

Renewable Energy

Curtailment : Cause & solution

Regulatory provisions for Must Run

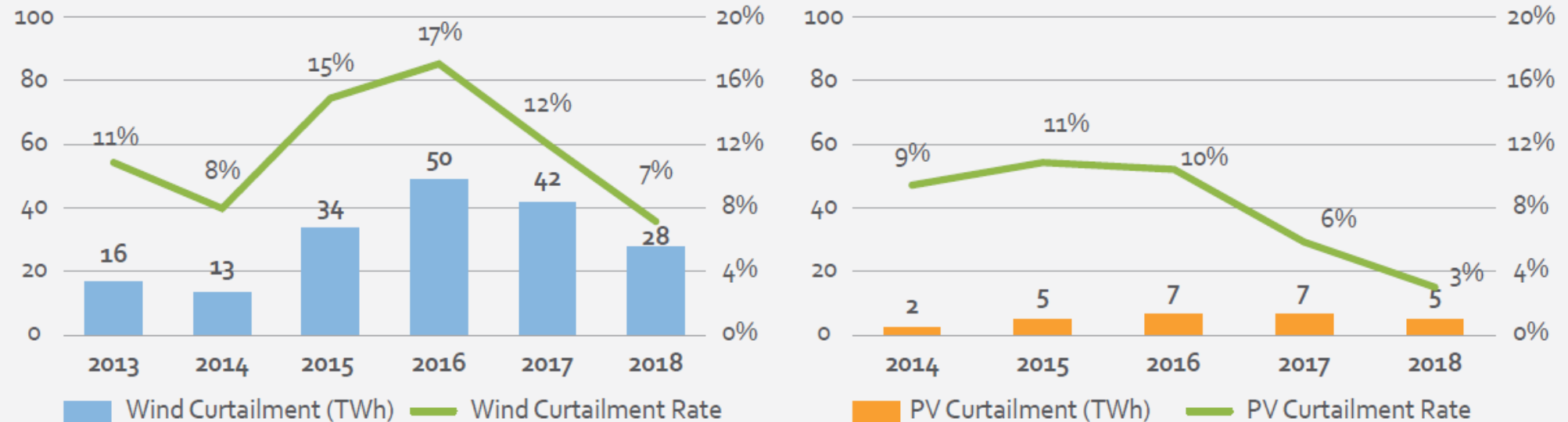
- **'Must run' status has been accorded to both wind and power projects in the states in line with the Indian Electricity Grid Code 2010 and the Electricity Act 2003.**
- **As per IEGC RE can be curtailed due to Grid Security .**
- **However what constitute "Grid Security" is not well defined , so SLDCs are linking curtailment with Over drawl and under drawl**
- **Renewable Energy is being curtailed for reasons of Transmission constraints, Low demand and grid safety and security and that too after communicating reasons of curtailment in writing to generators,"**
- **CERC(DSM Regulations) clause 7.1 The over drawl/Under drawl by any buyer shall not exceed 250MW for renewable rich state.**
- **CERC(IEGC) Regulations clause 5.4.2(a) SLDC/SEB/Discom shall initiate action to restrict the drawl of its control area, from the Grid within the drawl schedule.**

Regulatory clauses for RE Curtailment

- **CERC(IEGC) Regulations clause 5.2.(m) all SEBs, SLDCs, RLDCs and NLDC shall take all possible measures to ensure that Grid frequency remains within (49.90Hz-50.05Hz) the band.**
- **POSOCO issued instruction under section 29(1) of the Electricity Act, 2003 on 5.8.2019**
- ***“4 (c)... The reasons for any such curtailment/backing down shall be made known to the concerned renewable generator and RLDC in writing and/or through the SLDC website on a daily basis.”***

China

Figure 3: China 2018 Curtailment of Wind (Left) and Solar PV (Right)



Majority of curtailments were due to transmission constraints from RE Rich area.

USA

Table 1. Summary of Curtailment Levels and Reasons for Curtailment

Utility/Grid Operator	Wind and Solar Curtailment Levels Frequency	Primary Reasons for Curtailment
Alberta Electric System Operator (AESO)	Infrequent	Oversupply; transmission constraints, high wind ramps
Arizona Public Service (APS)	Infrequent	Local transmission outages or constraints
Bonneville Power Administration (BPA)	Varies by year; less than 2% of wind production	Balancing issues related to exhaustion of reserves; oversupply
California Independent System Operator (CAISO)	Infrequent; not tracked	Oversupply; transmission constraints, congestion
Electric Reliability Council of Texas (ERCOT)	Varies by year; 2% to 4% in 2012–2013, but higher in previous years	Transmission constraints; oversupply, new transmission lagged wind capacity
Hawaiian Electric Co. (HECO), Hawaii Electric Light Co., (HELCO) and Maui Electric Co. (MECO)	Substantial curtailment on Maui and the island of Hawaii	Oversupply in low load periods and balancing challenges
ISO New England (ISO-NE)	Infrequent, but some plants experienced substantial curtailment	Local transmission constraints; oversupply; voltage control; other (wildlife protection, ice formations)
Midcontinent ISO (MISO)	1%–4% of wind generation	Transmission congestion; oversupply handled by downward dispatch
NV Energy	Infrequent; 6–7 occasions per year	Oversupply; local transmission outages
PacifiCorp	Much less than 1% of total wind production	Transmission congestion; avoid area control error (ACE) violations
PJM Interconnection	Not tracked	Local transmission constraints,
Puget Sound Energy	Infrequent in PSE balancing area and not tracked	PSE wind subject to BPA's curtailment protocols related to balancing and oversupply

USA

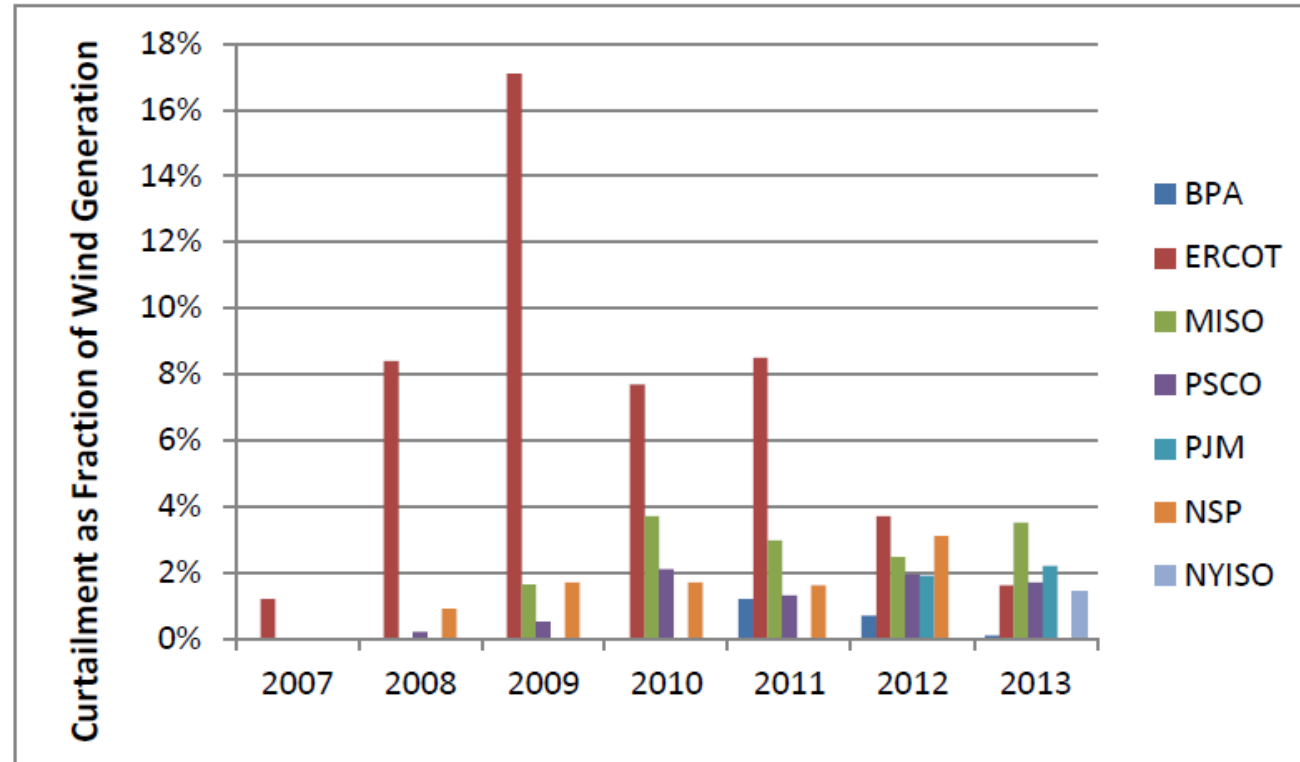


Figure 1. Curtailment levels by region, 2007–2012

Constraints and curtailment

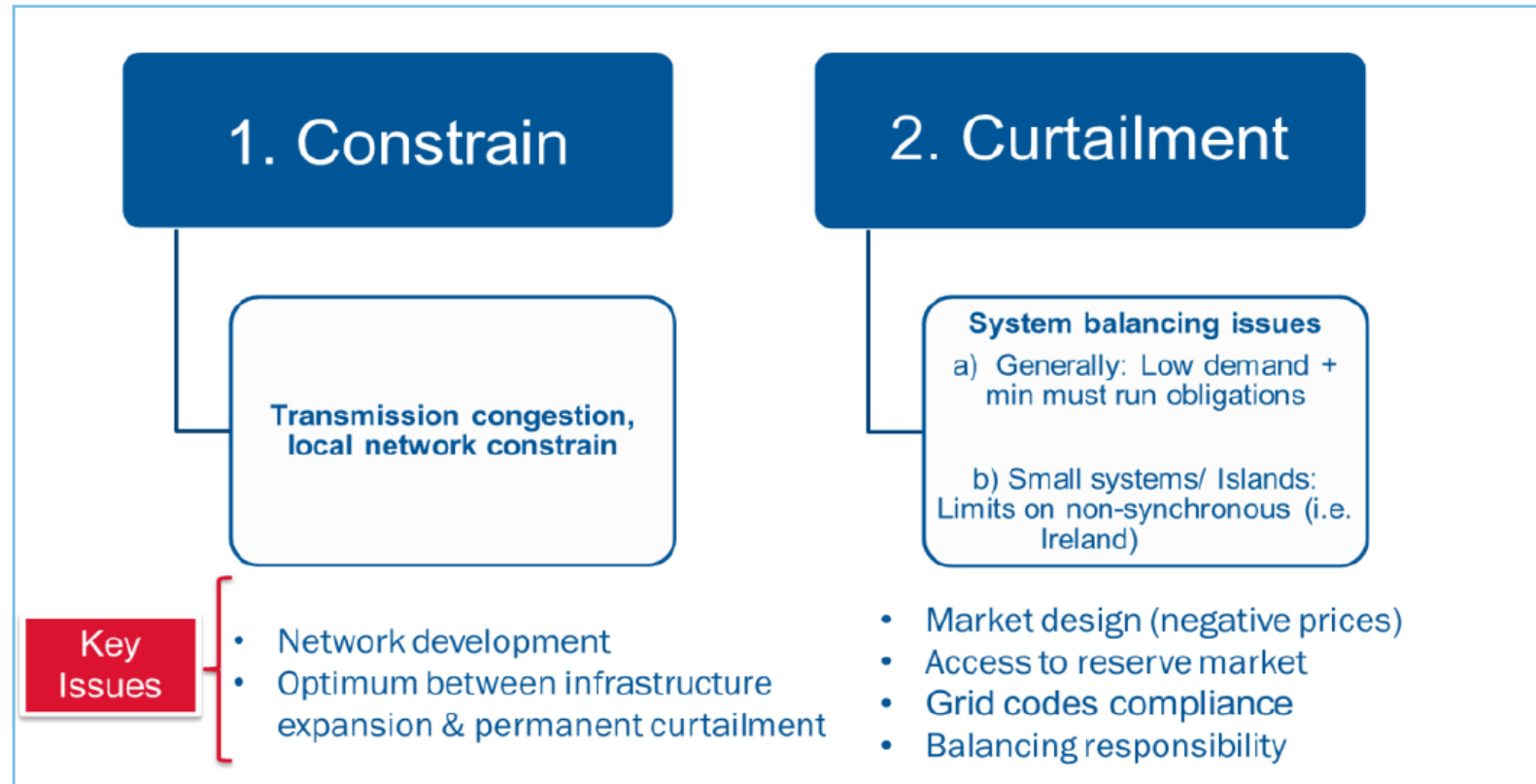


Figure 3. Differences between curtailment and constraint

Europe

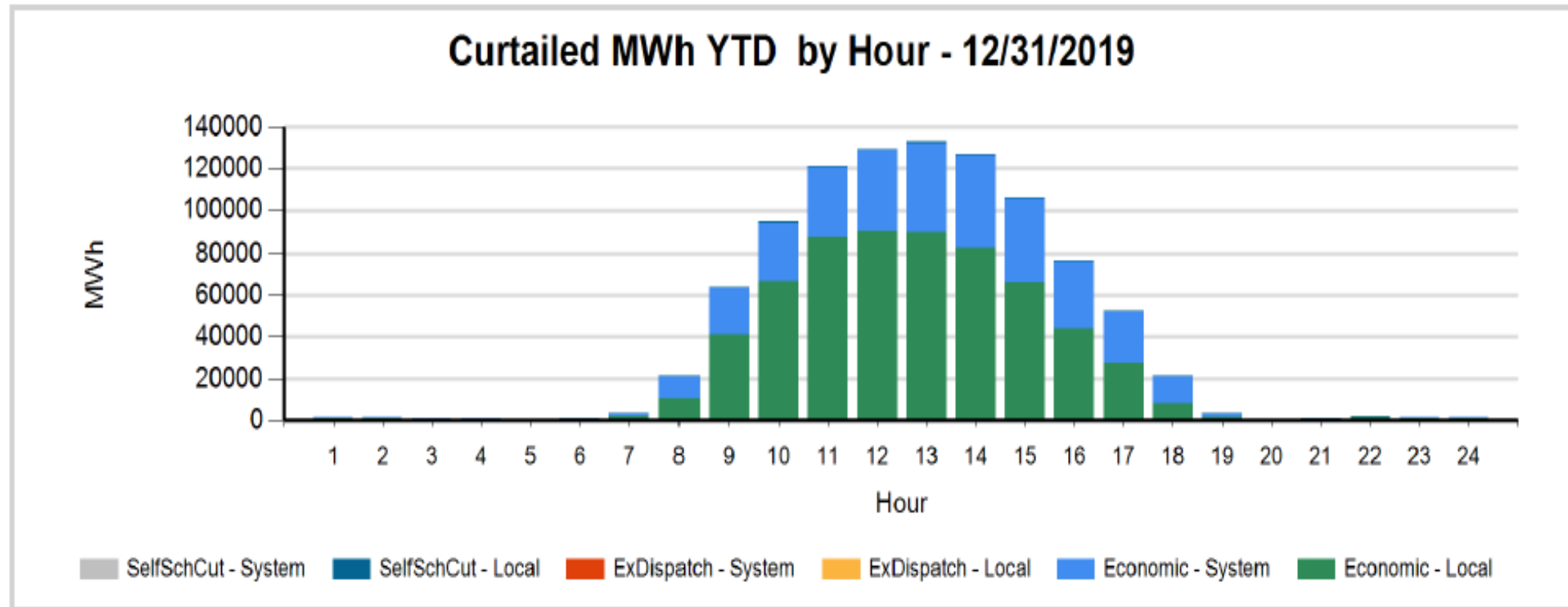
Country	Year	Total Generation (GWh)	Wind Generation (GWh)	Wind curtailments (GWh)	Penetration Ratio Wind	Curtailment Ratio Wind	Constrained ratio	Curtailed ratio
Germany	2011	613,068	48,883	410	8.0%	0.8%		
	2012	629,812	50,670	358	8.0%	0.7%		
	2013	638,729	51,708	480	8.1%	0.9%		
	2014	627,795	57,357	1,221	9.1%	2.1%	99.8%	0.2%
	Till 3Q2015	600,865	87,975	3,060	14.6%	3.5%		
UK	2012	320,860	12,606	45	3.9%	0.4%	95%	5%
	2013	317,565	18,620	380	5.9%	2.0%	94%	6%
	2014	301,606	21,146	659	7.0%	3.1%	98%	2%
	2015			1,277			95%	5%
Ireland	2012	27,592	4,010	103	14.5%	2.5%	38%	62%
	2013	26,041	4,541	171	17.4%	3.5%	28%	72%
	2014	28,185	5,133	236	18.2%	4.4%	35%	65%
Italy	2013	278,833	14,897	164	5.3%	1.1%		
	2014	269,148	15,178	106	5.6%	0.7%		
	2015	270,703	19,913	119	7.4%	0.6%		
Denmark	2014	31,905	13,079	-	41.0%	0.0%		
Portugal	2014	52,886	12,103	0	22.9%	0.0%		
Spain	2012	297,559	48,126	121	16.2%	0.3%		
	2013	285,260	54,338	1166	19.0%	2.1%		

Table 1. Curtailment rates in selected EU countries. Note that many countries do not differentiate between constrain and curtailment, so figures may display a combination of both. Sources: WindEurope based on: Ireland Annual-Renewable-Constraint-and-Curtailment Report-2014, Eirgrid; UK: RenewablesUK; Germany: Bundesnetzagentur; Italy: Enel Greenpower and Terna; Spain, Portugal, Denmark: IEA task 25 Lori Bird et Al

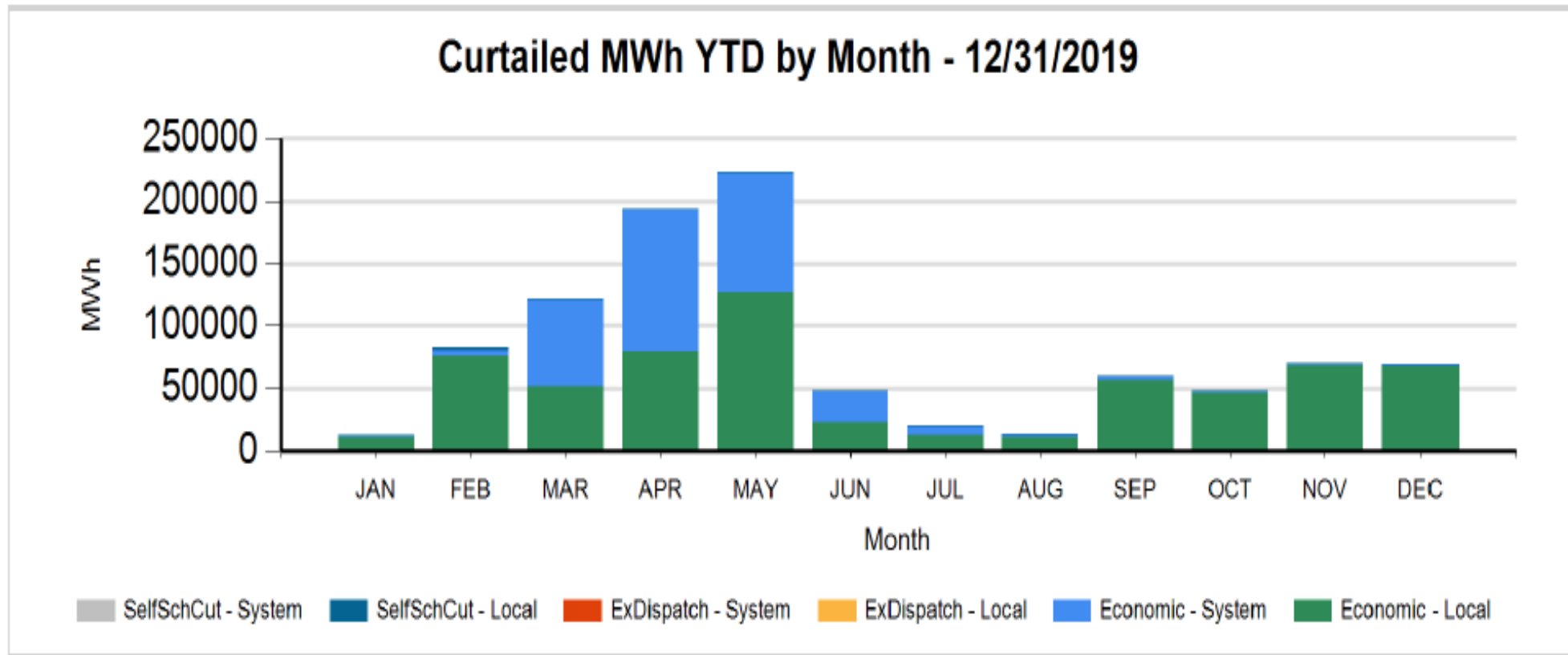
CASIO reports

- Wind and solar curtailments are grouped into the following categories:
 - 1.Economic – Local: Market dispatch of generators with economic bids to mitigate local congestion³.
 - 2.Economic - System: Market dispatch of generators with economic bids to mitigate system-wide oversupply.
 - 3.SelfSchCut - Local: Market dispatch of self-schedules to mitigate local congestion.
 - 4.SelfSchCut - System: Market dispatch of self-schedules to mitigate system-wide oversupply.
 - 5.ExDispatch - Local: Exceptional dispatch to mitigate local congestion.
 - 6.ExDispatch - System: Exceptional dispatch to mitigate system-wide oversupply.

CASIO report

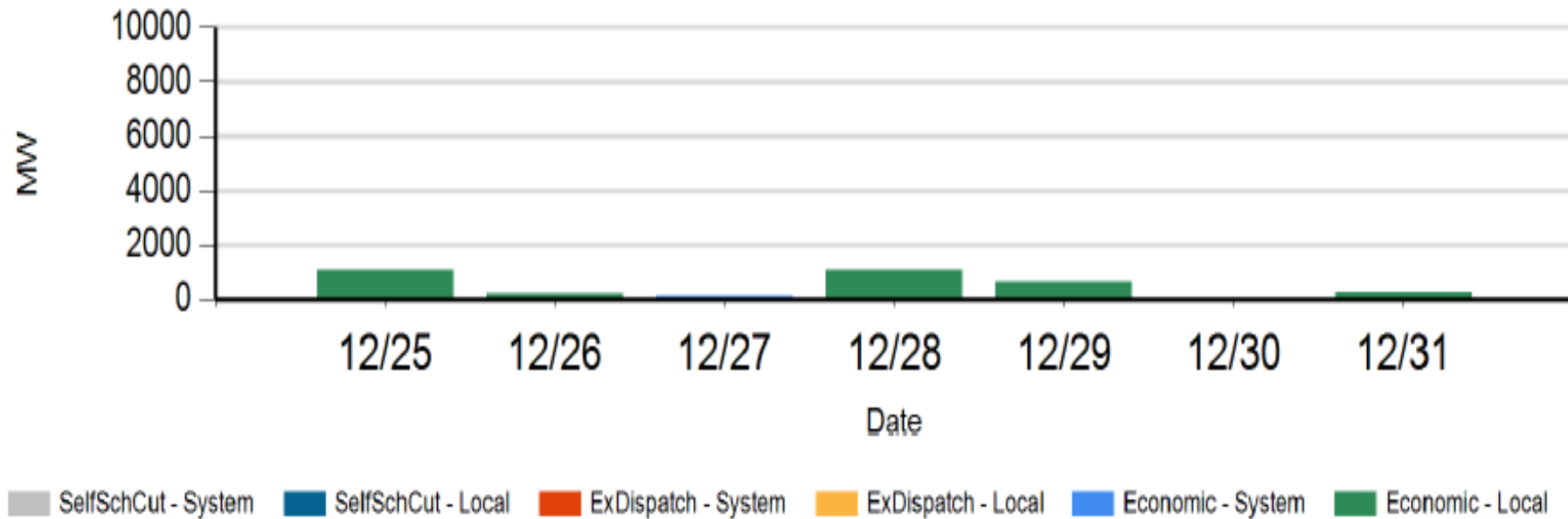


CASIO



CASIO

4. Maximum generation curtailment in MW for any one of the twelve real-time dispatch intervals in a particular day on a 7-day basis. - 12/31/2019



RE developers who have summited their RE curtailment details:-

- Avaada Energy,
- Sterlin Agro Industries Lt.,
- SGIL Group Company,
- Atria Power,
- GRT Jewellers (India) Pvt Ltd.,
- Sembcorp Green Infra Ltd.,
- Sprng Energy, Think Energy,
- ACME,
- Tamil Nadu Spinning Mills Association.
- Mahindra
- Few entities submitted late last evening
- **Data is not complete as it is very less than what State SLDCs had reported .**

TamilNadu & Telangana

Tamilnadu Renewable Generation Curtailment						
Wind curtailment from September 18 to August 19				Solar curtailment from September 18 to August 19		
S.No	Month	Wind Generation in MU	Curtailment due to grid security		Curtailment due to Transmission elements over load	
			in MU	in %	in MU	in %
1	Sep-18	1109	6.41	0.58%	0.76	0.07%
2	Oct-18	146	1.58	1.08%	0.00	0.00%
3	Nov-18	179	1.60	0.89%	0.00	0.00%
4	Dec-18	204	0.15	0.07%	0.04	0.02%
5	Jan-19	374	8.67	2.32%	0.76	0.20%
6	Feb-19	345	11.22	3.26%	0.32	0.09%
7	Mar-19	233	2.29	0.98%	0.09	0.04%
8	Apr-19	263	3.14	1.19%	0.00	0.00%
9	May-19	1322	16.42	1.24%	1.56	0.12%
10	Jun-19	2070	54.75	2.64%	4.26	0.21%
11	Jul-19	2123	72.07	3.39%	2.62	0.12%
12	Aug-19	2061	106.21	5.15%	1.58	0.08%

Telangana: Sept 2019 : 39.66 MU Oct,2019 :167.63 MU

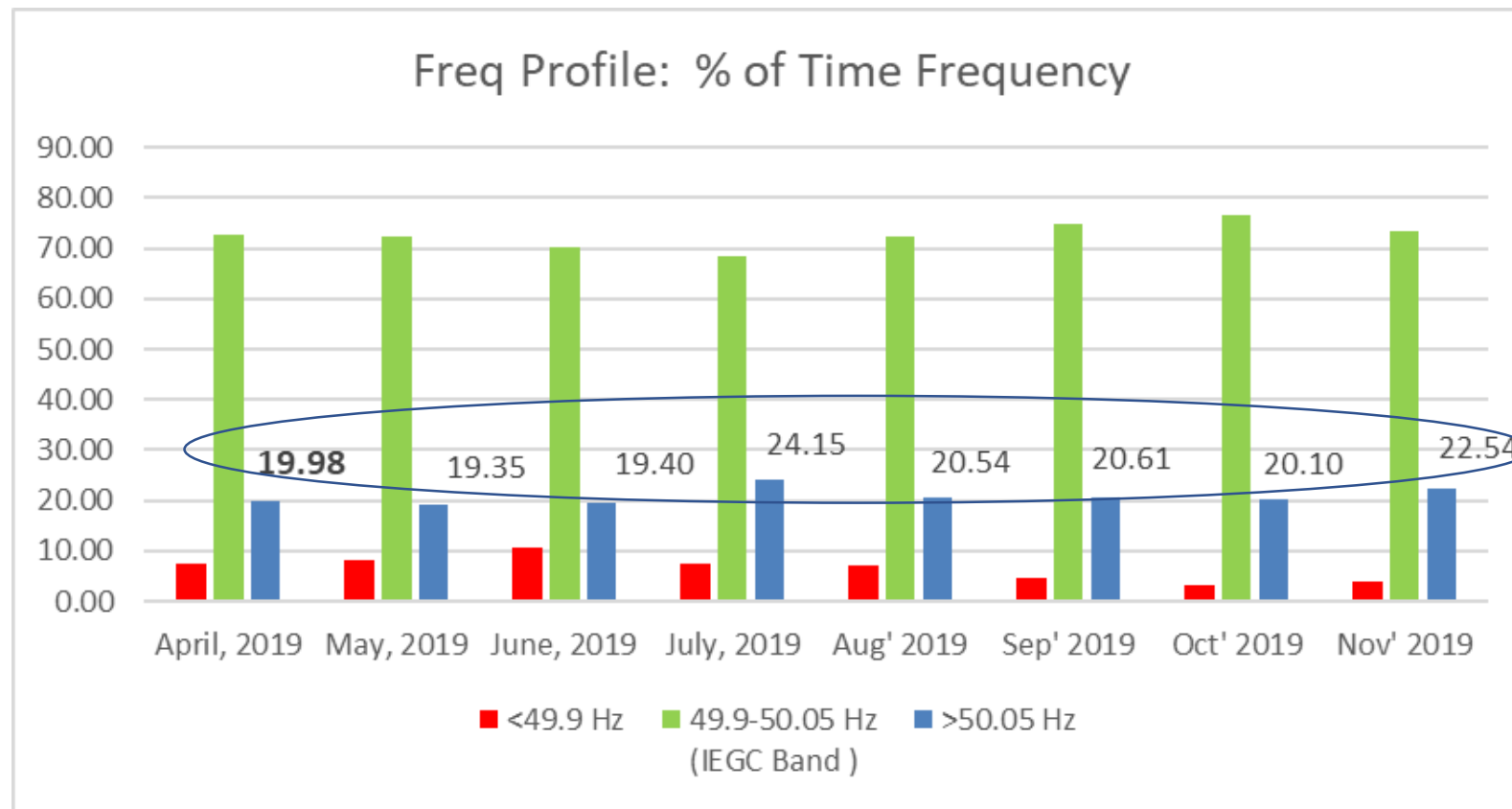
Data on Website

- <https://sldc.rajasthan.gov.in/mis/monthlyReDsmReports>
- http://223.31.122.117/mpsldc/RE_DATA
<https://apps.aptransco.co.in/sldcreports/forms/BackDownWind.aspx>

QUESTIONS

- Mode of communication for RE curtailment.
- Provisions mentioned in PPA about RE curtailment.
- Legal actions taken by RE generation companies against RE curtailment.
- How grid security is defined.

Problem area : High Frequency



Optimum utilization

- Curtailment is likely to have a significant impact on the pace and feasibility of RE deployment going forward.
- Since grid upgradation efforts will require a longer horizon to implement, immediate solutions to address the impacts of curtailment are the need of the hour.

1.EFFECTIVE IMPLEMENTATION OF MUST RUN STATUS OF RENEWABLES

- Provisions for ‘Must Run’ status for Renewable Energy Sources(RES), is already existing in the Central Grid Code (IEGC) and State Grid Codes. However, if due to operational reasons, curtailment of renewable is done, this needs to be declared transparently. After deliberation on international practices, following was suggested:-
 - i. Each SLDC/DISCOM while curtailing renewable energy, will send instructions in writing to renewable generator stating exact reason of curtailment.
 - ii. Every day, the quantum of curtailment and reasons thereof will be published by the SLDC/DISCOM on its website along with name of generator/site, to whom curtailment instruction was given.

CEA Report – April,2017: Issue of curtailment in the case of renewables

- The issue of compensation for curtailment of renewable energy was discussed in detail. After deliberation and considering the international practices, following were suggested: -
 - (i) The provision of compensation for curtailment would be applicable only to the RES giving day ahead forecast & schedule.
 - (ii) The decision regarding curtailment would be taken considering the balancing cost of renewable generation. The balancing cost will be published by Appropriate commission. Till the time the concerned SERC declares this, the balancing cost as decided by Central Commission may be applied.
 - (iii) Curtailment compensation shall be as per provisions in the PPA. In the absence of PPA, the compensation shall be as per regulations notified by the appropriate commission.
 - (iv) Suggested framework for different types of compensation for curtailed energy is as given below:-

ISSUE OF CURTAILMENT IN THE CASE OF RENEWABLES

S.No.	Reason of curtailment	Recommended compensation
(i)	Due to transmission constraints	
		(a) Upto 2% of annual energy No compensation
		(a) From 2-7% 50% of curtailed energy at contracted price.
		(c) Beyond 7% Limited to 50% of curtailed energy. Matter will be enquired by expert group of CEA/ POSOCO/ Powergrid to ascertain the reason for so high curtailment.
(ii)	Grid security reason	No compensation. Security reasons are to be given transparently by SLDC/DISCOM in writing with parameters like line flows, voltage or angular difference necessitating RES curtailment.
(iii)	For low system demand	(i) If curtailment is done after curtailing conventional generators upto technical minimum limits, then compensation at 50 paise/kwh. (ii) Else at power market price during the concerned time block.

Issue of curtailment in the case of renewables

(v) It was felt that for optimum utilization of renewable generation, coordinated regulatory approach at Regional level is required. If regional coordination in system operation is done, the curtailment of renewable generation can be reduced. To formulate operational principles for regional cooperation like larger control area, deviation settlement, etc., there was a need of regional regulators or regulations by CERC.

Way Forward

- For optimum utilization of RE :
- From 1st April,2020 Real Time Power Market will start , it will help states to operate their system near real time.
- Complete data of RE contracts of states is required.
- Forecasting and scheduling will help in better operation.
- Major problem of underdraw during over frequency need to be handled .
- Are developers ready for loss minimization concept ?