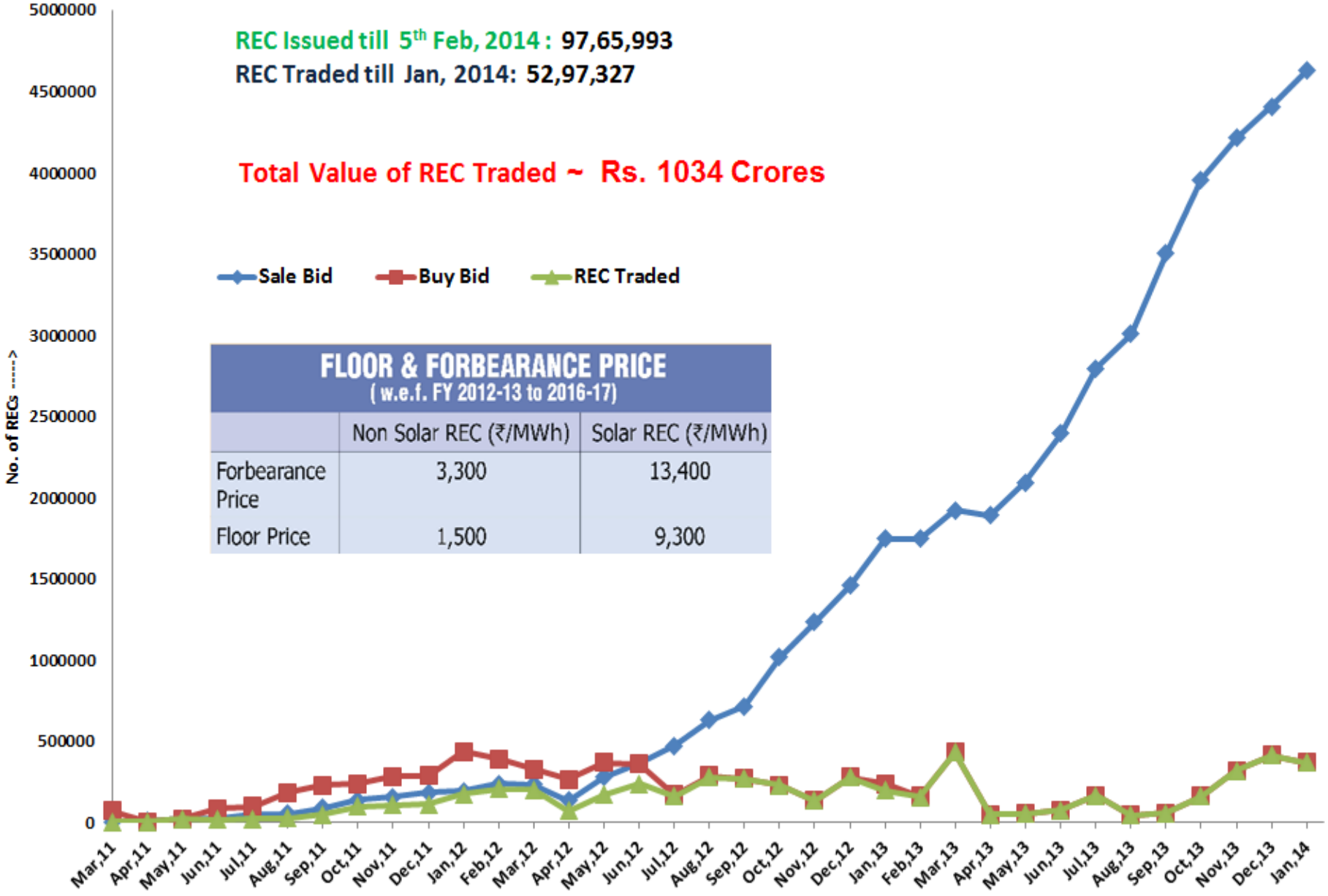


Market Trend – Trading of RECs

REC Issued till 5th Feb, 2014 : 97,65,993

REC Traded till Jan, 2014: 52,97,327

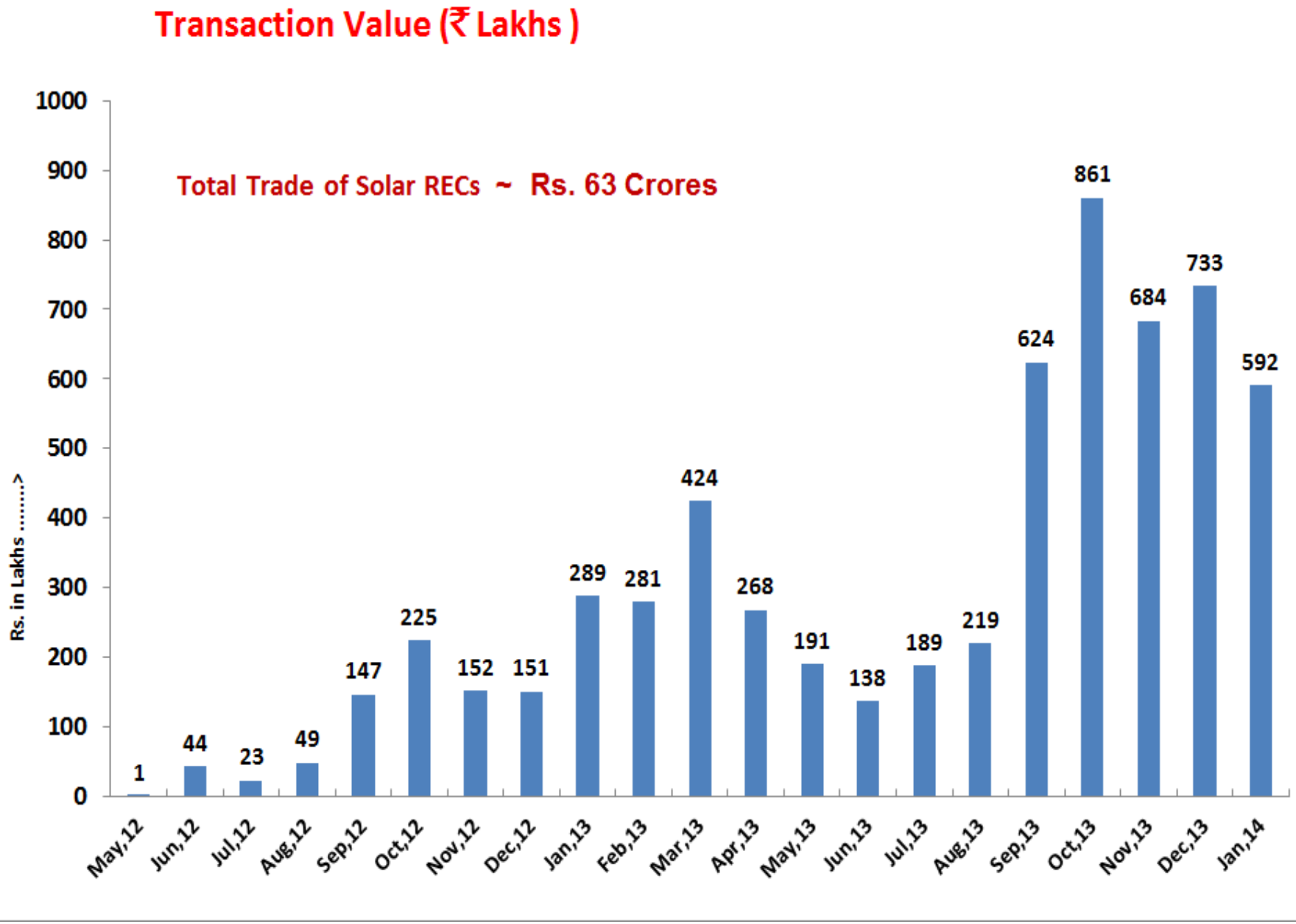
Total Value of REC Traded ~ Rs. 1034 Crores



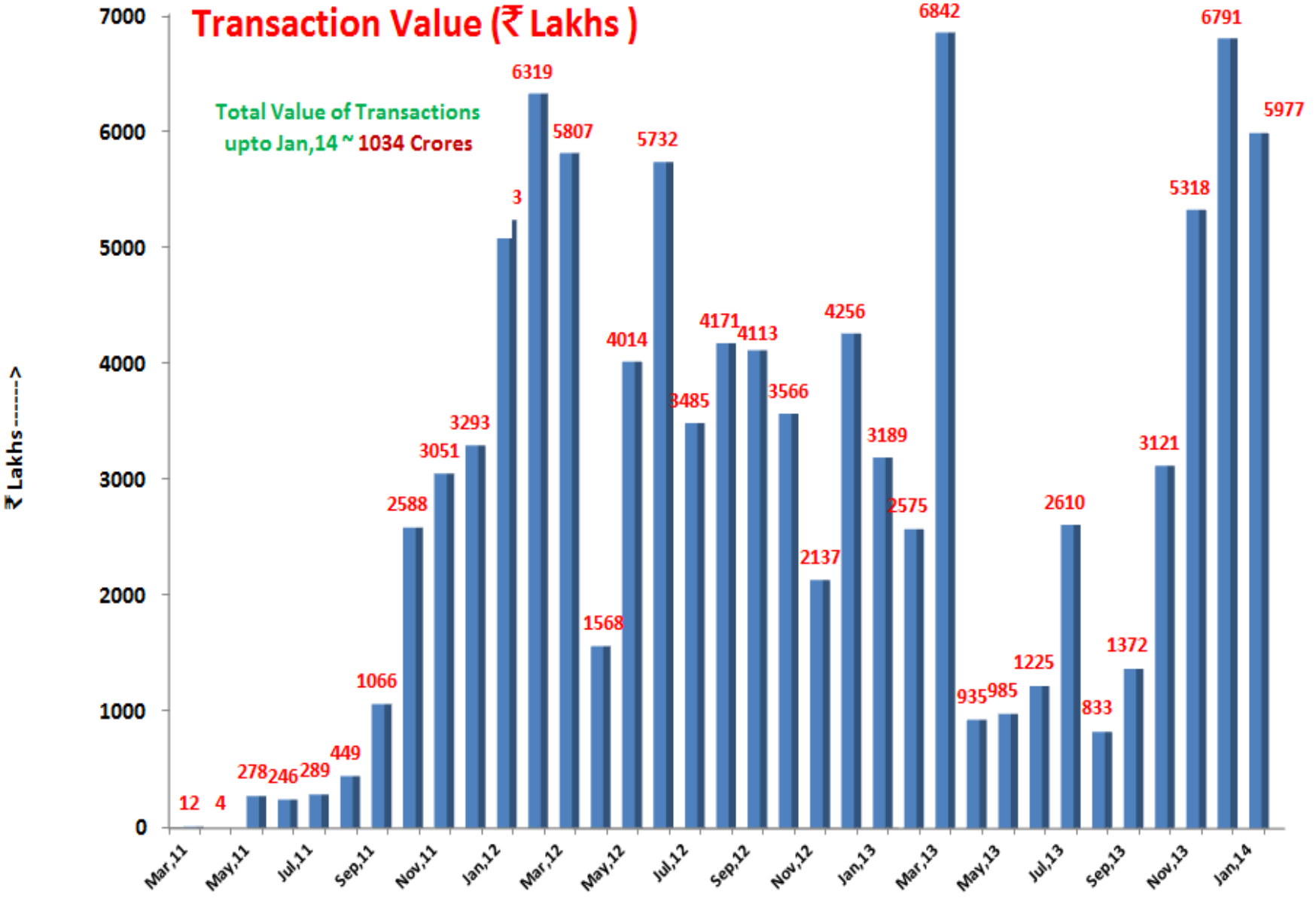
FLOOR & FORBEARANCE PRICE
(w.e.f. FY 2012-13 to 2016-17)

	Non Solar REC (₹/MWh)	Solar REC (₹/MWh)
Forbearance Price	3,300	13,400
Floor Price	1,500	9,300

Monetary Value of Solar REC Traded



Monetary Value of total RECs Traded



Issues and Way Forward

- **Lack of enforcement of RPOs.**
- **Demand Supply mismatch impacting trading.**
- **Bankability and longer term visibility of Floor and Forbearance price.**
- **Absence of Sunset clause.**
- **Significant mismatch between Solar Certificate prices and Solar PV tariff.**
- **Separate Floor and Forbearance price for Solar PV and Solar Thermal technology.**
- **Vintage based multiplier for Solar Certificates.**
- **Liquidity in REC Trading**

RRF Mechanism

Implementation of RRF Mechanism

- **IEGC Regulations, 2010 notified on 28.04.2010**
  - Implementation of RRF Mechanism from 1st Jan 2011
- **RRF Procedure**
  - CERC examined the proposal submitted by NLDC and the modified procedure was notified on 18.02.2011
  - Mock Exercise: 1st July 2011
  - Implementation: 1st Jan 2012
- **Task Force by MNRE**
  - MNRE has convened a meeting on 23.03.12
  - MNRE constituted the Task Force on 28.03.2012
  - MNRE Submitted the Task Force Report to CERC on 04.09.2012
- **CERC Order dated 16.01.2013**
  - Mock Exercise to be started from 01.02.2013
  - RRF Shall be Implemented from 01.07.2013
- **CERC order dated 09.07.2013**
  - RRF Mechanism to be implemented from 15.07.2013
- **CERC order dated 07.01.2014**
  - suspended the Commercial mechanism
  - Forecasting and scheduling of wind generation shall continue

Implementation difficulties of RRF Mechanism

- **Jurisdiction Issues related to Intra-State entities**
  - Applicability of CERC Regulations for intra-state entities.
  - RLDCs are entrusted for collection / disbursement of renewable regulatory charges from RE Generators/ State Utilities for Intra-State transactions.
  - SLDCs may be entrusted for all commercial settlements for Intra-State transactions.
  - Most of the SERCs haven't notified the Grid Code consistent with the IEGC, with regard to RRF Mechanism.
    - Many SERCs has exempted Wind Generators from scheduling. Due to this, RE generators are not providing schedules.
    - Intra-State Deviation Settlement mechanism - not in operation in many States.

Implementation difficulties of RRF Mechanism

Implication of Renewable Regulatory Charge on States

- The operation of RRF involves payment of Renewable Regulatory Charge to be shared by all States.
- The States which have low potential of wind and solar generating capacity are likely to default / delay in making payment to RRF which may jeopardize the mechanism.
- States that are meeting the peak demand load on higher side shall be required to pay higher charges, and may be opposed by them on ground of discrimination among States
- Some SLDCs have informed that RE Generators are apparently resorting to Gaming by over declaring to avoid capping beyond 150%.
- It is apprehended by SLDCs that RRF Mechanism has negative commercial implication on States and they may end up in paying huge amount of money to Private Generators.

Implementation difficulties of RRF Mechanism

Non- submission of Schedules

- Eligible Pooling stations are not submitting the schedules on regular basis.
- Solar generating units are not covered under the commercial mechanism, the quality of forecast services under this category has been poor.

Learning from operationalization of other Funds

- Maintenance of accounts, utilization, monitoring, audit, income tax, other statutory taxes, etc. are required to be addressed
- To avoid taxation related issues, it needs to be categorically provided in the regulation that RRF will not be a part of income of the implementing agency.

Implementation difficulties of RRF Mechanism

Other Issues

- Till date, none of the SLDCs have submitted the details of Coordinating agency to respective RLDCs for implementation of the RRF Mechanism.
- Data communication facilities are yet to be made available by the most of the Pooling Stations
- Due to strict enforcement of Deviation Settlement Mechanism and related matters Regulations 2014, states are resorting to Curtailment of RE generation
- Settlement of accounts in case of non-receipt of schedules from Pooling Stations
- Special Energy meters, compliant to CEA Regulations, are yet to be installed on some of the eligible pooling stations
- Actual energy data is not being validated by SLDCs

Conclusions

- With Larger Grid interconnection the variability can be better handled.
- With Forecasting, Operational planning can be better executed
- With Scheduling accountability is induced
- With REC mechanism and trading across seams, RE will be an attractive business
- Concerns of System Operators to be taken care of
- Separate Control Centre for Renewable Power at each LDC


Thank You