Renewable Energy Integration & REC Market

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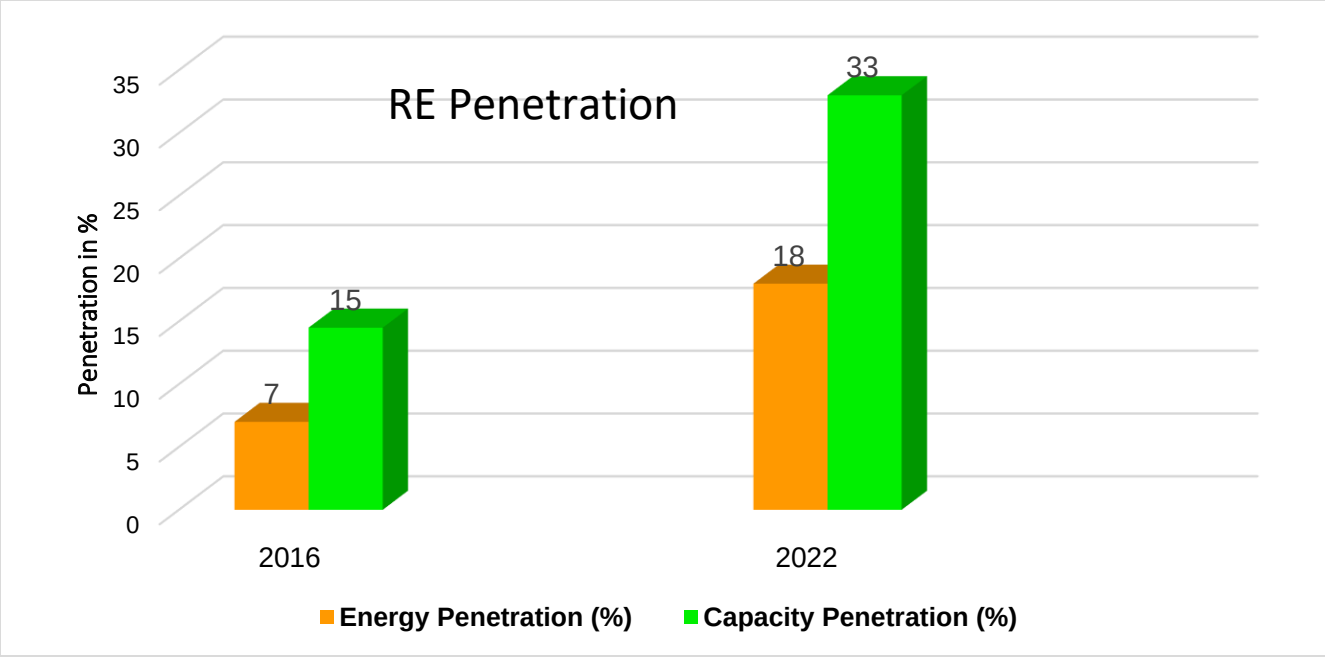
Renewable Energy

Grid connected Renewable Energy Technology	Achievement as on 30.06.2019 In MW
Wind Power	36368.47
Solar Power - Ground Mounted	27499.05
Solar Power - Roof Top	2050.29
Small Hydro Power	4604.80
Biomass (Bagasse) Cogeneration)	9131.50
Biomass (non-bagasse) Cogeneration)/Captive Power	674.81
Waste to Power	138.30
Total	**80467.22**

Renewable Addition Plan

Plan to add 1,00,000 MW solar, 60,000 MW Wind, 10,000 MW Biomass & 5,000 MW Small Hydro by the end of 13th plan(2022)

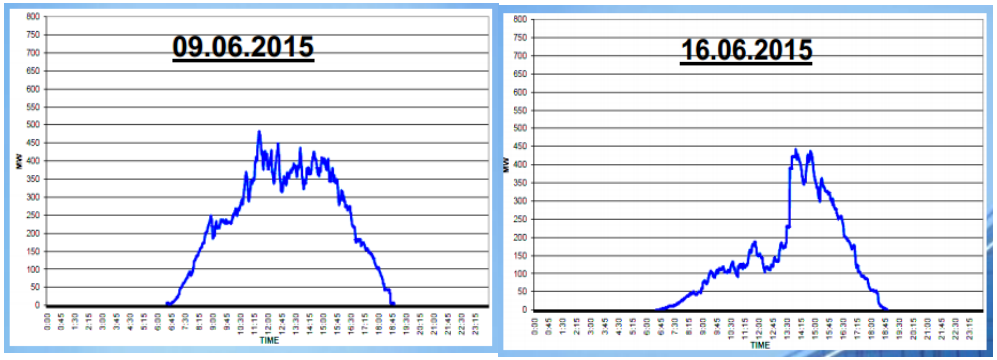
- About 20,000 MW through Solar Power Parks
- About 40,000 MW through Distributed Solar Generation
- About 40,000 MW through Roof Top Solar Generation



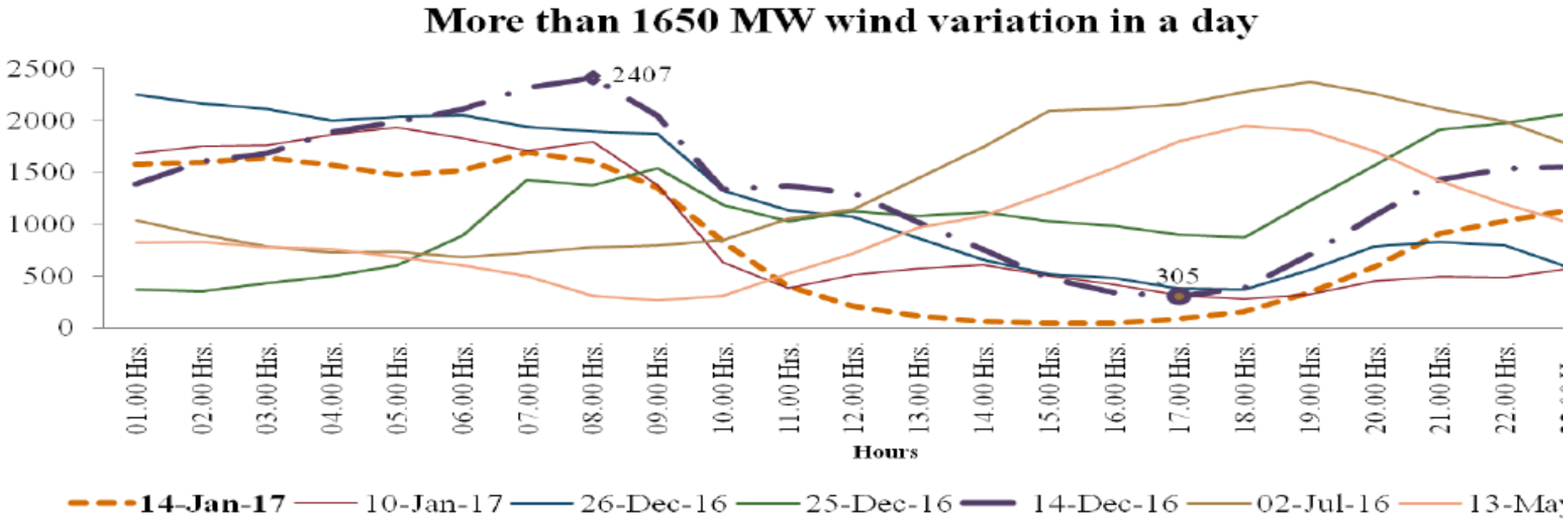
Renewable Integration - Challenges

Issues

- Short Gestation period (9-12 months)
- Variability & Intermittency
- Low Utilisation Factor



Typical Wind Generation Pattern

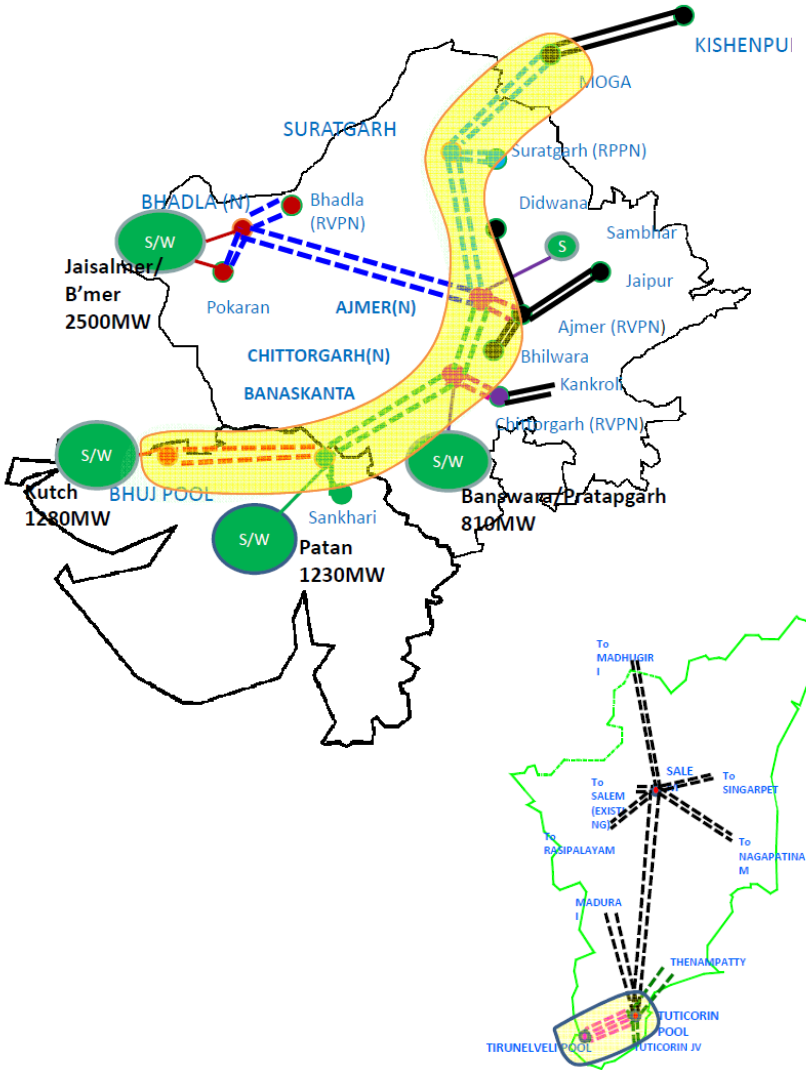


Initiatives

Green Energy Corridors	Integration of renewable resources through Strong Grid connections, enlarging balancing areas etc.
Wide Area Measurement	Enhanced situational awareness, Better visualisation of grid parameters, Stable operation of Grid
Renewable Energy Management Centres	Renewable forecasting, SCADA for RE generation, Scheduling of RE

GREEN ENERGY CORRIDORS

Green Energy Corridor-I

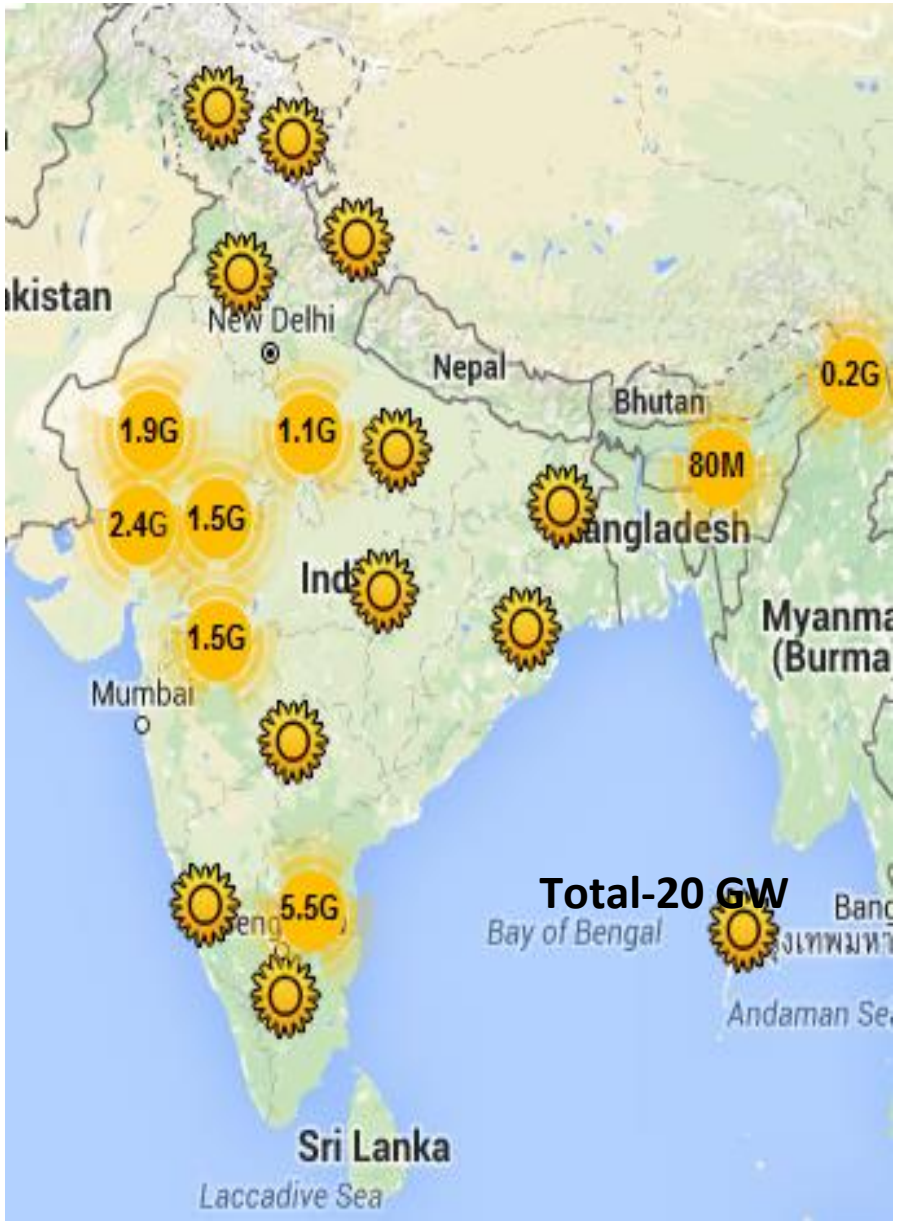


- Green energy corridor to facilitate Grid integration of large scale renewables
- About 33GW capacity addition envisaged through wind & solar in next 4-5 years
- The Plan includes
  - Transmission Strengthening(s) –Intra & Inter
  - Dynamic reactive compensation
  - Energy Storage
  - Smart grid applications
  - Establishment of Renewable Energy Management Centre enabling forecasting of renewable generation, real time monitoring, etc.

Green Energy Corridors-Inter State Transmiss

Envisaged Solar Parks

Locations of Solar parks



S.No.	State	No. of Solar Park & Capacity
1	Andhra Pradesh	Ananthapur Solar Park -1500 MW
2	Andhra Pradesh	Kurnool Solar Park-1000 MW
3	Andhra Pradesh	Kadapa Solar Park-1000 MW
4	Andhra Pradesh	Ananthapuramu Solar Park-500 MW
5	A&N Island	100 MW at South Andaman
6	Arunachal Pradesh	100 MW at Tezu
7	Assam	69 MW at Amguri in Sibsagar district
8	Chhatishgarh	500 MW at Rajnanadgaon and Janjgir Champa
9	Gujarat	700 MW at Banaskantha
10	Haryana	500 MW at Hisar, Bhiwani & Mahindergarh districts
11	Himachal Pradesh	1000 MW at Spiti Valley of Lahaul & Spiti
12	Jammu & Kashmir	100 MW at Jammu
13	Karnataka	2000 MW at Pavagada Taluk in Tumkur Distt
14	Kerala	200 MW at Kasargode
15	Madhya Pradesh	750 MW at Rewa
16	Madhya Pradesh	1000 MW at Neemuch, Agar, Mandsaur
17	Madhya Pradesh	500 MW at , Shajapur- Rajgarh
18	Madhya Pradesh	500 MW at Chhatarpur and Morena
19	Maharashtra	500 MW at Sakri, Dhule
20	Maharashtra	500 MW at Dondalcha, Dhule
21	Maharashtra	500 MW at Patoda, Beed
22	Meghalaya	20 MW at Thamar, West Jaintia Hills & Suchen, East Jaintia Hills
23	Nagaland	60 MW at Dimapur, Kohima and New Peren
24	Odisha	1000 MW at Multiple locations of Odisha
25	Rajasthan	Bhadla Ph-II Solar Park: 680 MW
26	Rajasthan	Bhadla Ph-III Solar Park: 1000 MW in distt.Jodhpur
27	Rajasthan	Bhadla Ph-IV Solar Park: 500 MW in distt.Jodhpur
28	Rajasthan	750MW at Jodhpur(450MW) & Jaisalmer (300MW)
29	Rajasthan	321MW at Fatehgarh & Pokaran in Jaisalmer district
30	Tamil Nadu	500MW at Ramanathapuram
31	Telangana	500 MW at Gattu, Mahabubnagar
32	Uttar Pradesh	600 MW at Jalaun, Kanpur dehat, Allahabad & Mirzapur
33	Uttarakhand	50 MW at Sitarganj & Kashipur
34	West Bengal	500 MW at East Mednapur, West Midnapur and Bankura

Enabling Framework for Renewable Integration

- Renewable Purchase Obligation and Renewable Energy Certificates
- Implementation for frequency response Regulation
- Regulatory framework for Forecasting, Scheduling and Deviation Settlement of Renewable generation
- Regulatory framework for Reserves
- Regulatory framework for Ancillary services operations

Transmission Challenges and Technologies

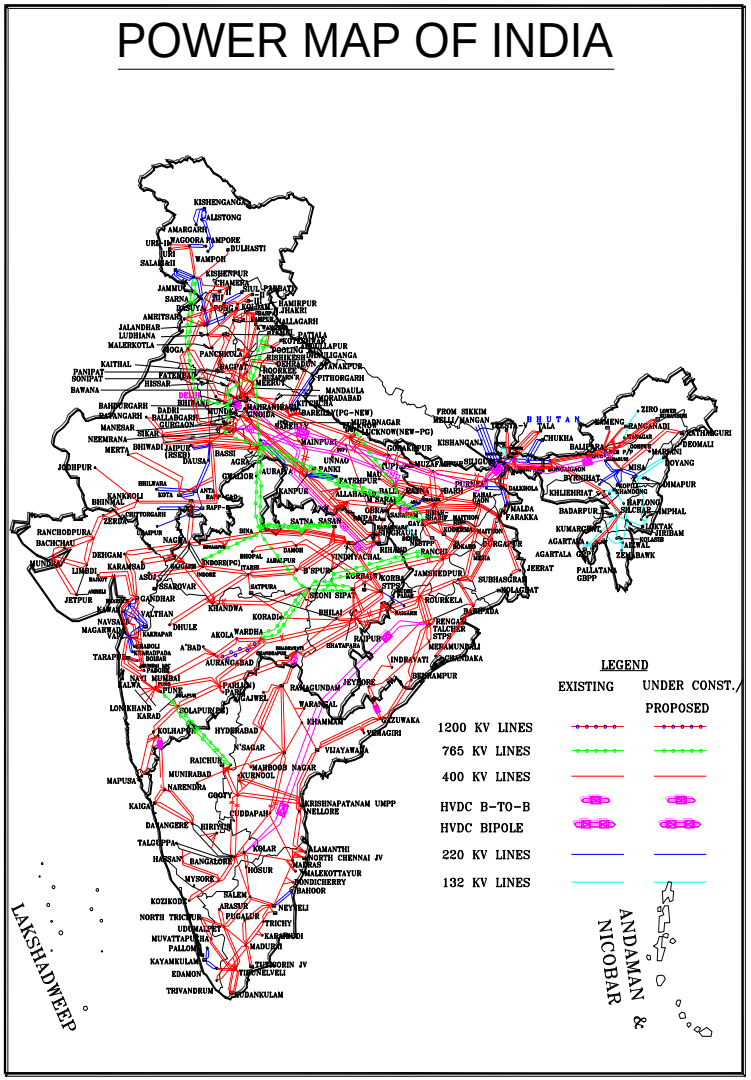
Challenges & Measures

Challanges	Measures
Right-of-Way	• 1200 kV, UHVAC, 765kV, +- 800kV HVDC • 400 kV Multi Circuit Tower • Compact Tower, Narrow based Tower, Pole Structure • Series compensation, STATCOM, FACTS
Land Acquisition	• GIS substation • Automation of Substation, • Digital Substation
Renewable Integration	• Transmission to lead generation • Strong Interconnection for large Balancing Area • Establishment of REMC for Renewable forecasting & Scheduling • Balancing reserves, Power Market, Ancillary Services • Energy Storage
Grid Management	• Smart Grid- Real time monitoring System with Self-healing • WAMs through PMU • Automation of Substations • Advanced Metering Infrastructure (AMI), Net metering, Demand Side Management, Consumer Participation

Investment Envisaged

Area	Total Investment Potential by 2022 (USD Bn)
Renewables	120
Generation(CPSUs, States, UMPPs & Private Sectors)	50
Transmission	50
Sub Transmission & Distribution	25
Energy Efficiency	5
Total	250

Indian Power System : Transmission



765 kV Backbone Network:

- 25,647 ckm
- 147000 MVA

HVDC (±500kV, ±800 kV)

- 12938 ckm
- 15000 MW

400 kV :

- 150021 ckm
- 216282 MVA

Inter-regional Capacity: 61150 MW

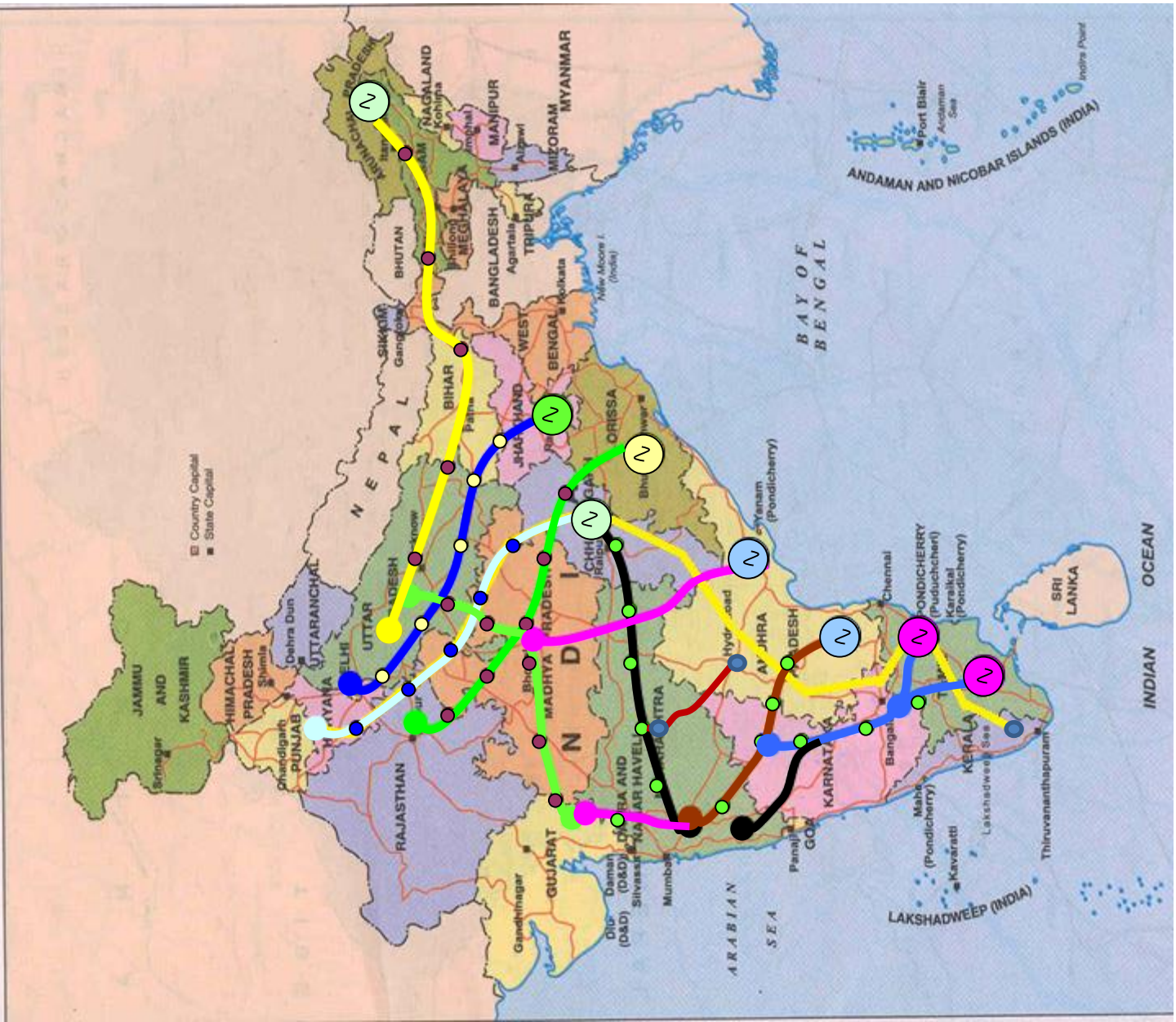
National Grid | ***High Capacity Transmission Corridors***

Transmission Capacity addition by 2021-22

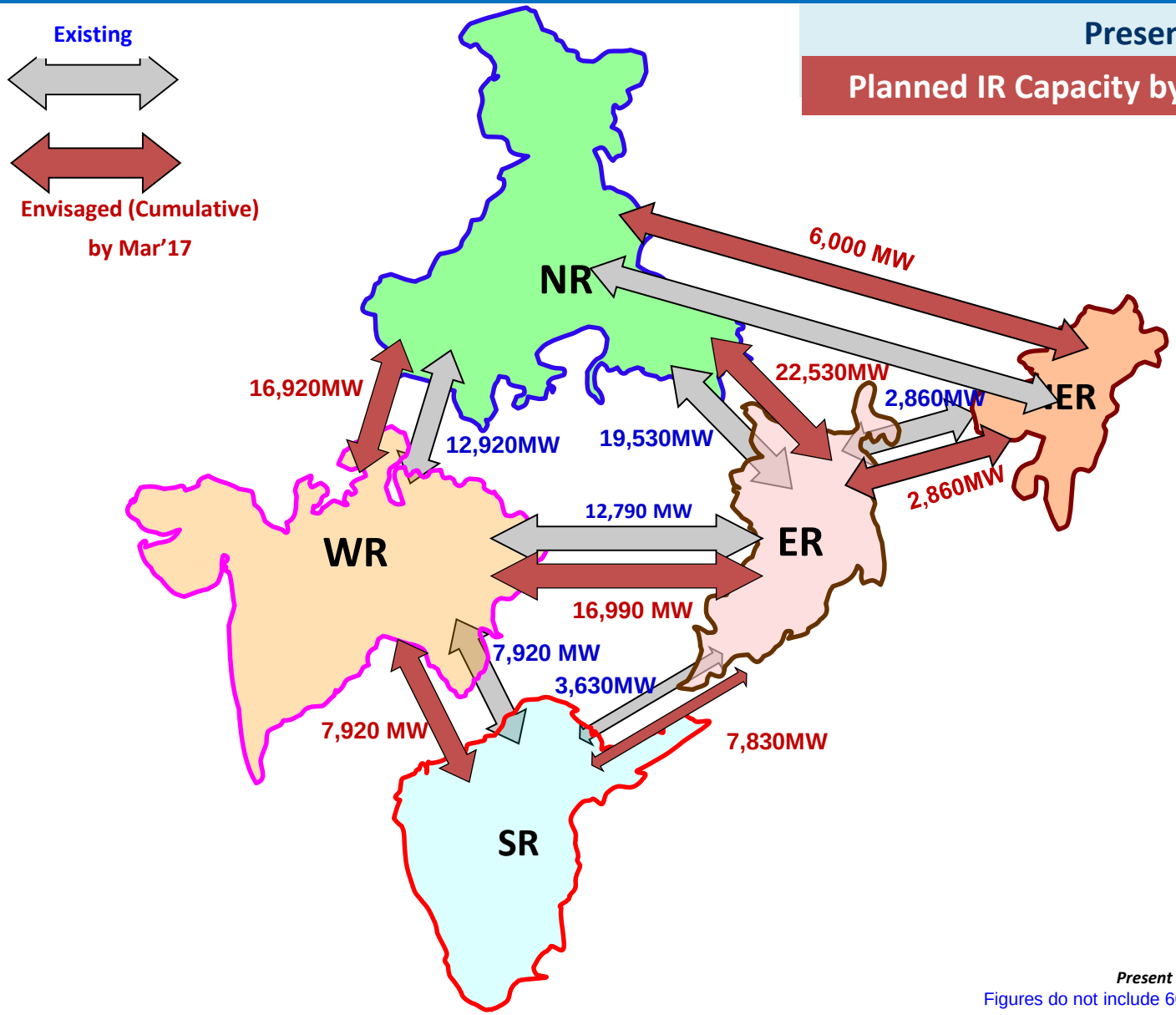
MVA-3,00,000

Ckt km-1,30,000

High Capacity Transmission Corridors



National Grid – Present and Envisaged



Present IR Capacity: 61,150 MW

Planned IR Capacity by XII Plan end: 78,050 MW

Present & Targeted IR Capacity include Pvt. Sector lines also

Figures do not include 600MW (in aggregate) pertaining to various 132kV

Way Forward

- Grid Flexibility
- RE Forecasting
- Balancing Reserves- Capacity, Ramping, AS market

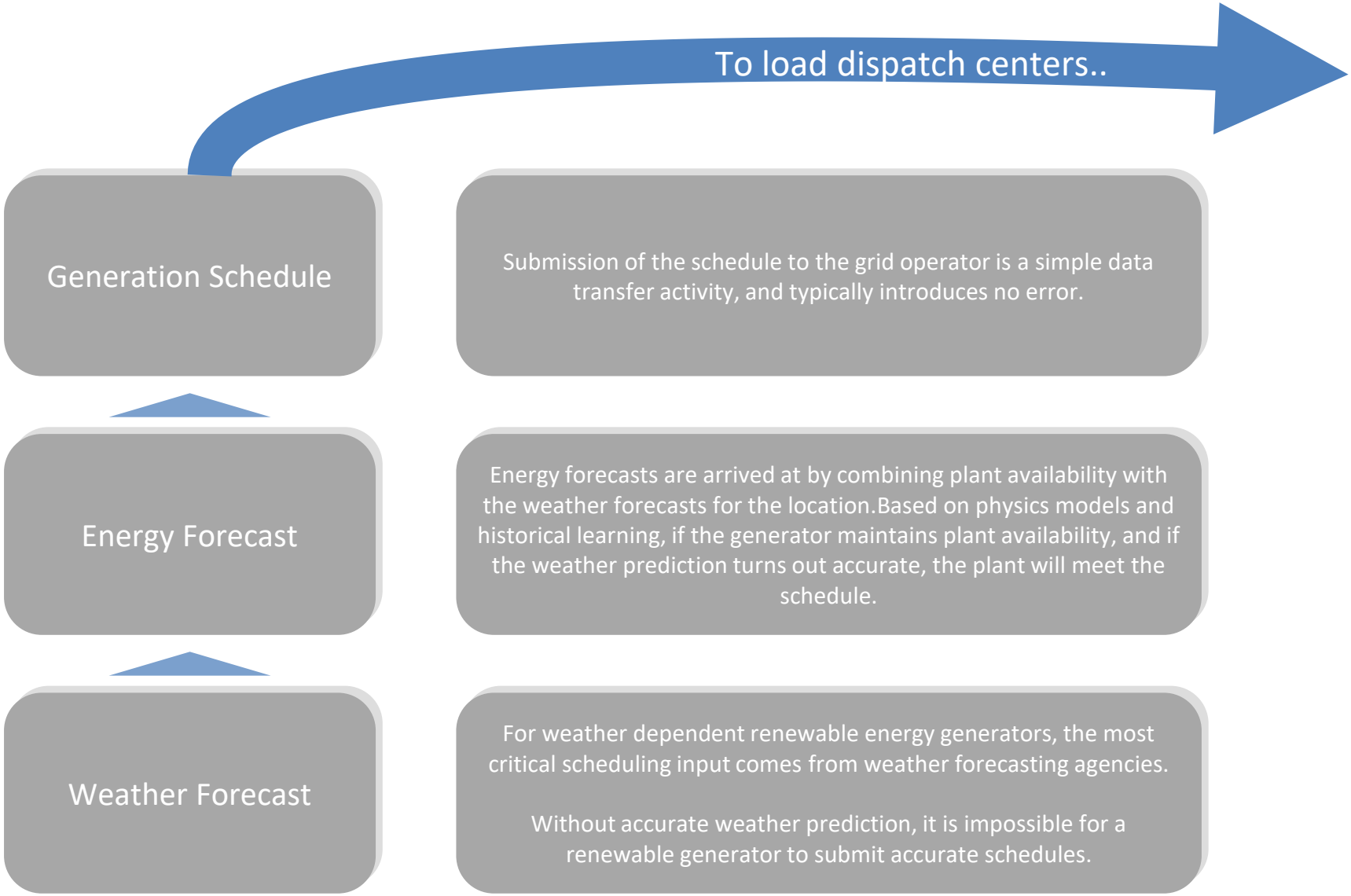
Integration of wind and solar energy

Forecasting of wind and solar energy generation

Objectives of the DSM regulations

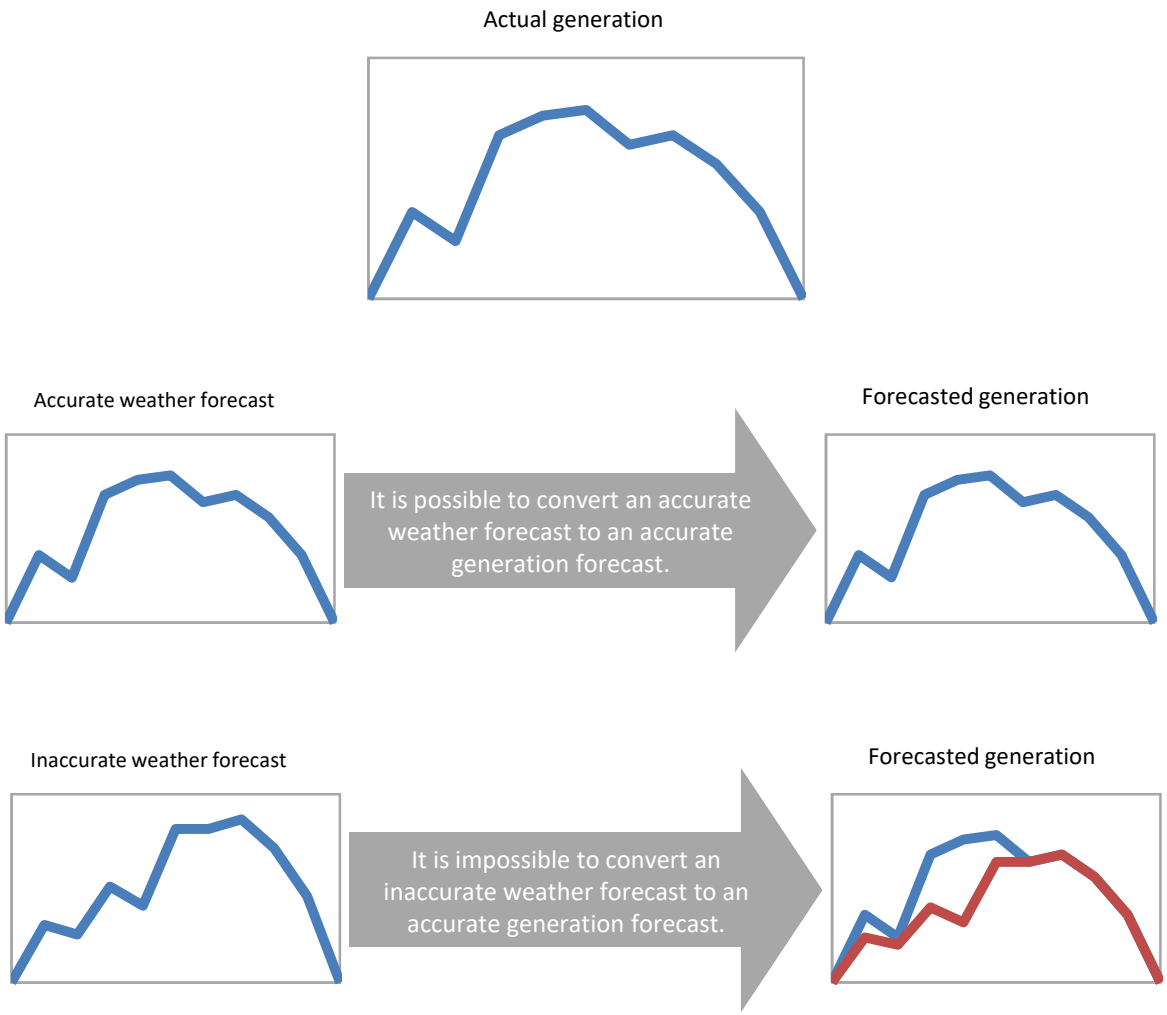
- Ensuring safe and secure operation of the grid by matching demand with supply.
- Successful large-scale integration of renewable energy into the grid in-line with the nation's goal of greening the grid.
- Unlike conventional sources of energy which can control generation dispatch, renewable sources like wind and solar are completely weather dependent
- Forecasting of RE generation involves forecasting of local weather conditions.

What goes into a renewable plant's schedule?



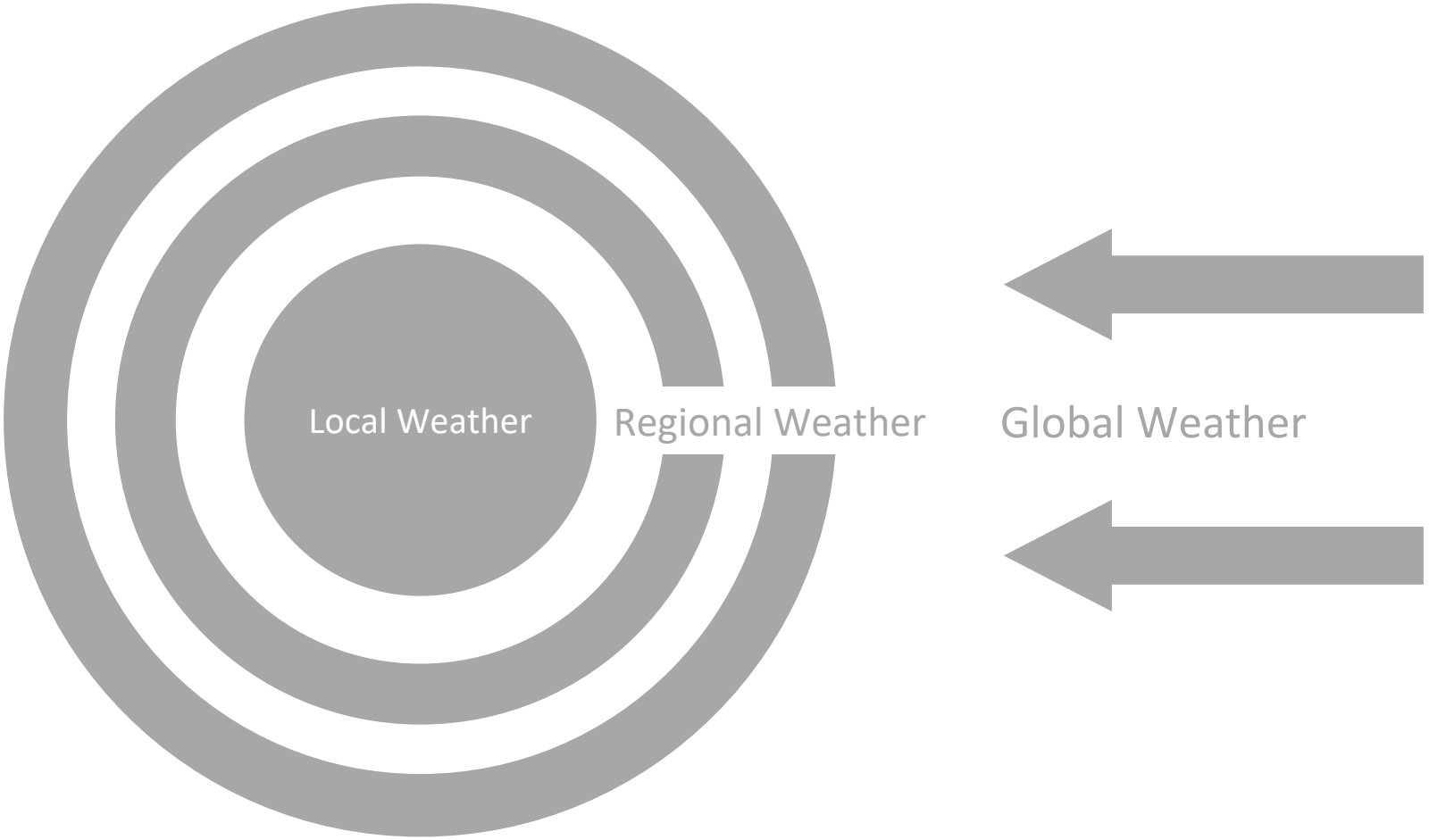
Accurate weather forecasts are the major inputs to renewable generation schedules

The major source of in-accuracy is the weather.



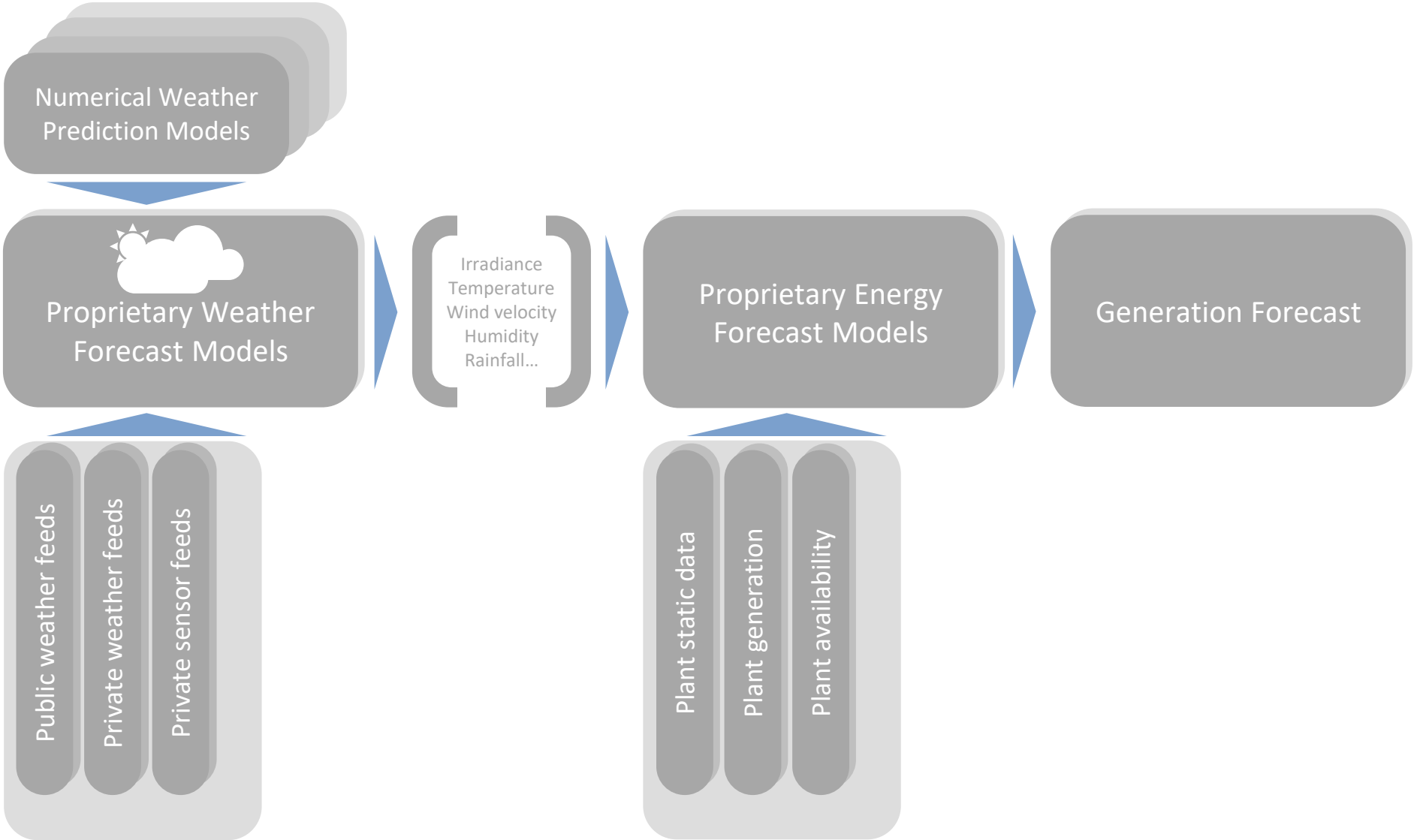
Without accurate weather forecast, a generator cannot submit accurate schedules

There is no simple way to predict the weather.



Weather forecasting is a science involving complex local and global phenomenon

Current best forecasting methodology - Day ahead



Complex modelling is required to account for all the variables that affect local weather

Details of Forecasting Methods used Globally

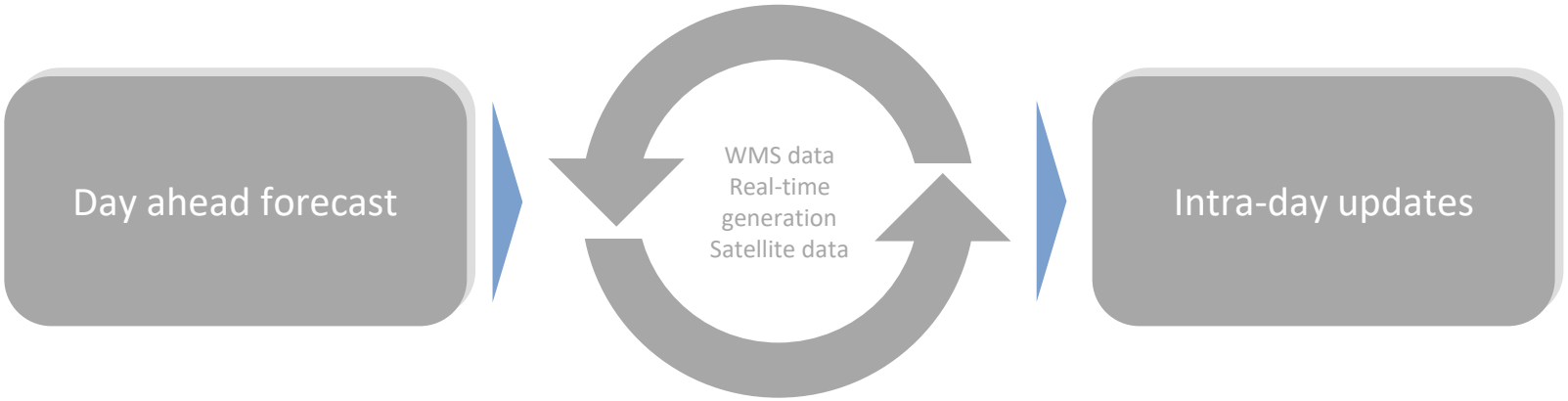
	NWP based forecasting	Satellite based forecasting	Total sky imager	Statistical approaches
Refresh rate	6-24 hours	0.5-24 hours	< 1 minute	0.5 - 2 hours
Forecast's temporal resolution	1-6 hours	Minutes	Minutes	< 15 minutes
Forecast's spatial resolution	4-120 sq km	> 1 sq km	Local surroundings	< 1 sq km
Best forecast accuracy achieved	> 6 hours ahead	1-6 hours ahead	< 0.5 hour ahead	Short term
RMSE (local, hour ahead)	Very high	20-25%	Not available	N/A
RMSE (large grid, day ahead)	20-60%	~ 5%	No long term forecast	N/A

In India only NWP models are being used that perform poorly in 15min timescales.

Source : Various papers and case studies

Current best forecasting methodology - Intra day updates

- Forecasts can be corrected in real-time to account for present conditions, but these do not act as good predictors for upcoming conditions beyond 15-30 minutes.
- The number of revisions (16/day) and gate closure (4th time block) defined in the current regulations greatly reduce the efficacy of intra-day updates.



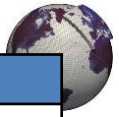
Current regulations don’t allow

Numerical weather prediction - The global perspective

- Every forecast invariably starts with NWP models, which are the accepted baseline predictions being tuned and run by large and mostly government funded organisations.
- The United States spent $1.25bn in 2013 for meteorological R&D, part of which went into the global forecast system. Still among NPWs, GFS ranks low on accuracy, specially for the Indian region.
- There are no publicly or commercially available, accurate NWP models for the Indian subcontinent.
- Regardless, these models are not accurate for small regions over short time scales of under a few hours.

- Typical RMSE for parameters using these models can range from 15-35% depending on the location, and season.

Best NWP models available for the Indian subcontinent



Model	Agency	Resolution	Horizon	Updates
High resolution global model (HRES)	European Center for Medium-Range Weather Forecasts (ECMWF)	9x9 Km	240h	2/day
Icosahedral Non-hydrostatic model (ICON)	Deutscher Wetterdienst (DWD)	13x13km	180h	4/day
Global deterministic prediction system (GDPS)	Canadian government - meteorological department	23x26km	240h	2/day
Global forecast system (GFS)	National Ocean atmospheric administration (NOAA)	48x55km	180h	4/day

NWPs are wholly inadequate to meet the accuracy demands of DSM regulations

Types of Weather Models-:

2. Satellite based forecasting -

- Assumes steady state cloud cover, but clouds are a dynamic system which are constantly changing.
- Altitude differences and shadows are challenges that reduce the accuracy of the forecasts made using satellites.

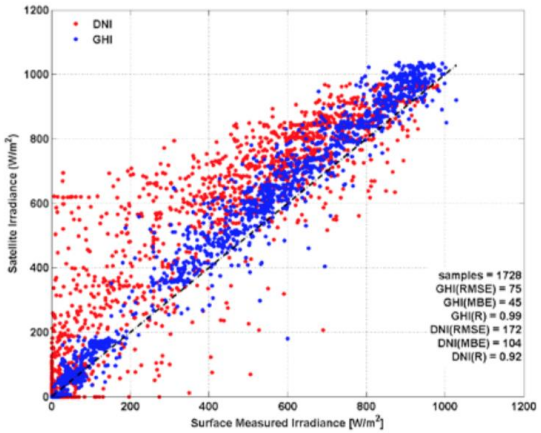
3. Total sky imager -

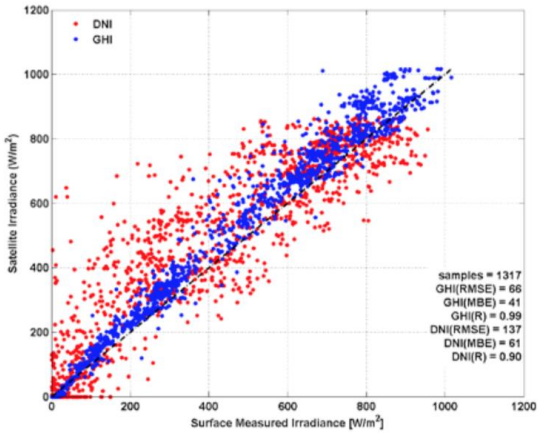
- Captures the real time local cloud conditions to generate a cloud mask and estimates the motion vectors for cloud cover predictions.
- It can tell you about the current cloud cover, but cannot give you a forecast beyond half-hour ahead.

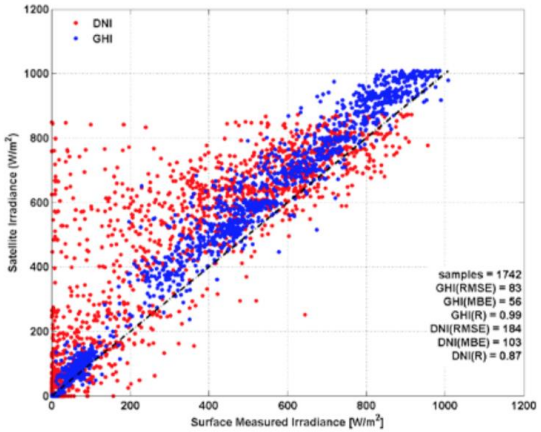
4. Statistical approaches

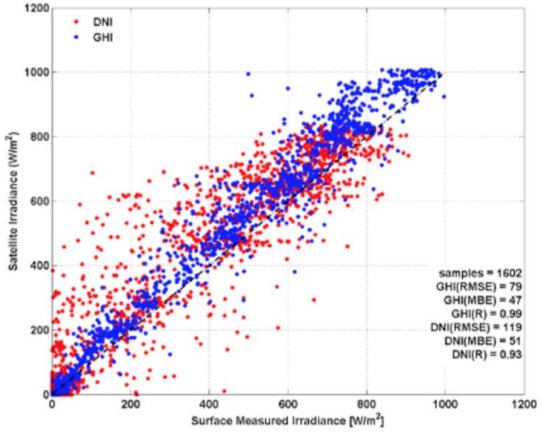
- Require many years of historical data and custom modelling for every location, and
- As they are based purely on historical learning, they have no effect of global and regional weather conditions that affect the local

Satellite measured vs ground measured irradiance









Satellite data can add limited value to intra-day updates

Summarising the challenges in radiation forecasting.

Challenges for radiation in NWP models

Solar spectrum

Non-LTE effects

Water vapour biases

Middle atmosphere

Ozone

Code optimization

GPUs

Efficiency

Spatial/temporal/spectral resolution

Clouds

Overlap

Sub-grid heterogeneity

3D effects

Particle size

Optical properties

Longwave scattering

Water vapour continuum

Clear-sky absorption

Aerosols

Sea emissivity

Snow albedo

Forests

Coastlines

Urban areas

Surface

Orography

Land albedo datasets

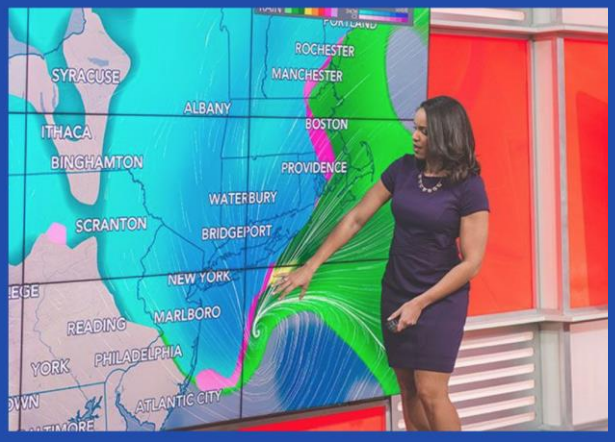
ECMWF

Complex modelling is required to account for all the variables that affect local weather

Summarising the challenge in radiation forecasting.

AccuWeather

Founded: 1962 by CEO Joel Myers
Private forecasts for consumers, media outlets and enterprises
Number of employees: 500
Money raised: Self-funded

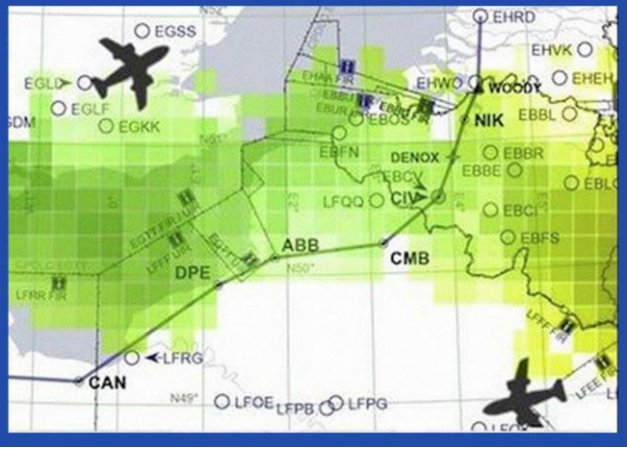


Saildrone

Founded: 2012 by CEO Richard Jenkins
Sensor data from oceangoing robots produces unique forecasts
Number of employees: 100
Money raised: $90 million

ClimaCell

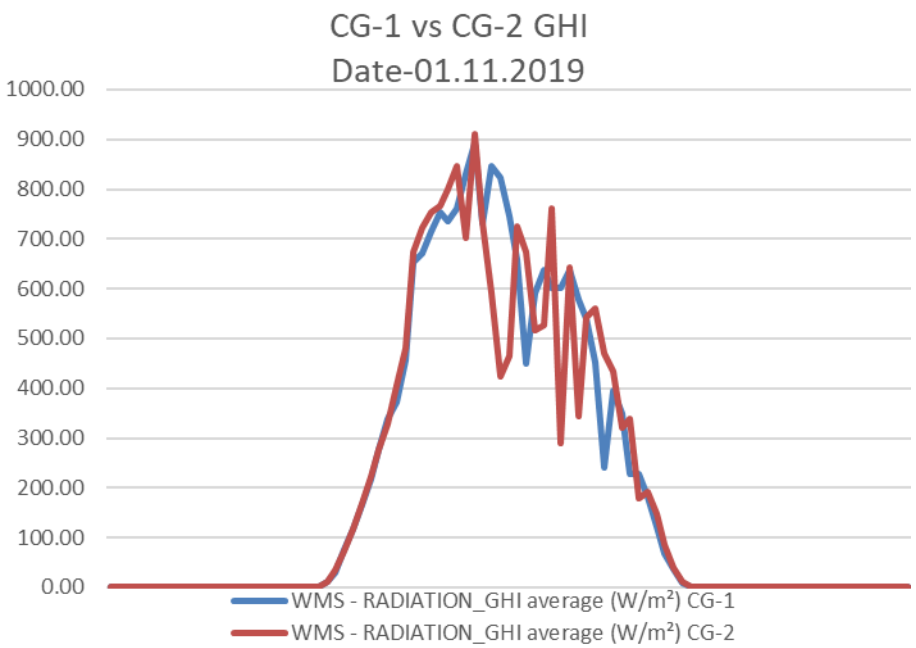
Founded: 2015 by CEO Shimon Elkabetz
Hyperlocal forecasts using data from cellphone towers and street cameras
Number of employees: 100
Money raised: $77 million

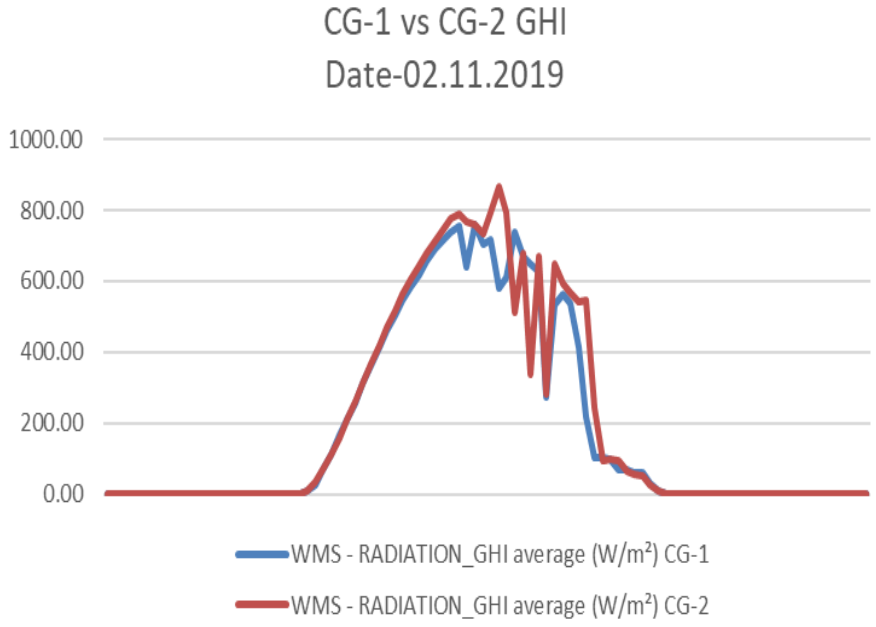


$6bn market trying to improve accuracy of weather forecasting, still a long way to go

Weather Uncertainties

Case Study- Difference in CG-1 vs CG-2 (GHI), WMS Distance- 3km





- Substantial Difference in GHI recorded by 2 weather monitoring stations located at distance of 3 kms.
- For the same projects , in the time interval between ***1st Aug-18 to 20th July-19,*** following error has been recorded-:
  - Root mean Sqr error = 83.01
  - MAPE= 99.1%

Approach for RE Forecasting

Centralized forecasting-:

- Best practice approach for economic dispatch.
- Administered by the balancing authority or system operator.
- Centralized forecast provide system wide forecasts for all RE generators.

Decentralized forecasting-:

- Individually done at plant level.
- Systems operators rely on individual plants performance for system balance.
- Generators get penalized for their deviation at individual plant level.

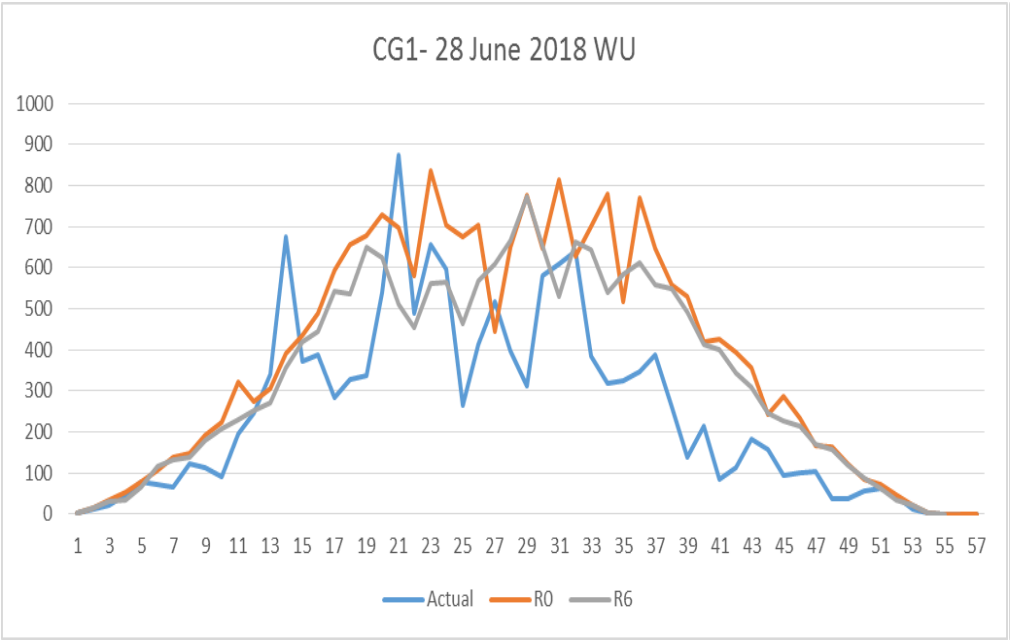
Centralised Forecasting provides:

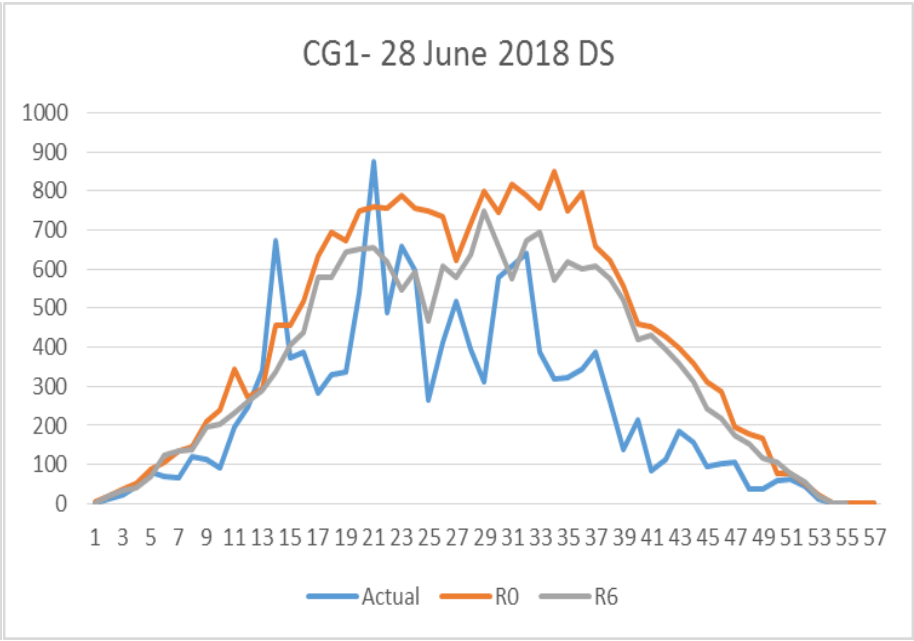
- **Greater consistency in results** due to the application of a single methodology.
- **Lower uncertainty** due to the system operator's ability to aggregate uncertainty across all generators
- **Reduced financial burden** for RE plants to produce and submit individual forecasts.

Centralised Forecasting is more effective and efficient over decentralised forecasting.

Renewable Energy Forecasting
Field Experience

Case Study India – GHI (w/m2)Forecasting for CG-1

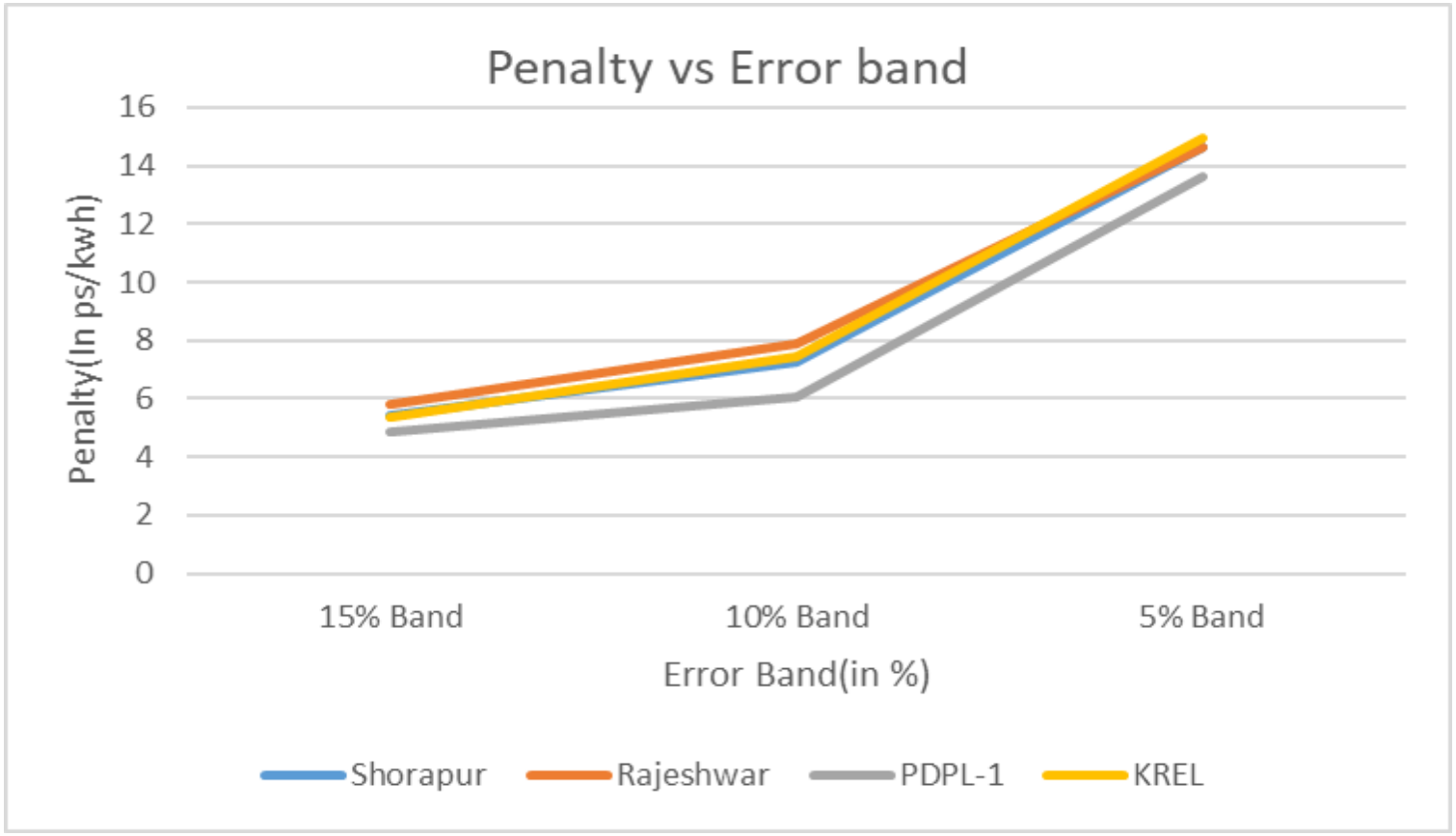




RMSE	R0	R6
Wunderground	255.93	211.46
Darksky	275.66	220.35

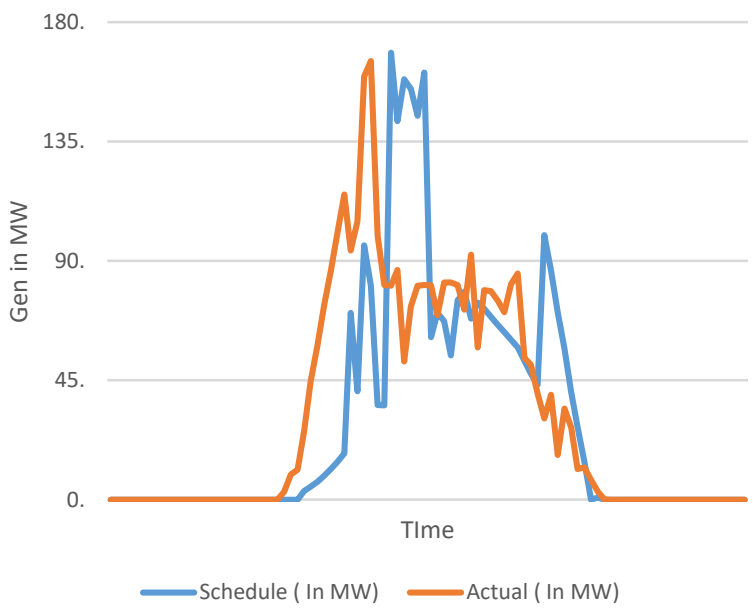
Forecasting agency : Climate connect

Penalties vs Accuracy bands for sample solar plants

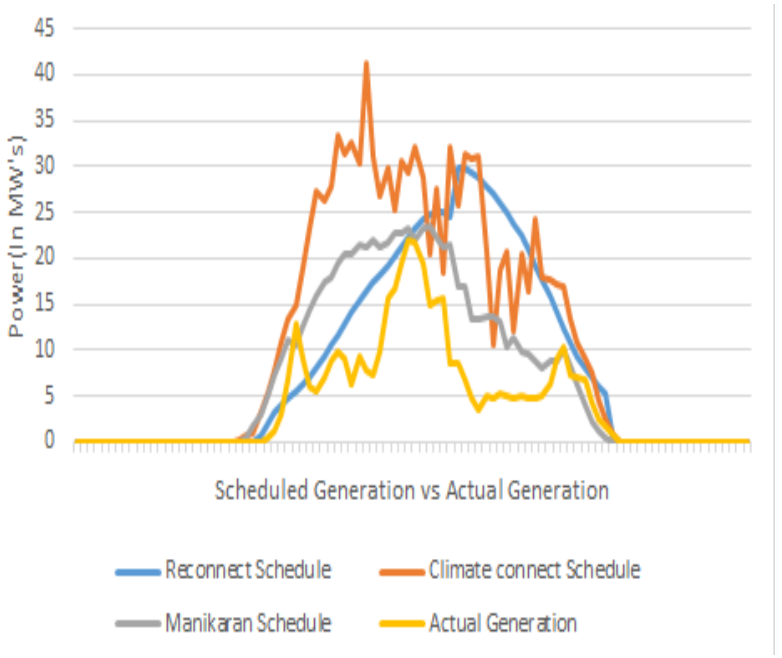


Use Cases - Sample Solar plants

216 MW- AGETL Solar Plant, Date- 11.08.2018



50 MW- Punjab-1 Solar Plant, Date- 07.08.2018



In cloudy conditions none of the established forecasting agencies have forecasted the generation correctly.

Comparison of DSM Regulations in States

Regulations	Applicable to	Aggregation of Multiple pooling stations by QCA/Generator	Error Based on	Permissible Deviation	Charges on Deviation	No of Revisions	Implementation procedure status
FoR - Model Regulation	All	Yes	Available Capacity	+/- 15% Old +/- 10% New	Fixed rate of Rs./Unit	Every 1.5 hours	NA
CERC Inter State DSM Regulation	Regional Entities: Wind & Solar projects	No	Available Capacity	+/- 15% for all	As % of PPA	Every 1.5 hours	Final Procedure issued
Karnataka	>=10MW- Wind >=5MW- Solar	Yes	Available Capacity	+/- 15% for all	Fixed rate of Rs./Unit	Every 1.5 hours	Not issued
Andhra Pradesh	All	Yes	Available Capacity	+/- 15% Old +/- 10% New	Fixed rate of Rs./Unit	Every 1.5 hours	Final Procedure issued
Rajasthan	>=5MW for both Wind & Solar	No	Available Capacity	+/- 15% for all	Fixed rate of Rs./Unit	Every 1.5 hours	Final Procedure issued
Madhya Pradesh	All	No	Available Capacity	+/- 15% Old +/- 10% New	Fixed rate of Rs./Unit	Not specified	Final Procedure issued
Telangana	>=5 MW	No	Available Capacity	+/- 15% for all	Fixed rate of Rs./Unit	Every 1.5 hours	Not issued
Maharashtra	>=5 MW	No	Available Capacity	+/- 15% for all	Fixed rate of Rs./Unit	Every 1.5 hours	Final Procedure issued
Meghalaya	>=1MW	No	Available Capacity	+/- 15% for all	Fixed rate of Rs./Unit	Every 1.5 hours	Not issued

Comparison of DSM Regulations in States Contd..

Regulations	Applicable to	Aggregation of Multiple pooling stations by QCA/Generator	Error Based on	Permissible Deviation	Charges on Deviation	No of Revisions	Implementation procedure status
Punjab	>=5MW	No	Available Capacity	15% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Draft Procedure issued
Jharkhand	>=5MW	Yes	Available Capacity	15% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Not issued
Gujarat	>=1MW	No	Available Capacity	+/-12% for Wind and +-7% for Solar	Fixed Rat of Rs/unit	Every 1.5Hours	Draft Procedure issued
Uttar Pradesh	>=5MW	No	Available Capacity	15% for all	% of PPA	Every 1.5Hours	Not issued
Tamil Nadu	>=1MW	No	Available Capacity	10% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Draft Procedure issued
Haryana	>=1MW	No	Available Capacity	10% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Not issued

Rajasthan : DSM for Wind and Solar

Hon'ble High court order on RERC Wind and Solar DSM regulation 2017 w.e.f 01.01.2018:

"…Regulatory Commission to bear in mind the facts that in the case of generation by wind energy, the scheduling or forecasting may not be as accurate or flawless as in case of thermal power or other traditional mode of generation of electricity."

Hon'ble High court directed RERC to conduct Public Hearing and Until then RRVPNL shall remain restrained from recovering the deviation charges from the petitioners and/or QCAs.

Double DSM on Inter-state wind and solar projects

Unlike Karnataka and AP where DSM is at State Aggregate level, DSM are calculated at PSS level.

Maharashtra : Petition by Shapoorji Pallonji in High Court

- Challenging the regulation for imposing DSM charges at PSS level (Wind and Solar separate) as against FOR model regulation recommending DSM to be calculated at Aggregate State level (Virtual Pool).

- Double DSM penalty on all the generators. Plant/PSS level + State DSM charges de-pooled to all the generators

- Only penalty imposed on the RE generators

What wind and solar developers want

Uniform Deviation Settlement Mechanism (Frequency Based) across Generating plants and States/Regions

- **RLDC's/SLDC's to bifurcate DSM charges paid at State/Regional level on account of:**
  1. Deviation on Demand side
  2. Deviation on Generation side
     a. Deviation on account of Conventional power plant (Controlled generation)
     b. Deviation on account of Renewable power plant (Infirm nature)

- **Deviation on account of Renewable power plant to be apportioned as per below mechanisms-**
  1. Based on Connected capacity (MW)
  2. Based on Actual generation (kwh)
  3. Based on the %Error in schedule (% Error)
  4. Based on the frequency based DSM charges applicable at plant level.

Separate DSM for Wind and Solar power plants

- **Centralized(Regional/State) Forecasting should be done as against Plant level / PSS level**
  - Forecasting should be made centralized as followed by other developed countries like USA, Australia , Germany , Spain etc. The forecasting charges to be shared amongst RE Generators.
  - **Allow aggregation at State level as recommended in the NREL, MNRE report/FOR Model**. As it is in keeping with the primary objective of the regulations and is not punitive in its impact.

- **Harmonizing DSM Regulation across states-**
  - DSM charges should be **linked to % of PPA tariff's**, rather than be fixed; the current mechanism puts new capacity at disadvantage since PPA tariffs has fallen drastically.

Alternative 2 : Separate DSM for Wind and Solar power plants

- **Rationalisation of Error bands for Solar/Wind based on achievable weather forecast accuracy at local level across India in NWP model**
  - Permissible deviation and DSM charges shall be as below for monsoon period (June to Oct)
    - <35% - No charges
    - >35% to <50% – 10% of PPA tariff
    - >50% to <65% - 20% of PPA tariff
    - >65% - 30% of PPA tariff

- **Incentivising RE Generators for supporting Grid during low frequency**
  - Currently **Only penalty is levied** for deviation by RE generators, whereas in case of Thermal power, deviation is incentivised if it is supporting grid stability. Similar treatment to be extended to the RE power under DSM Regulation.

Separate DSM for Wind and Solar power plants

- **Remove restriction of 16 revisions (Once in 1.5 hours ahead forecast) in 24 hours**
  - This will enable capturing the rapid fluctuations in solar generation
  - Will be in line with thermal generators, wherein only constraint is that revision will be applicable from 4th time block.
  - Revision shall be applicable from 2nd time block to capture sudden changes in local weather conditions.
- **Exclude time-blocks where grid was unavailable for any reason -**
  - Current regulations are silent on such an exclusion.
  - Rajasthan is a lead example of incorporating such an exclusion; this should be made standard practise across all states
  - Frequent grid unavailability also impact forecasting model accuracy, which relies on Machine Learning and AI based approaches, thus reducing overall accuracy.

Separate DSM for Wind and Solar power plants

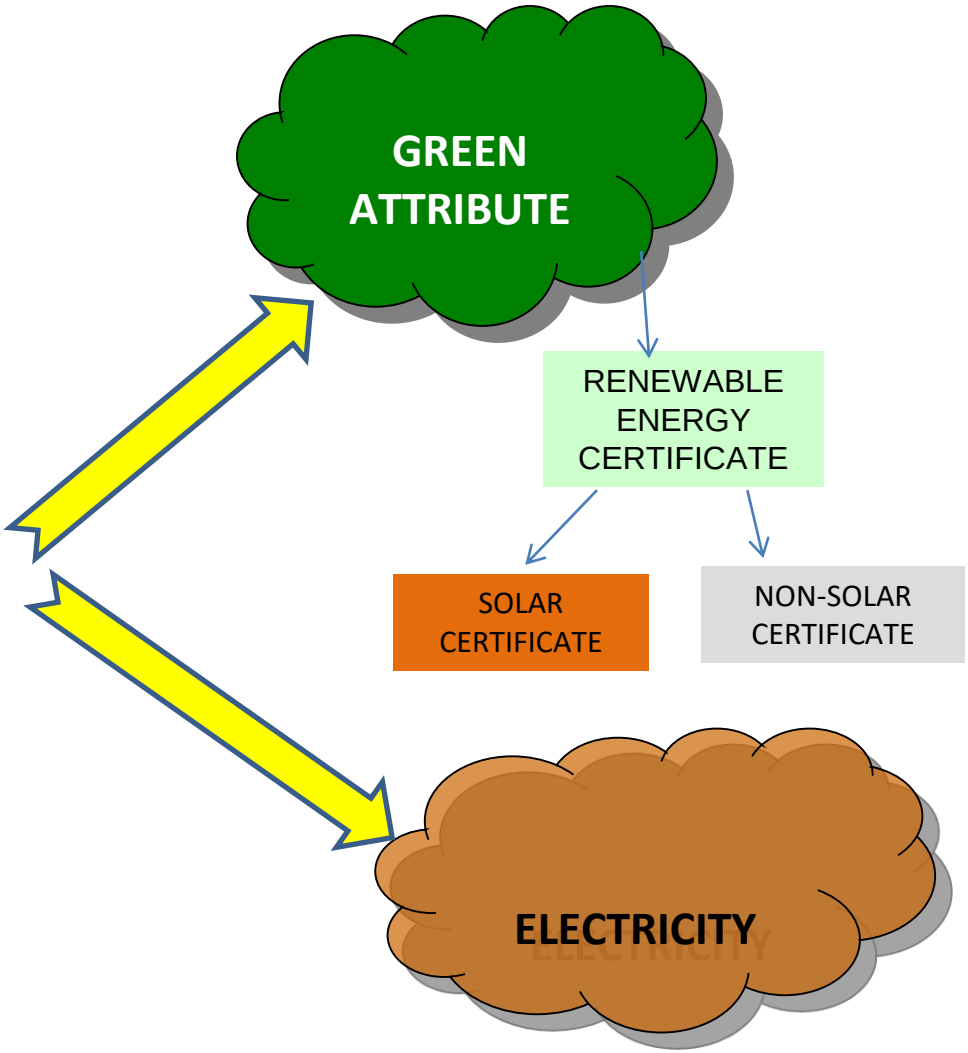
❑ **DSM charges should be made applicable one year after the COD-**

❑ The Accuracy of forecasting improves with availability of local historic weather data. Forecasting agencies are demanding a minimum 1 seasonal cycle historic data to train the forecasting model for better accuracy. The Machine learning through artificial intelligence deliver accurate results only if the model is having enough historic data for modelling.

- Rather than being a threat to grid , RE plants can provide valuable ancillary services like immediate frequency, quick ramp-up in case of shortfall followed in Australia.

Renewable Energy Certificate (REC) Mechanism

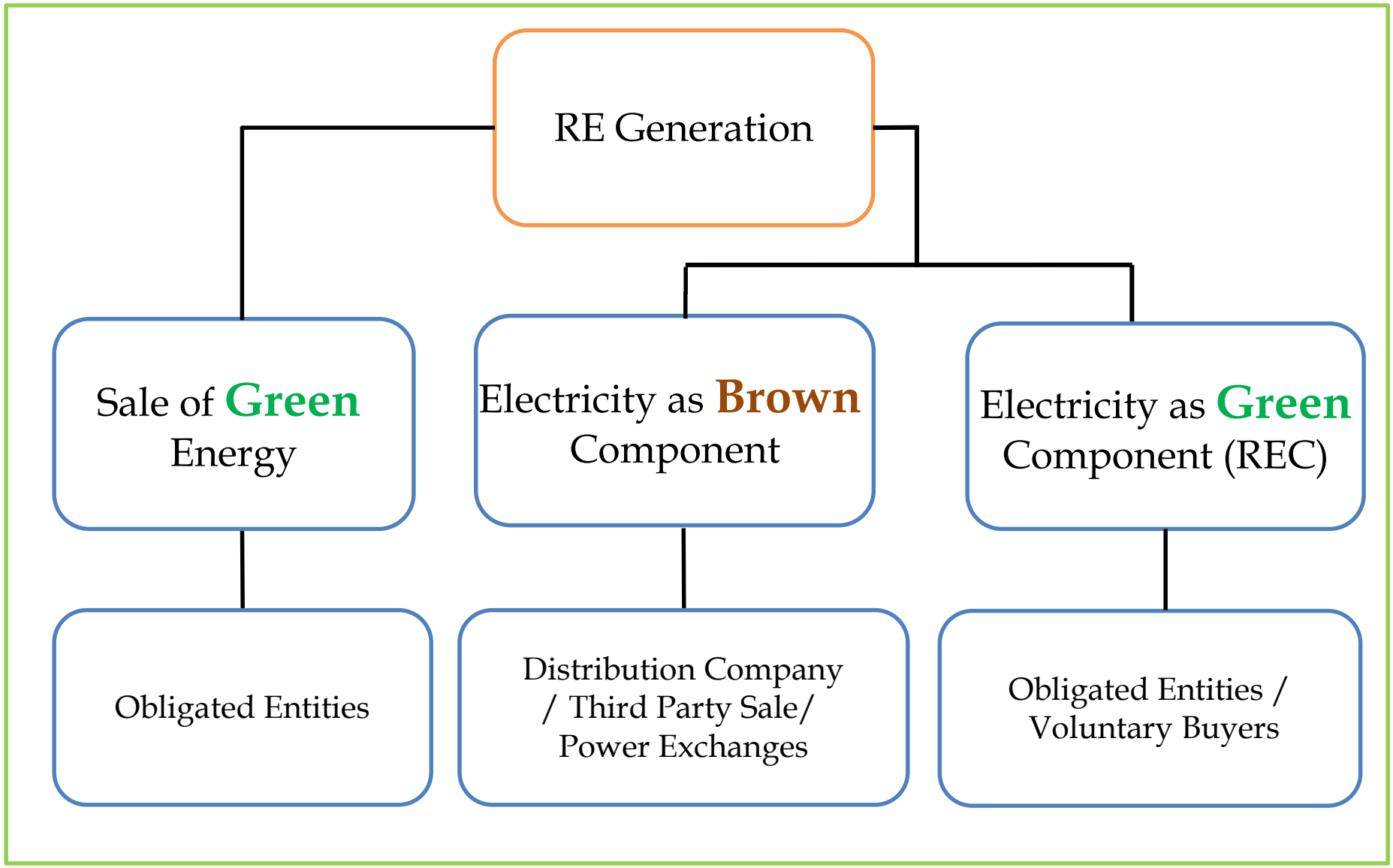
Concept of Renewable Energy Certificate



Transaction of 'electricity' and 'green certificates' in different markets

One REC represents one MWh of energy generated from renewable sources

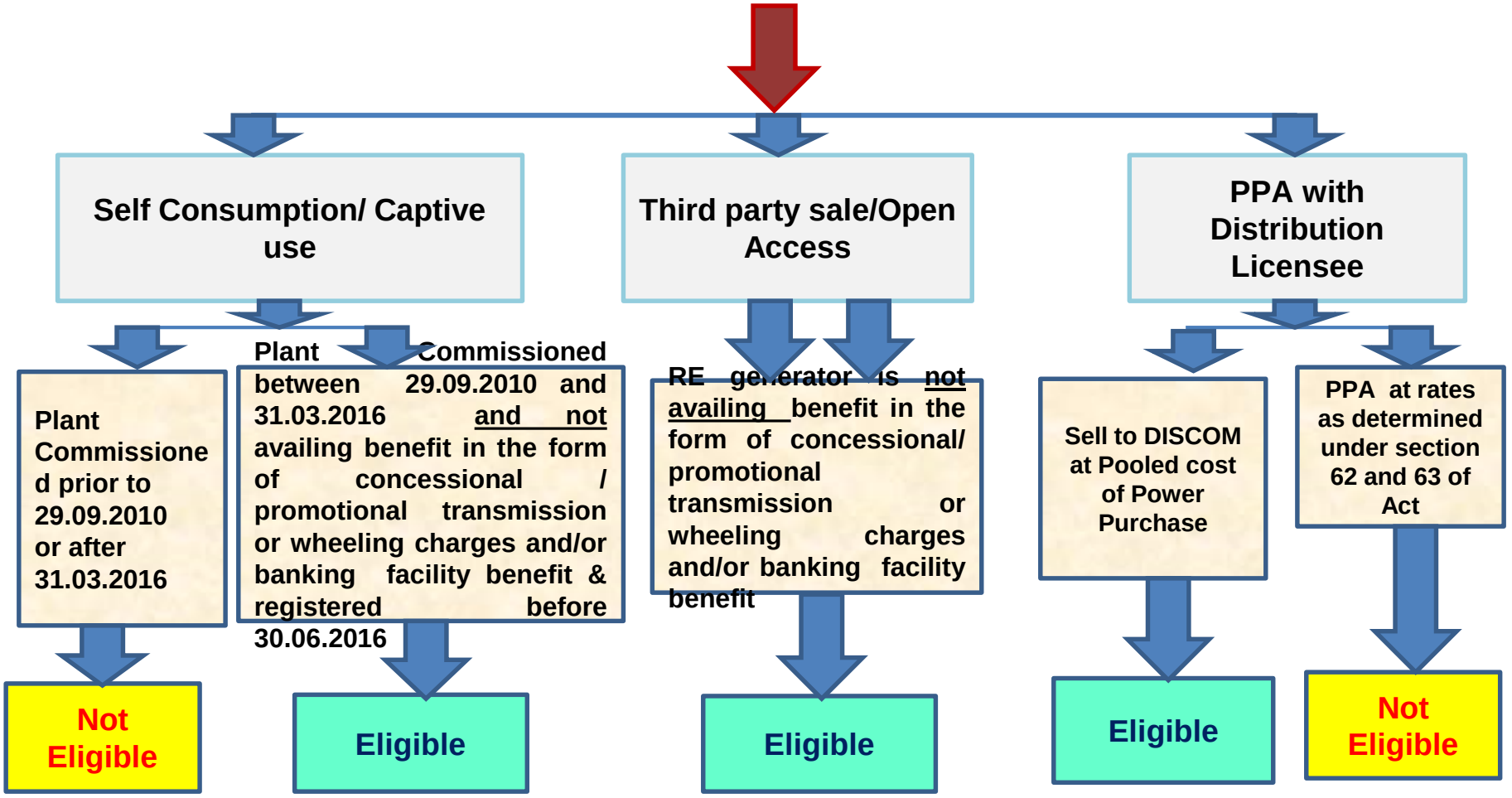
CERC REC Regulations -2010



Eligibility for Registration under REC Mechanism

1. Distribution Licensee – which has purchased Renewable Energy over and above their RPO

2. Grid Connected RE technology approved by MNRE under following routes



Chronology – REC Mechanism

Jun'08	**FOR initiated study for increasing RE Share and feasibility of REC**
Jun'08	NAPCC recognized market instruments as tool to promote RE
Oct' 09	FOR approved Model REC Regulations
Jan'10	CERC notified REC Regulations
Jun'10	CERC issued Order on Floor and Forbearance Price
Jun'10	CERC approved REC detailed procedures submitted by NLDC
Sep'10	CERC Issued Order on REC Fee and Charges
Sep'10	1st Amendment in REC Regulations
Nov'10	REC Mechanism Launched
Mar'11	1st REC Trading
July'13	2nd Amendment in REC Regulations
Dec'14	3rd Amendment in REC Regulations
May'15	Hon'ble Supreme Court Judgement regarding RPO Compliance
Mar'16	4th Amendment in REC Regulations
Mar'17	CERC Order on Floor and Forbearance Price

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 | डिस्कॉम / DISCOM | राज्य एजेंसियां / State Agencies | रिपोर्ट / Reports | सहायता / Help | हमसे संपर्क करें / Contact Us

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अक्षय ऊर्जा प्रमाण पत्र प्रक्रिया पर रिपोर्ट / Report on REC Mechanism 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 - 3222

Steps for REC

3 of 4

The basic procedure for issuance of Renewable Energy Certificates to the Eligible Entities includes the following steps:

STEP 3: An application for issuance of Renewable Energy Certificate shall be made by the Eligible Entity to the Central Agency. Read More >>

REC Summary

Month, Year	Opening Balance (A)	REC Issued (B)	No. of REC Redeemed		Total E=(C+D)	Closing Balance (F=A+B-E)
			RECs Redeemed through Power Exchanges (C)	RECs retained by RE Generators (D)		
Dec, 2017	16990859	837960	5217189	104415	5321604	12507215
Jan, 2018	12507215	667587	1230826	55514	1286340	11888462
Feb, 2018	11888462	336128	2358396	25004	2383400	9841190
Mar, 2018	9841190	492681	2769433	72153	2841586	7492285
Apr, 2018	7492285	330789	1062661	28704	1091365	6731709
May, 2018	6731709	508088	1316021	27109	1343130	5896667
Jun, 2018	5896667	559772	896229	63960	960189	5496250
Jul, 2018	5496250	411421	1618069	52150	1670219	4237452
Aug, 2018	4237452	610885	819608	3713	823321	4025016
Sep, 2018	4025016	550963	1903638	6335	1909973	2666006
Oct, 2018	2666006	672851	703256	11273	714529	2624328
Nov, 2018	2624328	643599	505738	28917	534655	2733272
Total:		50386370	45868391	1784707	47653098	

Login

Sign Up

RE Generators DISCOM

Related Links

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

Visitor Number - 5311336

Photo Gallery

Experience of management of REC registry

- Online payment gateway integrated w.e.f. August 2017
- Expenditure incurred ~ approx. 14 crore (0.25% of total value of transactions)
- Knowledge dissemination - technical papers, conferences, stalls etc.
- 30 workshops organized - on an average 30 officials trained
- More than 50 petitions have been filed in by the RE generators

Key Highlights

- Transparent
- User Friendly
- Real Time Data
- Single Touch Point for information

About POSOCO | Privacy Policy

Appointment of NLDC as Central Agency

- NLDC designated as Central Agency by Hon'ble CERC

- The functions of Central Agency includes :
  - Registration of Eligible Entities
  - Issuance of Certificate
  - Maintaining and settling accounts in respect of the certificate
  - Repository of transactions of certificates and
  - Any other function incidental to the implementation of REC Mechanism

- The NLDC has developed various procedures to operationalize REC mechanism

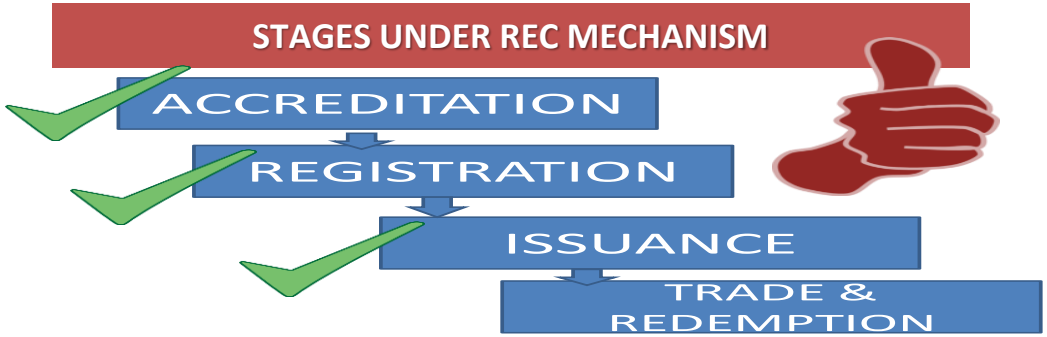
Regulations by CERC and SERCs

- **CERC REC Regulations 2010 (and 4 amendments)**
- **SERC Regulations- 29 SERCs/JERCs have notified the RPO Regulations/Orders**

S. No.	Name of ERC
1	Andhra Pradesh
2	Arunachal Pradesh
3	Assam
4	Bihar
5	Chhattisgarh
6	Delhi
7	Gujarat
8	Haryana
9	Himachal Pradesh
10	Jammu and Kashmir
11	Jharkhand
12	Karnataka
13	Kerala
14	Madhya Pradesh
15	Maharashtra
16	Meghalaya

S. No.	Name of ERC
17	Nagaland
18	Odisha
19	Punjab
20	Rajasthan
21	Sikkim
22	Tamil Nadu
23	Telangana
24	Tripura
25	Uttar Pradesh
26	Uttarakhand
27	West Bengal
28	JERC- Manipur, Mizoram
29	JERC- Chandigarh, Lakshadweep, Andaman & Nicobar Islands, Goa, Daman & Diu, Dadra & Nagar Haveli, Puducherry

Processes in REC Mechanism



1. ACCREDITATION

- ✓ RE GENERATOR APPLIES ONLINE
- ✓ STATE AGENCY VERIFIES DETAILS
- ✓ STATE AGENCY ACCREDITATE/ REJECTS

2. REGISTRATION

- ✓ RE GENERATOR APPLIES ONLINE
- ✓ CENTRAL AGENCY VERIFIES DETAILS
- ✓ CENTRAL AGENCY REGISTER/ REJECT

3. ISSUANCE

- ✓ RE GENERATOR APPLIES ONLINE (10th ,20th and last day of month)
- ✓ SLDC VALIDATES ENERGY INJECTION REPORT
- ✓ CENTRAL AGENCY ISSUES REC

4. REDEMPTION

Redemption through Power Exchanges (PX)

- ✓ BUYERS & SELLERS PLACE BIDS AT PXs
- ✓ POWER EXCHANGES SEND PROVISIONAL FILE TO CENTRAL AGENCY FOR VALIDATION OF SALE BIDS
- ✓ CENTRAL AGENCY SENDS EXCEPTION REPORT IF ANY
- ✓ PXs PROCESS FINAL TRADE

Redemption through Self-retention of RECs by RE generators

REC procedures

- In line with the CERC REC Regulations, Central Agency has developed procedures for each process
- 5 times the procedures have been modified since launch of the mechanism

REC Market Design

Power Market Regulations, 2010

- Rules and byelaws
- Type of contract (day ahead, term ahead etc.);
- Price Discovery methodology and matching rules

Regulatory changes in REC Market design,2012

- Modification in price discovery methodology and matching rules
- 'Price time priority' to 'Price-pro-rata' rule

Salient features of the REC Market Design

Auction type:	**Closed, double sided auction where both the sellers and buyers participate anonymously**
Bidding:	Anonymous
Participation:	Voluntary
Price formation:	Uniform price auction
Price caps:	Floor and ceiling prices notified by the CERC from time to time
Standard contract:	1 REC equivalent to 1 MWh
Categories of certificates:	Solar and Non-Solar

Salient Features of the REC Mechanism

Participation	Voluntary
REC Denomination	1 REC = 1MWh
Validity	1095 days after issuance
Categories	1. Solar 2. Non-Solar (unique certificate number)
Sellers	Eligible RE Generators / Distribution Licensees (DISCOM)
Buyers	1. Obligated Entities (DISCOM/ CPP / OA Consumers) 2. Voluntary
Trading Platform	Power Exchanges
Trading Periodicity	Last Wednesday of the month
Banking / Borrowing	Not Allowed
Transfer Type	Single transfer only, repeated trade of the same certificate is not possible

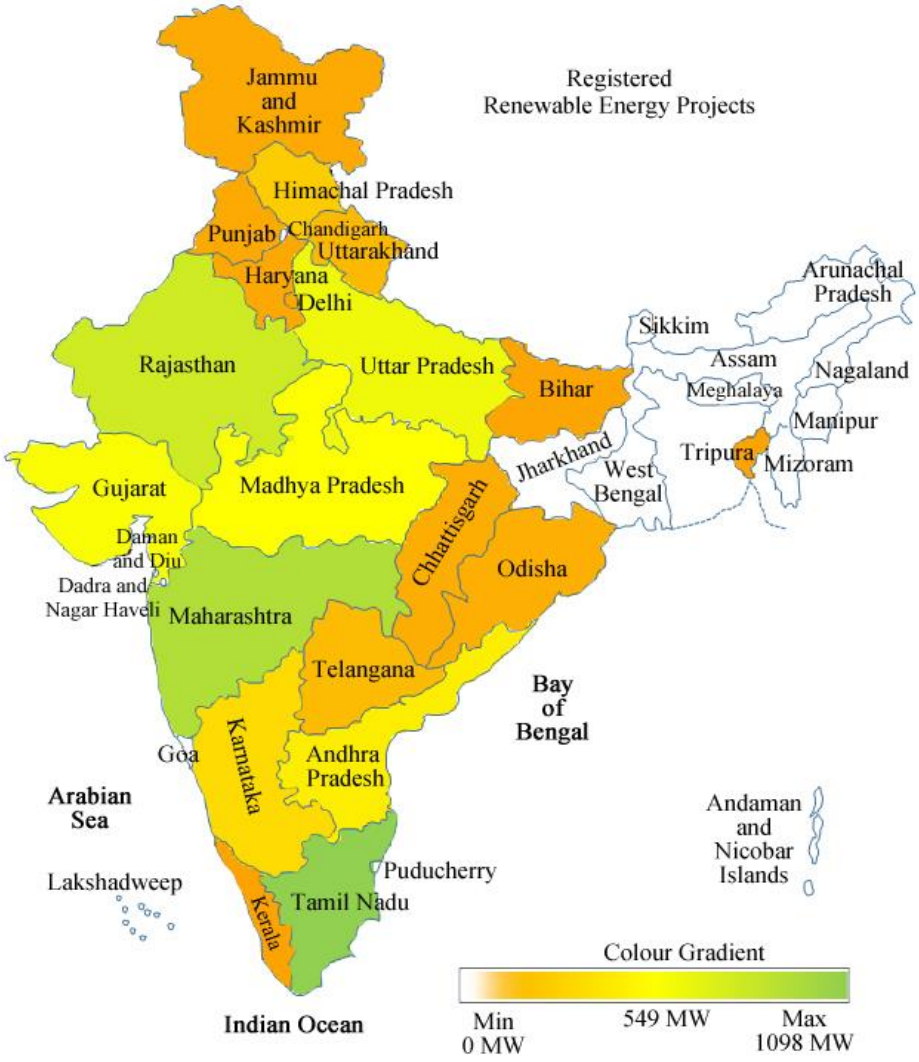
Floor and Forbearance Price

	Non - Solar REC			Solar REC			
	01.06.2010 - 31.03.2012	01.04.2012- 31.03.2017	w.e.f. 01.04.2017	01.06.2010 - 31.03.2012	01.04.2012 - 31.12.2014	01.01.2015 - 31.03.2017	w.e.f. 01.04.2017
Forbearance Price (Rs./MWh)	3,900	3,300	3,000	17,000	13,400	5,800	2,400
Floor Price (Rs./MWh)	1,500	1,500	1,000	12,000	9,300	3,500	1,000

Important Amendments in REC Regulations

- Renewable energy contracted through competitive bidding is not eligible under REC Mechanism
- After registration, the RE gen. eligible for RECs from the date of commercial operation or from the date of registration whichever is later
- The eligible entity shall apply to the Central Agency for certificates within six months from the corresponding generation
- Shelf-life of RECs extended from 365 days to 730 days to 1095 days
- Incentive to DISCOMs to procure beyond RPO target - DISCOMs eligible to receive RECs
- Project under Self-consumption route is not eligible for new Registration under REC Scheme
- Vintage multiplier factor of 2.66 for Solar Generators which have registered their project prior to 1st Jan 2015- upto 31.03.2017
- An RE Generator may retain the RECs for offsetting its RPO as a consumer
- Revocation of RECs/recovery of sale proceeds of RECs of those RE generators who have registered their projects on false information

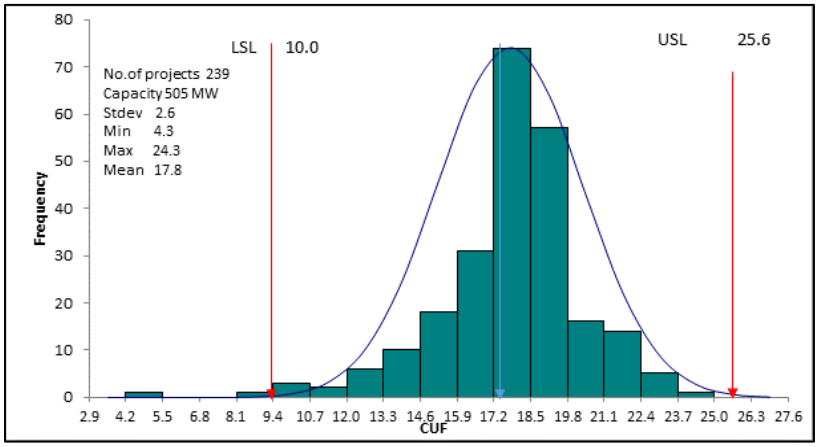
Registration Map



Report on REC in India : Key learnings, Data analysis and Way forward

https://recregistryindia.nic.in/pdf/Others/Report_on_REC_Mechanism.pdf

Registered Solar PV Projects

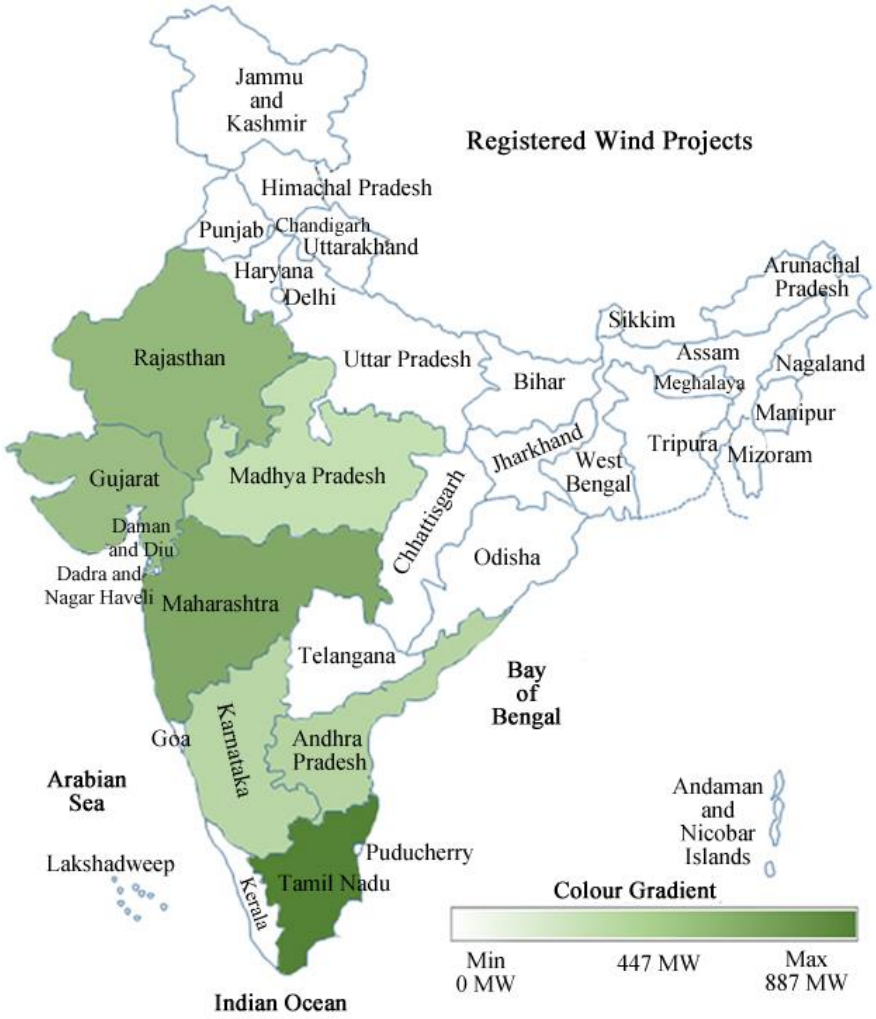


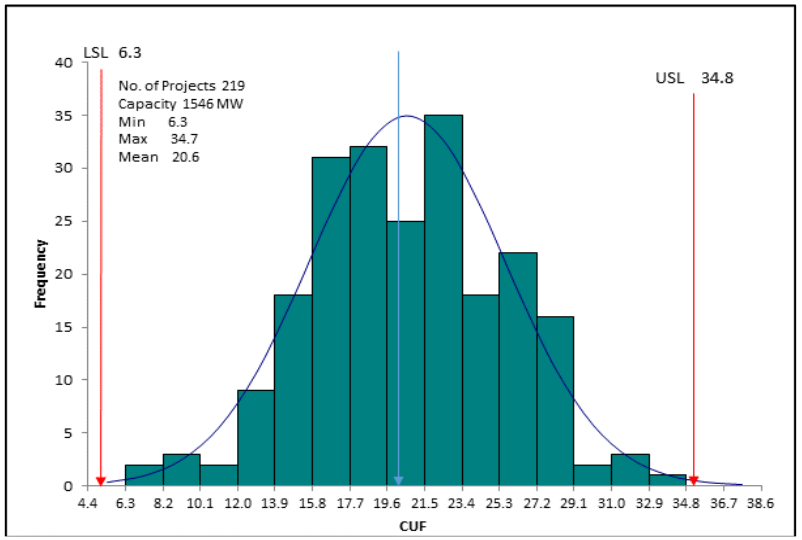
S. No.	State	No. of Projects	Capacity (MW)
1	Rajasthan	104	239
2	Madhya Pradesh	99	182
3	Maharashtra	62	99
4	Tamil Nadu	56	121
5	Andhra Pradesh	16	36
6	Telangana	10	28
7	Gujarat	4	7
8	Odisha	3	5
9	Delhi	2	8
10	Haryana	1	1
11	Chhattisgarh	1	5
12	Kerala	1	1
13	Tripura	1	5
	Total	360	736

Accreditation						Registration						Breakup of RECs			
Total		Revoked/ Expired		Net		Total		Revoked/ Expired		Net		Issued	Redeemed through		Closing Balance
No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)		PXs	Self Retaintion	
394	792	18	38	376	754	373	756	13	20	360	736	7,650,653	1,653,478	82,539	5,914,636

As on 31.03.2018- Report on REC Mechanism

Registered Wind Projects



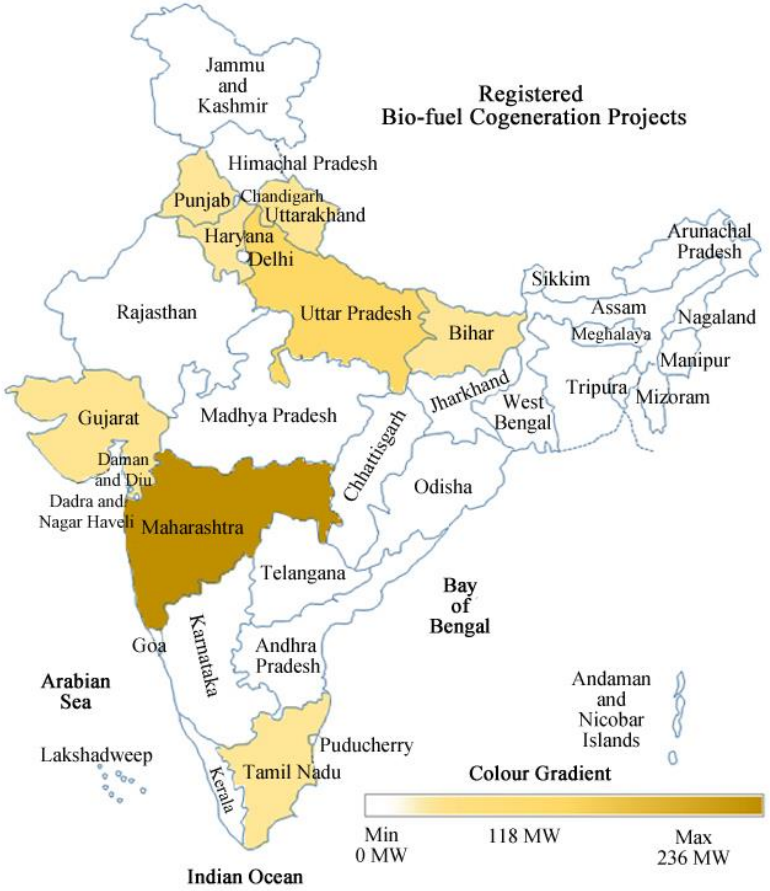


S. No.	State	No. of Projects	Capacity (MW)
1	Tamil Nadu	172	887
2	Maharashtra	161	454
3	Gujarat	32	227
4	Rajasthan	22	361
5	Andhra Pradesh	14	125
6	Karnataka	11	107
7	Madhya Pradesh	1	6
	Total	**413**	**2,167**

Accreditation						Registration						Breakup of RECs			
Total		Revoked/ Expired		Net		Total		Revoked/ Expired		Net		Issued	Redeemed through		Closing Balance
													PXs	Self Retaintion	
No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)				
699	2,934	266	703	433	2,231	664	2,781	251	614	413	2,167	18,145,199	16,090,035	1,324,427	730,737

As on 31.03.2018- Report on REC Mechanism

Registered Bio-fuel Cogeneration Projects

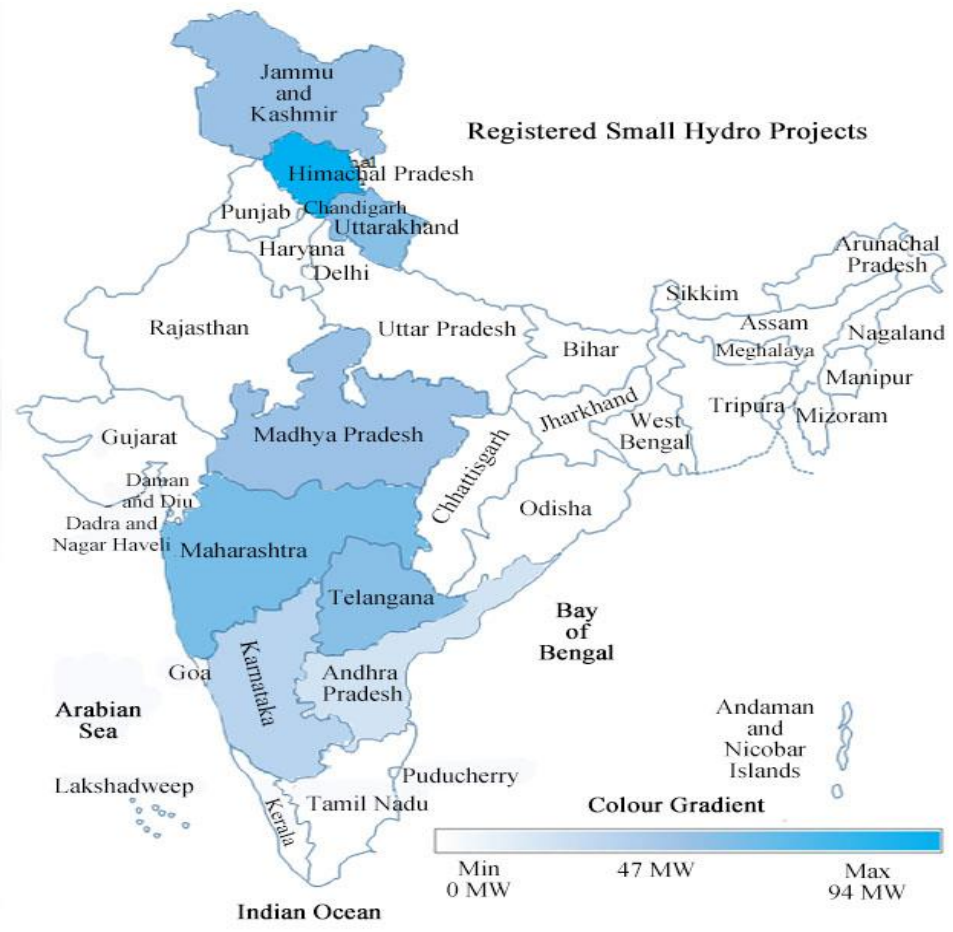


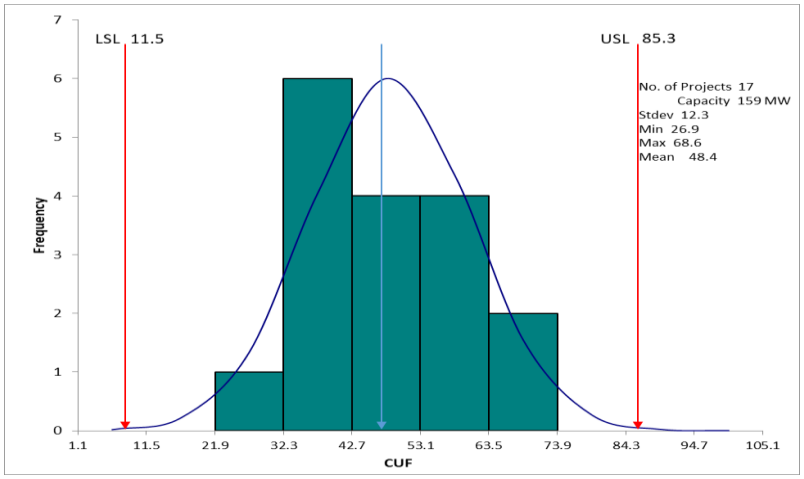
S. No.	State	No. of Projects	Capacity (MW)
1	Maharashtra	30	236
2	Uttar Pradesh	17	134
3	Gujarat	6	21
4	Uttarakhand	4	18
5	Tamil Nadu	1	10
6	Haryana	1	3
7	Punjab	1	5
8	Bihar	1	6
Total		61	431

Accreditation						Registration						Breakup of RECs			
Total		Revoked/ Expired		Net		Total		Revoked/ Expired		Net		Issued	Redeemed through		Closing Balance
No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)		PXs	Self Retaintion	
136	1,214	35	303	101	911	128	1,138	67	707	61	431	7,284,244	7,146,768	5,001	132,475

As on 31.03.2018- Report on REC Mechanism

Registered Small Hydro Projects



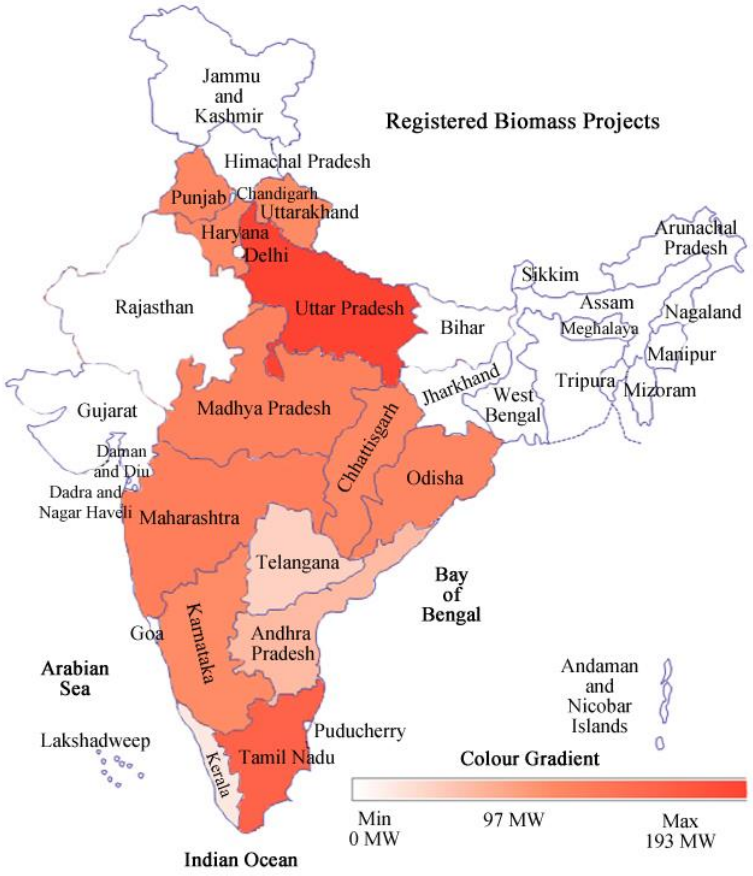


S. No.	State	No. of Projects	Capacity (MW)
1	Himachal Pradesh	13	94
2	Maharashtra	10	32
3	Karnataka	2	10
4	Madhya Pradesh	1	14
5	Andhra Pradesh	1	1
6	Telangana	1	24
7	Uttarakhand	1	24
8	Jammu and Kashmir	1	15
Total		30	212

Accreditation						Registration						Breakup of RECs			
Total		Revoked/ Expired		Net		Total		Revoked/ Expired		Net		Issued	Redeemed through		Closing Balance
No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)		PXs	Self Retaintion	
54	493	20	263	34	230	47	412	17	200	30	212	3,732,562	3,718,347	6,616	7,599

As on 31.03.2018- Report on REC Mechanism

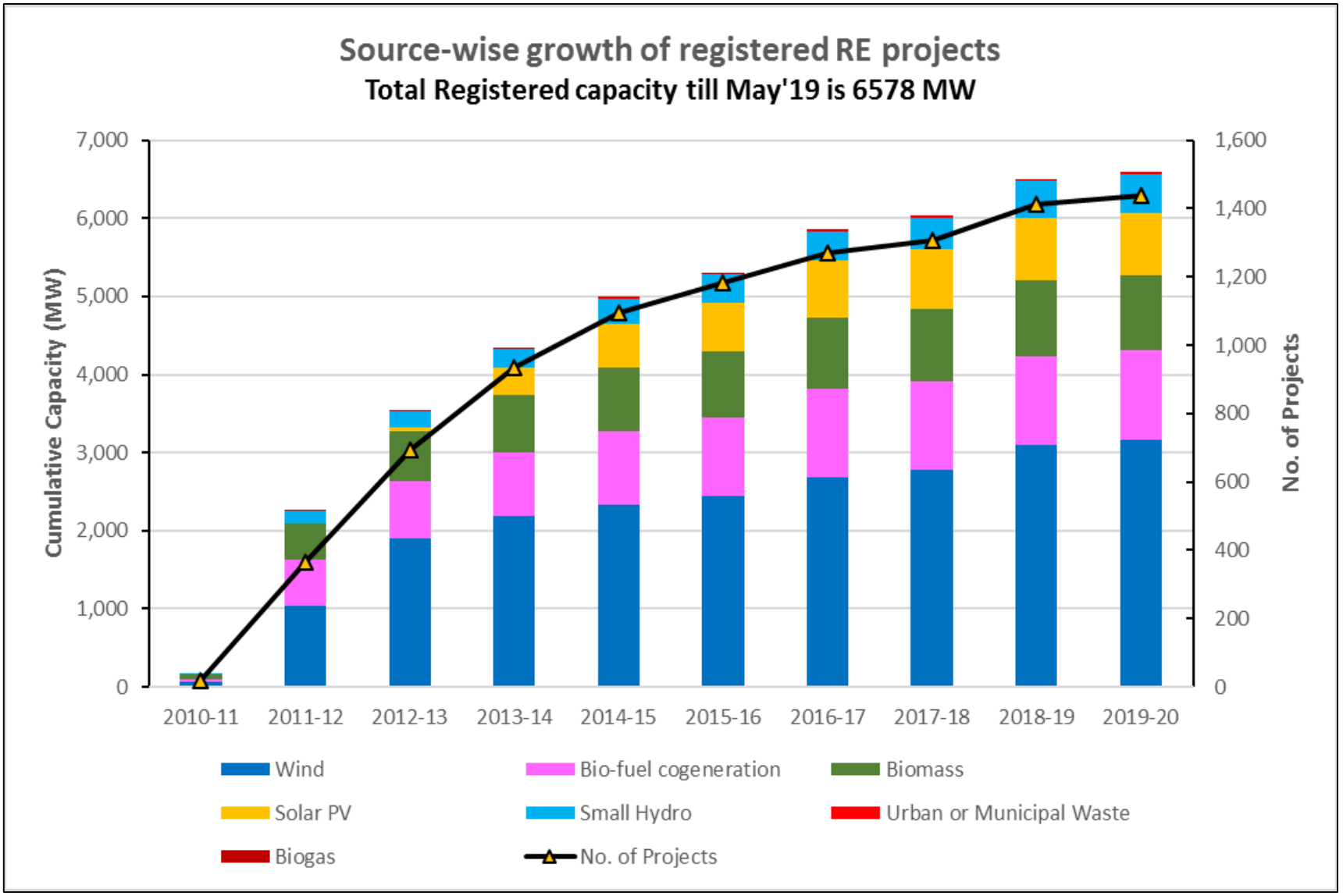
Registered Biomass Projects



S. No.	State	No. of Projects	Capacity (MW)
1	Uttar Pradesh	14	193
2	Tamil Nadu	10	81
3	Maharashtra	5	28
4	Haryana	4	11
5	Madhya Pradesh	1	4
6	Andhra Pradesh	1	6
7	Karnataka	1	10
8	Telangana	1	4
9	Uttarakhand	1	10
10	Odisha	1	25
11	Punjab	1	10
12	Chhattisgarh	1	20
Total		41	401

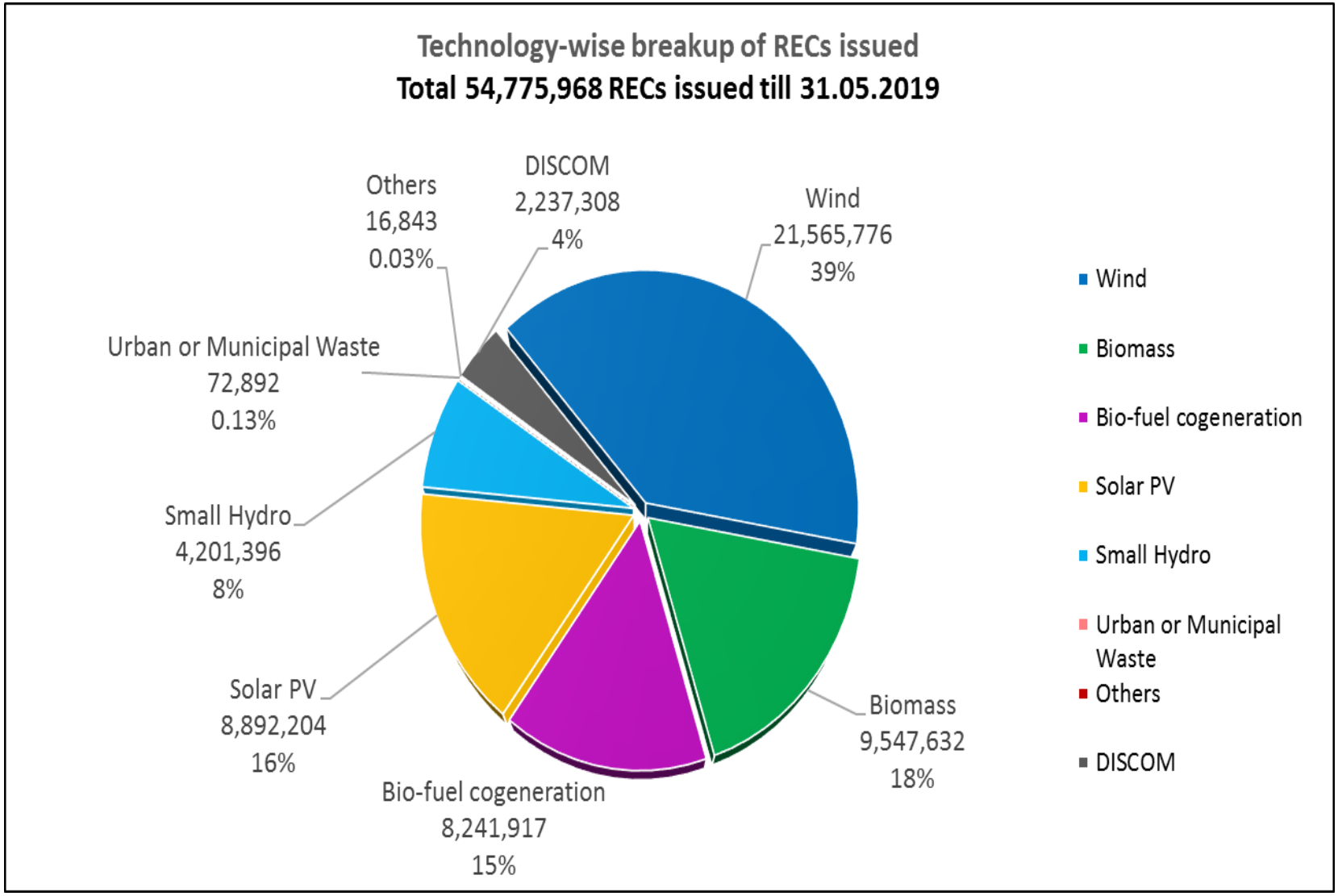
Accreditation						Registration						Breakup of RECs			
Total		Revoked/ Expired		Net		Total		Revoked/ Expired		Net		Issued	Redeemed through		Closing Balance
No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)		PXs	Self Retaintion	
104	1,044	53	518	51	526	93	925	52	524	41	401	8,560,742	8,341,279	138,953	80,510

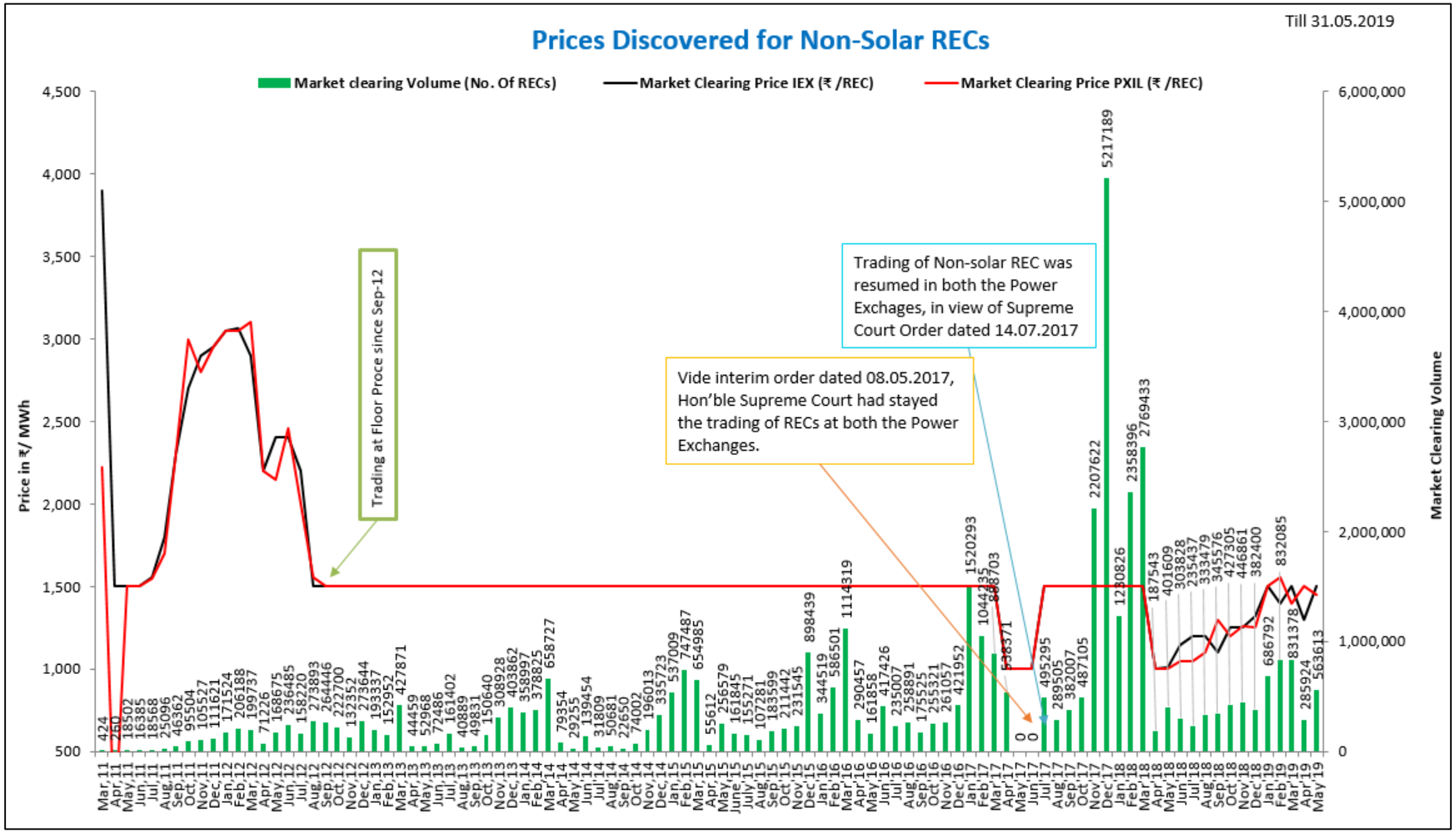
As on 31.03.2018- Report on REC Mechanism

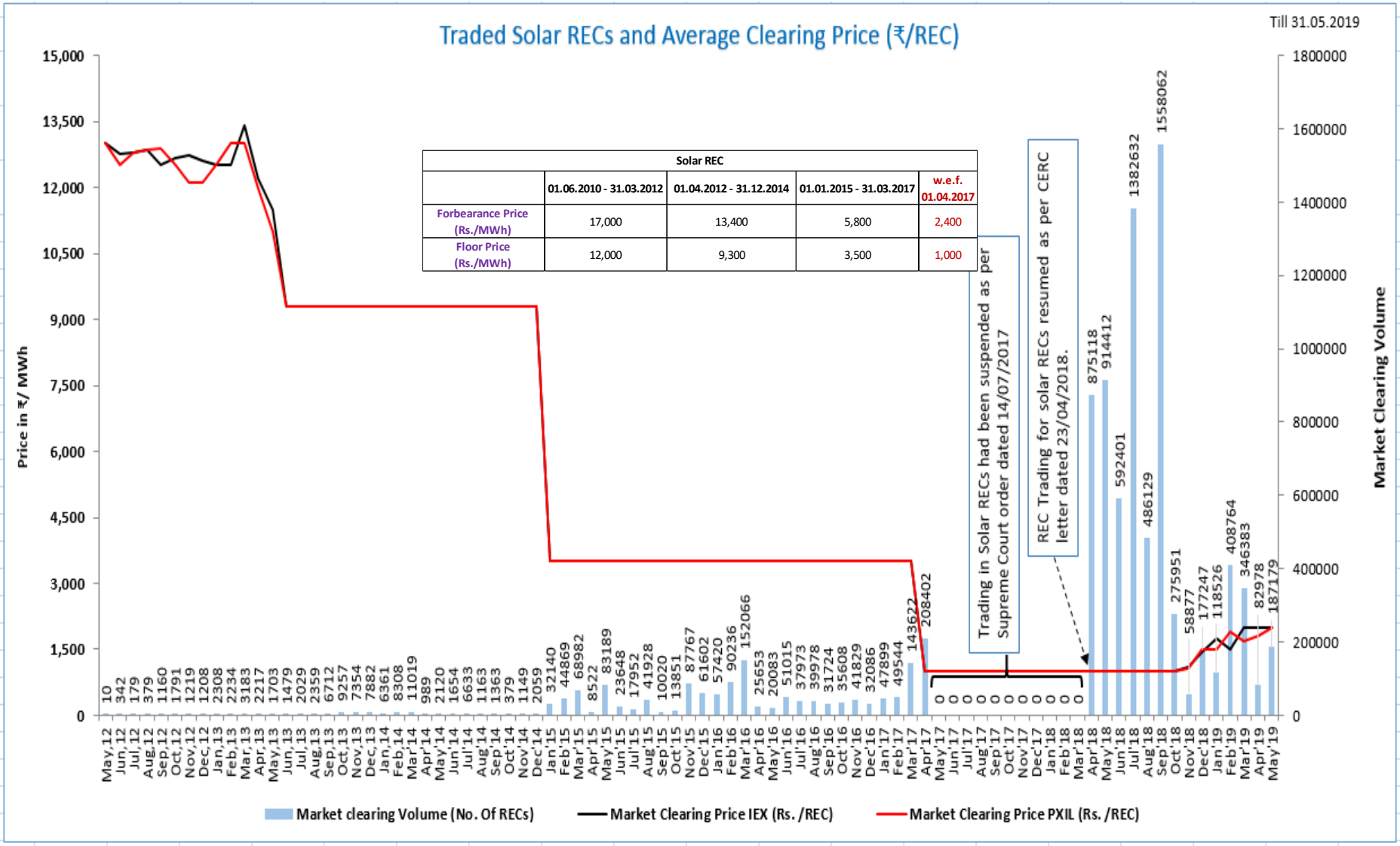

Source-wise growth of registered RE projects
Total Registered capacity till May'19 is 6578 MW
Cumulative Capacity (MW)
No. of Projects
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1,600
1,400
1,200
1,000
800
600
400
200
0
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
Wind
Bio-fuel cogeneration
Biomass
Solar PV
Small Hydro
Urban or Municipal Waste
Biogas
No. of Projects

Source wise breakup as on 31.05.2019

S. No.	Source Wise	Accreditation Capacity	Accreditation Unit	Registration Capacity	Registration Unit	No. of RECs Issued	No. of RECs Redeemed through Power Exchanges	No. of RECs Redeemed through Self Retain	Closing Balance	Percentage of Registered Units	Percentage of RECs Issued	Percentage of RECs Redeemed thorugh Power Exchanges
1	Wind	2,541	462	2,262	448	21,565,776	18,768,416	1,751,952	1,045,408	47.3%	39.4%	37.0%
2	Biomass	500	46	416	39	9,547,632	9,274,750	147,549	125,333	4.1%	17.4%	18.3%
3	Bio-fuel cogeneration	862	96	412	56	8,241,917	8,053,062	5,001	183,854	5.9%	15.0%	15.9%
4	Solar PV	760	377	749	369	8,892,204	8,634,405	109,064	148,735	39.0%	16.2%	17.0%
5	Small Hydro	220	34	220	34	4,201,396	4,184,346	6,899	10,151	3.6%	7.7%	8.2%
6	Urban or Municipal Waste	0	0	0	0	72,892	72,892	0	0	0.0%	0.1%	0.1%
7	Others	4	2	3	1	16,843	9,970	5,010	1,863	0.1%	0.0%	0.0%
8	DISCOM	NA	NA	NA	NA	2,237,308	1,773,819	0	463,489	NA	4.1%	3.5%
	Total	4,887	1,017	4,063	947	54,775,968	50,771,660	2,025,475	1,978,833	100%	100%	100%


Technology-wise breakup of RECs issued
Total 54,775,968 RECs issued till 31.05.2019
Others
16,843
0.03%
DISCOM
2,237,308
4%
Wind
21,565,776
39%
Urban or Municipal Waste
72,892
0.13%
Small Hydro
4,201,396
8%
Solar PV
8,892,204
16%
Bio-fuel cogeneration
8,241,917
15%
Biomass
9,547,632
18%
Wind
Biomass
Bio-fuel cogeneration
Solar PV
Small Hydro
Urban or Municipal Waste
Others
DISCOM

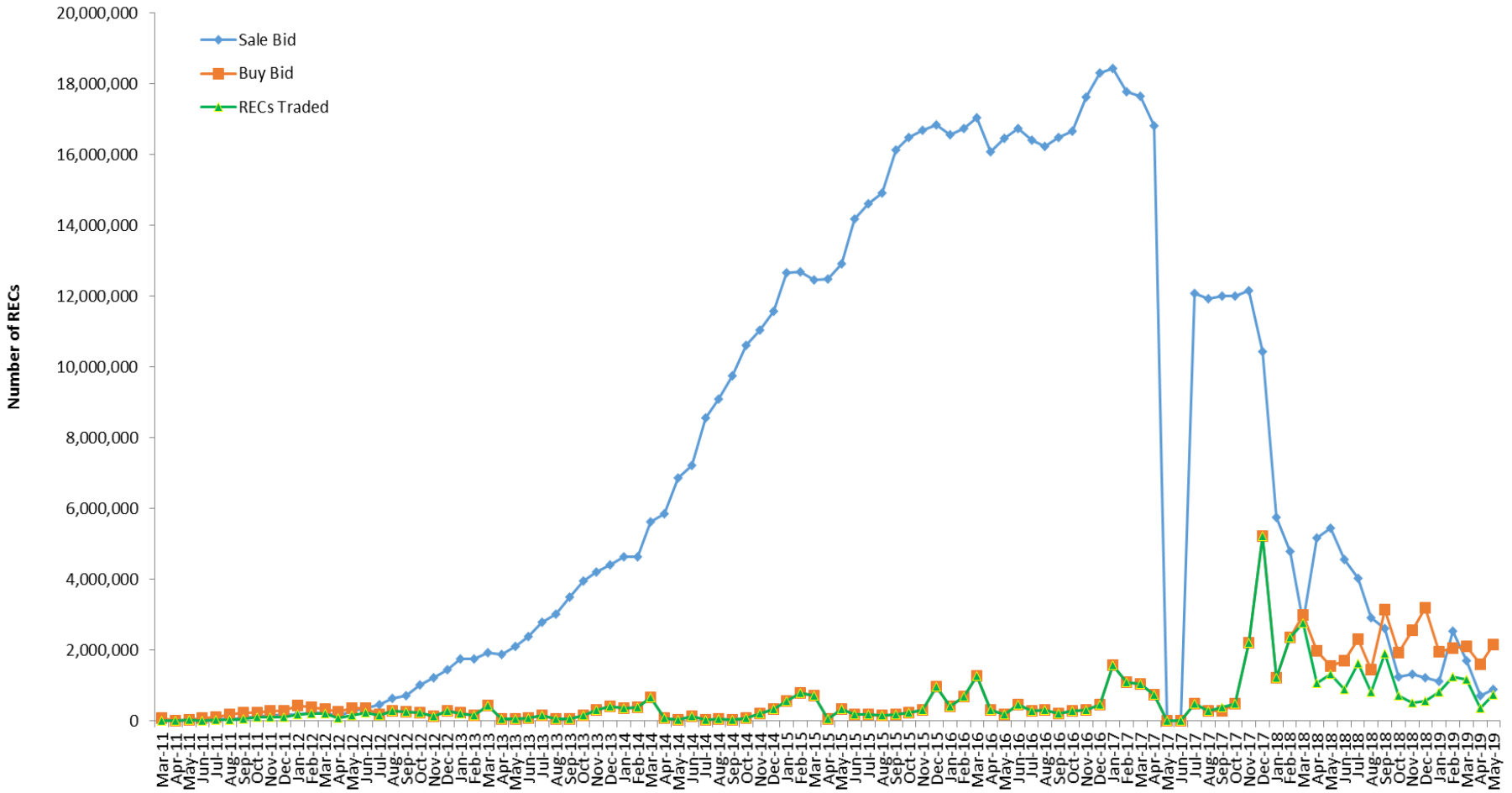

Till 31.05.2019
Prices Discovered for Non-Solar RECs
Market clearing Volume (No. Of RECs)
Market Clearing Price IEX (₹ /REC)
Market Clearing Price PXIL (₹ /REC)
Price in ₹/ MWh
Market Clearing Volume
Trading at Floor Proce since Sep-12
Vide interim order dated 08.05.2017, Hon'ble Supreme Court had stayed the trading of RECs at both the Power Exchanges.
Trading of Non-solar REC was resumed in both the Power Exchages, in view of Supreme Court Order dated 14.07.2017


Traded Solar RECs and Average Clearing Price (₹/REC)
Till 31.05.2019
Price in ₹/ MWh
Market Clearing Volume
Solar REC
01.06.2010 - 31.03.2012
01.04.2012 - 31.12.2014
01.01.2015 - 31.03.2017
w.e.f. 01.04.2017
Forbearance Price (Rs./MWh)
17,000
13,400
5,800
2,400
Floor Price (Rs./MWh)
12,000
9,300
3,500
1,000
Trading in Solar RECs had been suspended as per Supreme Court order dated 14/07/2017
REC Trading for solar RECs resumed as per CERC letter dated 23/04/2018.
Market clearing Volume (No. Of RECs)
Market Clearing Price IEX (Rs. /REC)
Market Clearing Price PXIL (Rs. /REC)

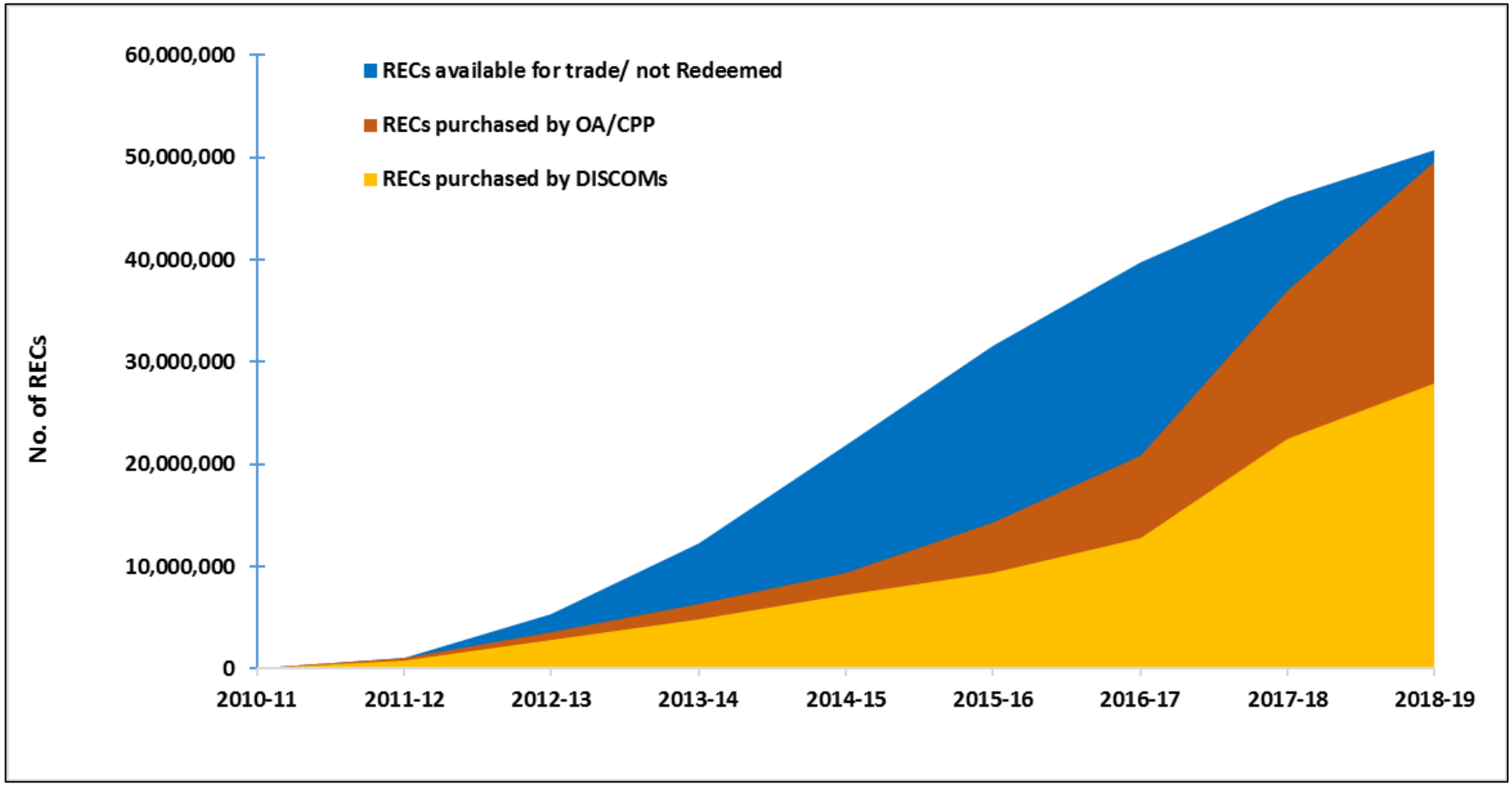
Till 31.05.2019

REC Trading Details

RECs Traded Till 30.04.2019: ~5.08 Crore RECs worth ₹ 7,729 Crore in 97 trading sessions



RECs purchased and available for Trade



RECs Purchased by Voluntary Buyers

S. No.	Name of Voluntary Buyer	State	Number of RECs			Number of Participatio
			Solar	Non-Solar	Total	
1	Aditya Birla Fashion and Retail Limited	Karnataka	0	405	405	1
2	Aman Taragi	Delhi	1	4	5	1
3	Canpack India Pvt Ltd NUH	Haryana	0	8	8	1
4	Customized Energy Solutions India Pvt Ltd	Maharashtra	2	14	16	4
5	Dipanshu Gupta	Delhi	0	1	1	1
6	EKI Energy Services Ltd	Madhya Pradesh	0	11	11	1
7	Ennore Port Ltd	Tamil Nadu	0	66	66	1
8	Indian Energy Exchange Ltd	Delhi	0	5	5	1
9	Indian Renewable Energy Development Agency Ltd	Delhi	0	100	100	1
10	Kimberly Clark Lever Private Limited	Maharashtra	0	63	63	1
11	Manikaran Power Ltd.	Jharkhand	0	5	5	1
12	Manikaran Power Trading Ltd.	West Bengal	0	5	5	1
13	Manikaran Thermal Power Pvt. Ltd.	West Bengal	0	2	2	1
14	Mikhail Harry Dhaul	Maharashtra	1	4	5	1
15	Neo Remark Marketing Services LLP Brand Remark	Delhi	0	4	4	3
16	Nikhil Vedprakash	Maharashtra	1	4	5	1
17	NMDC LTD	Andhra Pradesh	0	2,500	2,500	1
18	Power System Operation Corporation Ltd	Delhi	1,854	5,710	7,564	10
19	Rashtriya Ispat Nigam Limited	Andhra Pradesh	0	100	100	1
20	Reconnect Energy Trading	Karnataka	13	0	13	3
21	Reliance Retail Ltd	Maharashtra	0	71	71	1
22	Rural Electrification Corporation Limited	Delhi	0	16,400	16,400	1
23	Security Printing and Mining Corporation of India Ltd	Delhi	0	667	667	1
24	Sierra ODC Private Limited	Tamil Nadu	0	95	95	1
25	Sumit Kumar	Bihar	0	1	1	1
26	TATA Services Ltd	Maharashtra	0	1,090	1,090	1
27	World Bank Country Office	Delhi	0	575	575	1
		TOTAL	1,872	27,910	29,782	

Judicial Orders regarding RPO Compliance

❖ APTEL Order dated 20th April 2015

- Carry forward/review should be allowed - keeping in view of availability of REC.
- In case of default in fulfilling RPO, the penal provision should be exercised.

❖ Hon'ble Supreme court (SC) judgment dated 13.05.2015

- Hindustan Zinc vs RERC on the applicability of RPO regulations.
- RPO on captive consumer and open access consumer is justified
- Obligated entities have option to purchase of RECs from Power Exchange(s).
- Interpreted the RPO in the context of Article 51A (g) and Article 21 of the Constitution of India

❖ Hon'ble Supreme Court Order regarding REC Trading

- Hon'ble CERC vide order dated 30.03.2017 reduced the Floor and Forbearance Price
- Hon'ble Supreme Court(SC) vide interim order dated 08.05.2017, **stayed** the trading of RECs
- Hon'ble SC vide order dated on 14.07.2017, **allowed** the trading of **non-solar RECs**
- Hon'ble APTEL vide order dated April 12,2018 decided that the trading of RECs (solar and non-solar) shall be carried out **as per Hon'ble CERC order** dated March 30,2017
- Hon'ble SC in its interim order dated May 14, 2018, directed that "…Interim orders dated 08.05.2017 and 14.07.2017 to continue. However, we clarify that this interim order will not apply to RECs issued on or after 01.04.2017…".
  - ✓ Subsequently, **non-solar RECs** issued up to March 30, 2017, being traded as per the old rates

Impact of REC Mechanism

❖ Investment facilitated by the REC Mechanism

- Provided an additional avenue to RE generator(s) to sell their power locally to DISCOM and/or open access consumer
- Capital investment by RE generators
- Positive signal to investors- Traded value of RECs ~ Rs.7,000 crores

❖ Facilitates RPO Compliance

- 4.6 crore RECs purchased by more than 3,000 obligated entities(DISCOMs/CPPs/OA consumers) purchased
- Without REC Mechanism, **RPO compliance for small obligated entities like CPPs** / **Open Access consumers** would have been very difficult
- Choices to Obligated entities

❖ Inter-State RE Transactions

- Inter-state transaction of Renewable energy- CERC DSM Regulations
- RECs issued to projects located in 21 States/ UTs vs. RECs purchased by obligated entities of 30 States/ UTs
- Self-retention of RECs - RE generators may offset RPO as a consumer for their consumption units located in different parts of the country

❖ Development of Market for voluntary Buyers

- About 30,000 RECs have been purchased by voluntary buyers including companies, institutions and individuals.

Challenges and way forward

- *RPO Compliance*
- *Demand-Supply mismatch*
- *Limited Voluntary Market*
- *Market Design*
- Reduction in the floor and forbearance
- Enforcement of RPO by SERCs
- Capacity Building of the stakeholders

THANK YOU