Role of RLDCs in Integration of Renewable Energy

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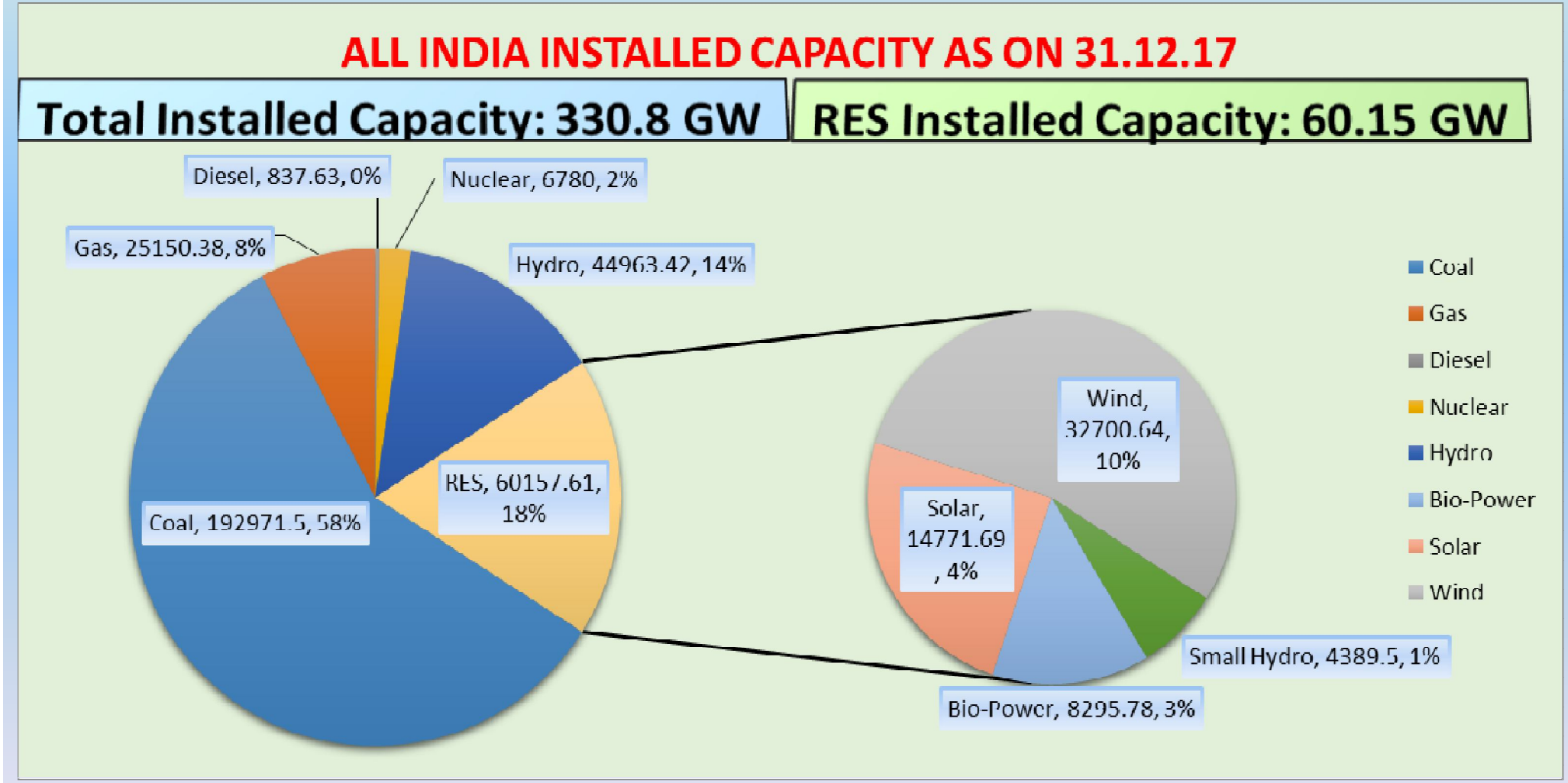
Presentation Outline

- Renewable Energy Sources and Characteristics
- Requirement for secure operation of Grid
- Role of RLDCs in RE integration: Regulatory framework for integration
- Integration of RE at Operation Stage: Tools for integration
- Case Study: Western Region RE Variability parameters

All India Scenario



Figures in MW.
Source: CEA

Renewable Characteristics

Characteristics

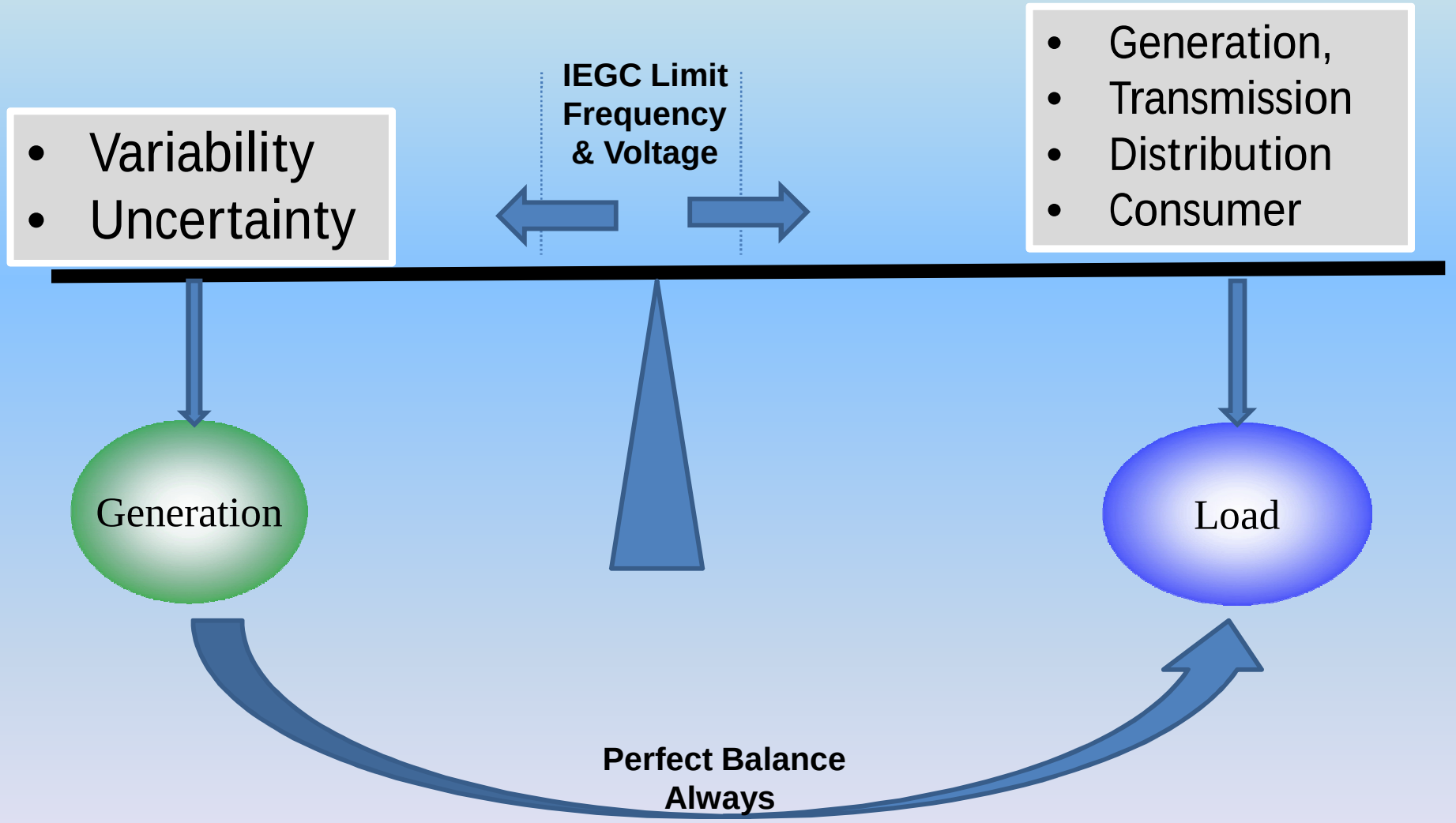
- Intermittency & Variability
- Uncertainty
- Location Specificity

Renewables
or
No Renewables

RE Sources Characteristics

Sr No.	Type Of Renewable Energy	Characteristics
1	Wind Energy	Highly Variable, Uncertain, Less Predictable than Solar, Can be harnessed 24 hours, Uncontrolled input
2	Solar Energy	Variable, fixed pattern, only day time production, uncontrolled input
3	Bio-Power Energy	Controlled input, Polluting By products, predictable
4	Small Hydro	Controlled input Clean energy, predictable

GRID Requirement:
Load Generation Balance



GRID Requirement:
Voltage and Faults Sustainability

1.Reactive Power Support To Grid.

2. Low Voltage Ride Through / Fault Ride Through

Regulatory Framework for Renewable Energy Integration

Regulatory framework for Renewable Energy(RE)

As per Clause 5.2 (u) (System Security Aspect) of IEGC, 2010

(u) Special requirements for Solar/ wind generators

System operator (SLDC/ RLDC) shall make all efforts to evacuate the available solar and wind power and treat as a must-run station. However, System operator may instruct the solar /wind generator to back down generation on consideration of grid security or safety of any equipment or personnel is endangered and Solar/ wind generator shall comply with the same. For this, Data Acquisition System facility shall be provided for transfer of information to concerned SLDC and RLDC:

Regulatory framework for Renewable Energy(RE)

As per Clause 5.2 (u) (System Security Aspect) of IEGC, 2010

(i) SLDC/RLDC may direct a wind farm to curtail its VAr drawl/injection in case the security of grid or safety of any equipment or personnel is endangered.

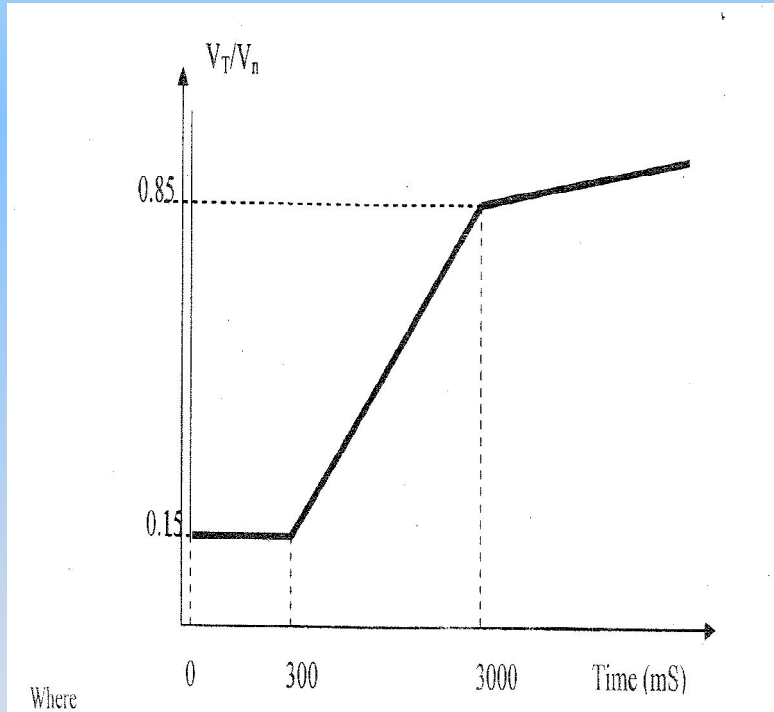
(ii) During the wind generator start-up, the wind generator shall ensure that the reactive power drawl (inrush currents incase of induction generators) shall not affect the grid performance.

Regulatory framework for Renewable Energy(RE)

Regulation Part II (B2) (3) of the CEA (Technical Standards for Connectivity to the Grid)

- Notified on 15th October 2013 mandates as under:
  - "B2. For generating station getting connected on or after completion of 6 months from date of publication of these Regulations in the Official Gazette.

    ....
  - (3) ***Wind generating stations connected at voltage level of 66 kV and above shall remain connected to the grid when the voltage at the interconnection point on any or all phases dips upto the levels depicted by the thick lines in the curve***



Where

V_T/V_n is the ratio of the actual voltage to the nominal system voltage at the interconnection point

Regulatory framework for Renewable Energy(RE)

CERC Order on LVRT

- Hon'ble Central Electricity Regulatory Commission vide its order dated 05.01.16 in Petition No.420/MP/2014 mandated that
- **"……*We are of the view that LVRT should be implemented for all wind turbines commissioned before 15.4.2014 and connected to voltage level of 66 kV and above except for Stall Type WTGs, which are not technically feasible to be retrofitted with LVRT. However, keeping in view the suggestions of IWTMA, we are of the view that presently LVRT should be implemented for all wind turbines (except Stall Types) commissioned before 15.04.2014 having installed capacity equal to or more than 500 KW.*"**

Regulatory framework for Renewable Energy(RE)

As per Clause 6.5 (23) of IEGC, 2010

[23. (i) Wind and Solar generators shall mandatorily provide to the concerned RLDC, in a format as prescribed by RLDC, the technical specifications at the beginning and whenever there is any change. The data relating to power system parameters and weather related data as applicable shall also be mandatorily provided by such generators to concerned RLDC in real time. The frequency and other details in this regard shall be provided in the Detailed Procedure to be prepared by NLDC and approved by the Commission.

Regulatory framework for Renewable Energy(RE) Integration:

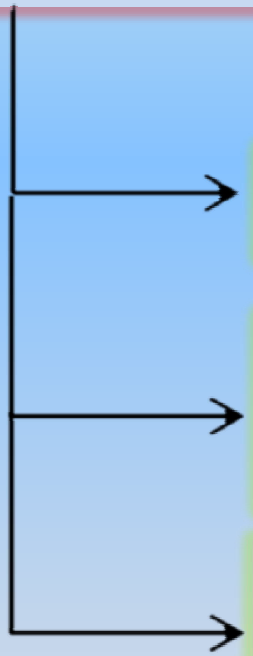
CERC Approved Procedure dated 03.03.2017 for '*Implementation of the Framework on Forecasting, Scheduling, Imbalance handling of Renewable Energy Generating Stations including power parks based on Wind and Solar at Interstate level*'.

Link: http://cercind.gov.in/2017/regulation/pro.pdf

Regulatory framework for Renewable Energy(RE) Integration:

Roles of RLDC

As per CERC Framework for Wind & Solar RE



Scheduling

Communication and Coordination with RE Generators

Forecasting: The forecast will be available on the website of the concerned RLDC. The generation forecast shall be done on the basis of the weather data .

Regulatory framework for Renewable Energy(RE) Integration:

FORECASTING

1. Regional forecasting to be done by the concerned RLDC. Forecasting agency may be engaged for forecasting.

2.RE generator to provide the forecast to the concerned RLDC which may be based on their own forecast or RLDC‟s forecast. In case a generator is utilizing service of RLDC for its forecasting, necessary fees shall be paid by generator to RLDC as approved by CERC.

Regulatory framework for Renewable Energy(RE) Integration:

FORECASTING

3. The concerned RLDC to consolidate and forecast based on various parameters and weather parameters.

4. RE Generators or Lead Generator or Principal Generator may prepare their schedule based on the forecast done by RLDC or their own forecast. Any commercial impact on account of deviation from schedule based on the forecast chosen by the wind and solar generator shall be borne by the respective generator.

Integration of Wind Energy in Grid:

Sr.	Characteristic of Wind Power	Effect of Characteristic	Tools to counter effects without compromising integration	Challenges
1	Variability	Change in wind power generation with time, place, season	Proper Forecasting	Nascent stage of forecasting due to lack of historic data with weather parameters, high real-time forecasting errors
2	Uncertainty	Deviation of generation from forecasted generation	Utilization of flexibility of other energy sources, utilization of reserves, High ramp generation sources, Pump mode operation of hydro station, RRAS	Ramp rate of conventional sources, low availability of hydro and gas based generating stations, low reserve availability

Tools for Renewable Energy(RE) Integration:

NEAR ACCURATE LOAD FORECAST

DAY AHEAD FORECASTING AND SCHEDULING

INTRA DAY FORECASTING AND SCHEDULING

UTILIZATION OF RESERVES FOR RAMPING UP/DOWN OF CONVENTIONAL ENERGY SOURCES

ANCILLIARY SERVCIES

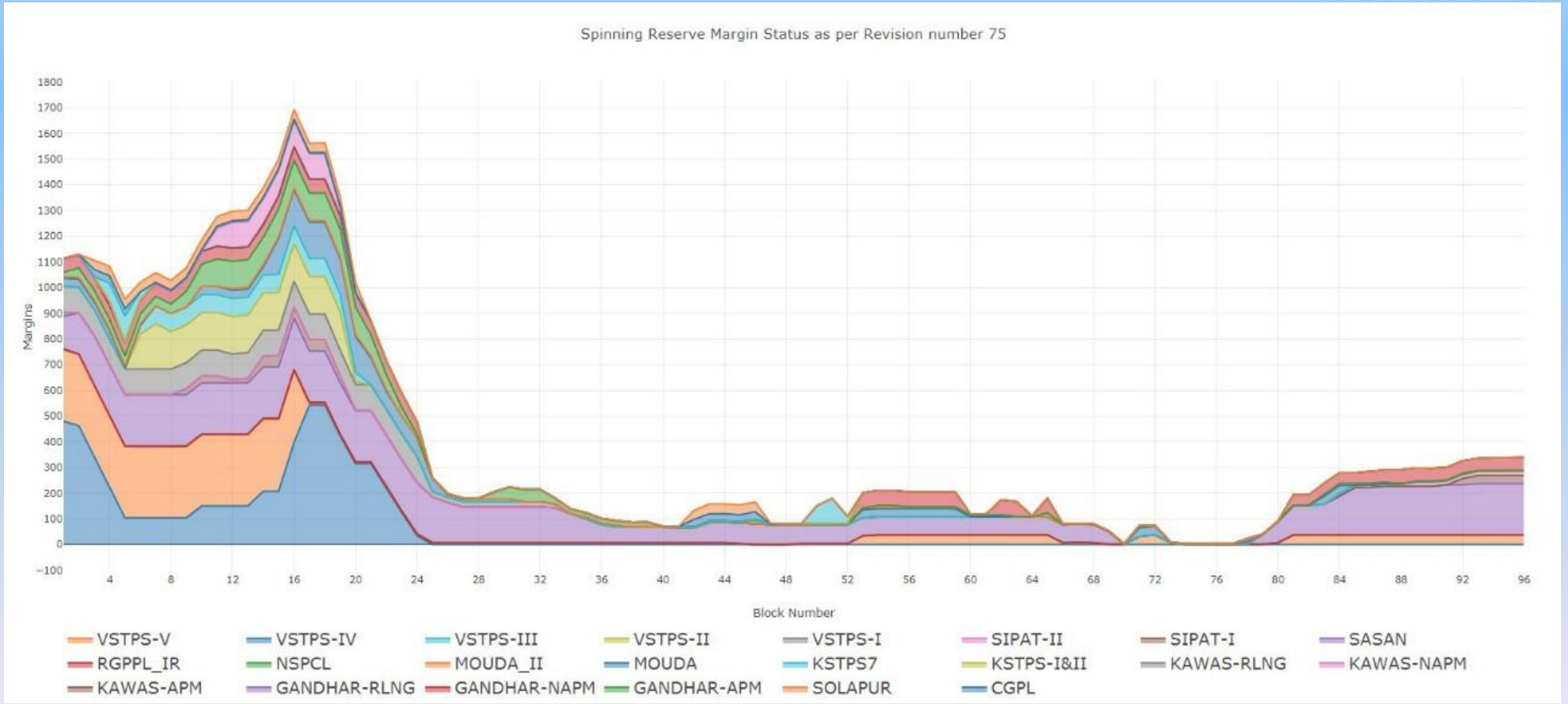
QUICK RESPONSE HYDRO AND GAS STATIONS FOR RAMPIMG UP/DOWN

Load Frequency Control (AGC/ FGMO / RGMO)

PUMP STORAGE PLANTS FOR RAMPING UP/DOWN

Tools for Renewable Energy(RE) Integration:

Utilization of Reserves for Ramping Up/Down



ISGS RESERVE AVAILABILITY OF WR AS ON 18.01.18

Tools for Renewable Energy(RE) Integration:

Challenges with Utilization of Reserves:

1. **Low Availability of ISGS Reserves During day time**
2. **The generation of wind power is high in night thus not supporting the morning high ramp (WR experience)**
3. **Ramp rate correction for reserves highly depends on forecasting accuracy.**
4. **Ramp rate of conventional sources are not high enough to meet the ramps resulted due to abrupt uncertainties.**

Tools for Renewable Energy(RE) Integration:

Reserves Regulatory Ancillary Services:

1. RRAS are dispatched by NLDC as per the real time grid condition considering the forecasted RES generation along with other factors.

Challenges:

1. RRAS at present provided only by CGS/UMPPs hence availability of power under RRAS is restricted.

Tools for Renewable Energy(RE) Integration:

Reserves Regulatory Ancillary Services:

Summary of RRAS Instructions:

Month	RRAS Up Instructions	RRAS Down Instructions	Total	Average no. of instructions/day
Oct.'17	358	2	360	12
Nov.'17	150	3	153	5
Dec.'17	235	46	281	9
Quartly Total	743	51	794	9

Tools for Renewable Energy(RE) Integration:

Hydro Power and Pump Storage Hydro Power Stations

1. Useful to compensate the ramping limitation of conventional sources.
2. Useful for countering abrupt generation changes as start up/ramp up time is less.

Challenges:

1. Use of water for power is prioritized below drinking and irrigation needs hence not available all times.
2. Water scarcity restricts the use of their full potential.

Regulatory framework for Renewable Energy(RE) Integration:

Roles of RE Generator

As per CERC Framework for Wind & Solar RE

- Initial Submission of one time details to concern RLDC (Annexure-I)
- Subsequently Submission of details to RLDC if there is any change
- Provide Day Ahead Available capacity to RLDC through web portal of RLDC (Annexure-II)
- Provide Day Ahead Forecast to RLDC through web portal (Annexure-II)

Regulatory framework for Renewable Energy(RE) Integration:

Roles of RE Generator

As per CERC Framework for Wind & Solar RE

- Provide real time availability (at turbine/ inverter level) and generation data to RLDC **(Annexure-III)**
- Monthly data transfer of wind plants, at the turbine level - average wind speed, average power generation at 15-min time block level**(Annexure-IV)**

Regulatory framework for Renewable Energy(RE) Integration:

Annexure-I Information:

1. Type: Wind/Solar Generator
2. Individual / on Behalf of Group of generators
3. If on Behalf of Group of generators group of then details of agreement to be attached
4. Total Installed Capacity of Generating Station
5. Total Number of Units with details
6. Physical Address of the RE Generating Station
7. Whether any PPA has been signed: (Y/N) If yes ,then attach details
8. Connectivity Details, metering details, connectivity diagram, Static Data, contact details

Regulatory framework for Renewable Energy(RE) Integration:

Annexure-II(A) : Day Ahead Forecast and Scheduling Format

Forecast and Schedule Data to be submitted by Wind/Solar plants/ Lead generator, Principal generator

FORMAT: A (to be submitted a day in advance)

15 Min time block (96 Block in a day)	TIME	Available Capacity (MW) - Day Ahead	Day Ahead Forecast (MW)	Day Ahead Schedule (MW)
1	00:00-00:15			
2	00:15-00:30			

Regulatory framework for Renewable Energy(RE) Integration:

Annexure-II(B) : Intraday Forecast and Scheduling Format

FORMAT: B (to be submitted on the day of actual generation, revision of availability and schedule, if any, shall be done as per CERC(IEGC) Regulations.

15 Min time block (96 Block in a day)	TIME	Day ahead schedule (MW)	Current Available Capacity (MW)	Revised Schedule (MW)
1	00:00-00:15			
2	00:15-00:30			
3	00:30-00:45			

Regulatory framework for Renewable Energy(RE) Integration:

Annexure-III : Real Time Telemetry Requirement

1. Turbine Generation (MW/MVAR)
2. Wind Speed(meter/second)
3.Generator Status (on/off-line)- this is required for calculation of availability of the WTG
4. Wind Direction (degrees from true north)
5. Voltage(Volt)
6. Ambient air temperature (^{o} C)
7. Barometric pressure (Pascal)
8. Relative humidity(in percent)
9. Air Density (kg/m^3

Regulatory framework for Renewable Energy(RE) Integration:

Other Roles of RE Generator As per CERC Framework for Wind & Solar RE

1. Be Responsible for metering and data collection, transmission and co-ordination with statutory bodies.
2. Undertake commercial settlement of all deviation-settlement charges as per applicable CERC Regulations .
3. Submission of agreement for operational and commercial responsibilities.
4. Use Automatic meter reading technologies for transfer, analysis and processing of interface meter data.

Case Study

Case Study: Variability of Wind Generation in Western Region (RMSD/GWoIC)

Sr. no.	Parameter (in MW)	High Wind Season			Low Wind Season		
		Year 2015	Year 2016	Year 2017	Year 2015	Year 2016	Year 2017
1	Average RMSD/GW of Installed capacity	48.5	45.1	47.0	42.0	36.5	39.7
2	Maximum RMSD/GW of Installed capacity	97.1	91.6	90.8	105.2	101.3	93.8
3	Minimum RMSD/GW of Installed capacity	12.5	14.6	20.7	9.9	9.1	8.1
4	Installed Capacity	8517	9797	12681	8517	9797	12681

High Wind Season: June-August **Low Wind Season: October-December**

Case Study: Variability of Wind Generation in Western Region (RMSD)

Sr. no.	Parameter	High Wind Season			Low Wind Season		
	(in MW)	Year 2015	Year 2016	Year 2017	Year 2015	Year 2016	Year 2017
1	Average RMSD	413.075	441.53	595.96	357.7	357.6	503.4
2	Maximum RMSD	825.35	896.76	1151.34	896	992.4	1189
3	Minimum RMSD	106.25	142.93	262.476	84.32	89.15	102.7
4	Installed Capacity	8517	9797	12681	8517	9797	12681

High Wind Season: June-August **Low Wind Season: October-December**

Case Study: Variability of Wind Generation in Western Region (Ramp Rate)

Year	High Wind Season (June-August)		Low Wind Season (October-December)	
	Abs daily Avg. Ramp Rate(max) (MW/Hr)	Abs daily Max. ramp Rate (MW/Hr)	Abs daily Avg. Ramp Rate(max) (MW/Hr)	Abs daily Max. ramp Rate (MW/Hr)
2015	236	908	229	920
2016	281	795	233	1037
2017	347	1304	273	1103

High Wind Season: June-August **Low Wind Season**: October-December

Renewable Integration – Way Ahead

1) Regulatory Initiatives (RRAS and ancillary market)
2) Generation
   - Flexibility in generation portfolio Good Mix
   - Load Frequency Control (AGC/ FGMO / RGMO) – First level of adaptive requirement. **Regulation in place** – Compliance required
   - Ancillary Service – **Regulation in place** – In operation
3) Load
   - Flexible Load: Demand Side Management / Demand Response
   - Storage - **Pumped Hydro**, Battery, Fly Wheel, Superconducting Magnetic Energy Storage (SMES).
4) Power Network – Transmission & Distributions
   - Strong Grid Interconnection to Enlarge Balancing Area
   - Expansion of ISTS / Intra-state system
5) System Operation & Control
   - Renewable Energy Management Centre
   - Forecasting & Scheduling
   - Smart Grid Application


THANK YOU