



Challenges with forecasting in solar 22nd July 2019

National Solar Energy Federation of India

Topics of discussion

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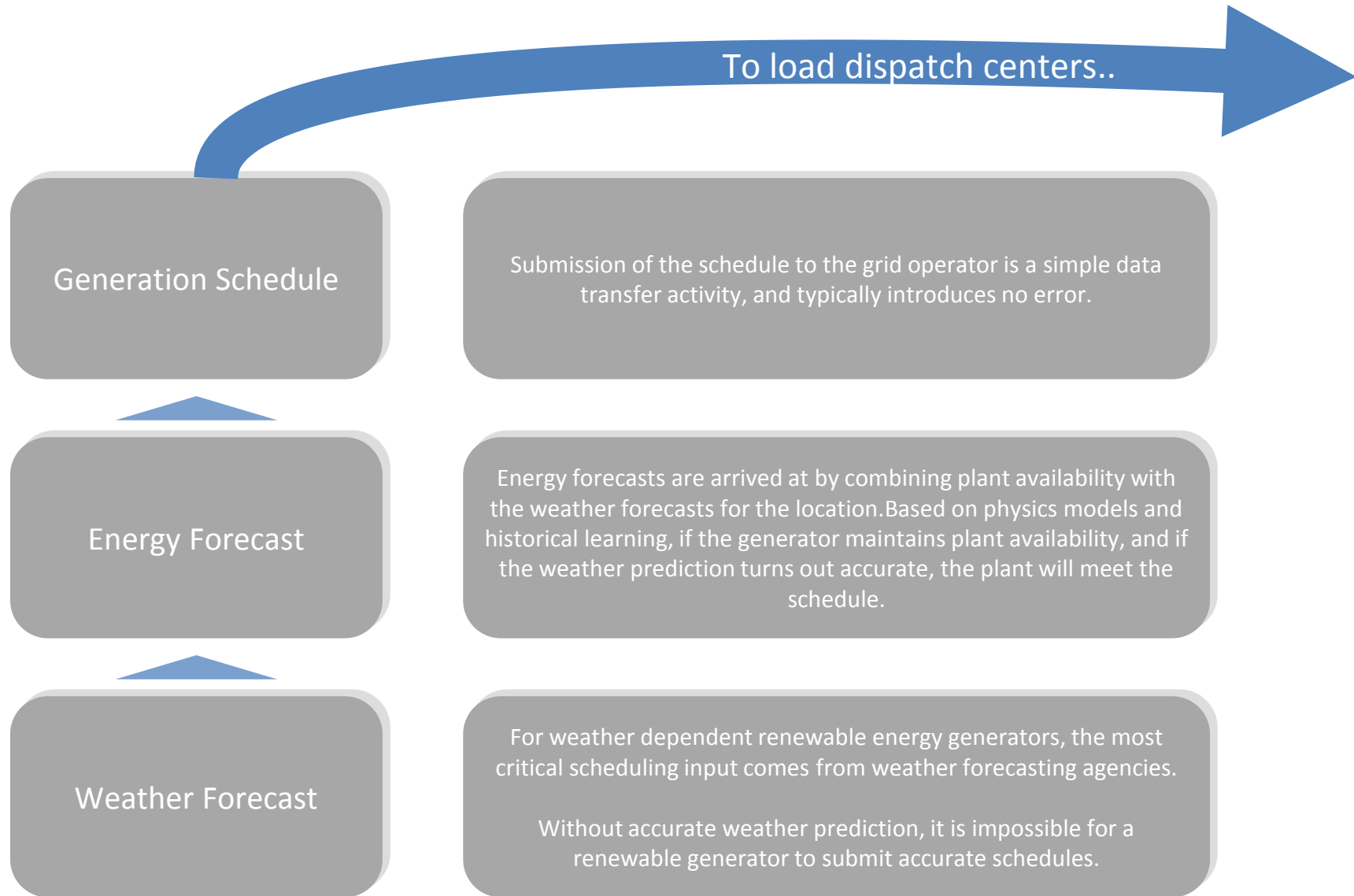
Objectives of the DSM regulations

- 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
 - Weather forecasting is a critical component of RE generation forecasting



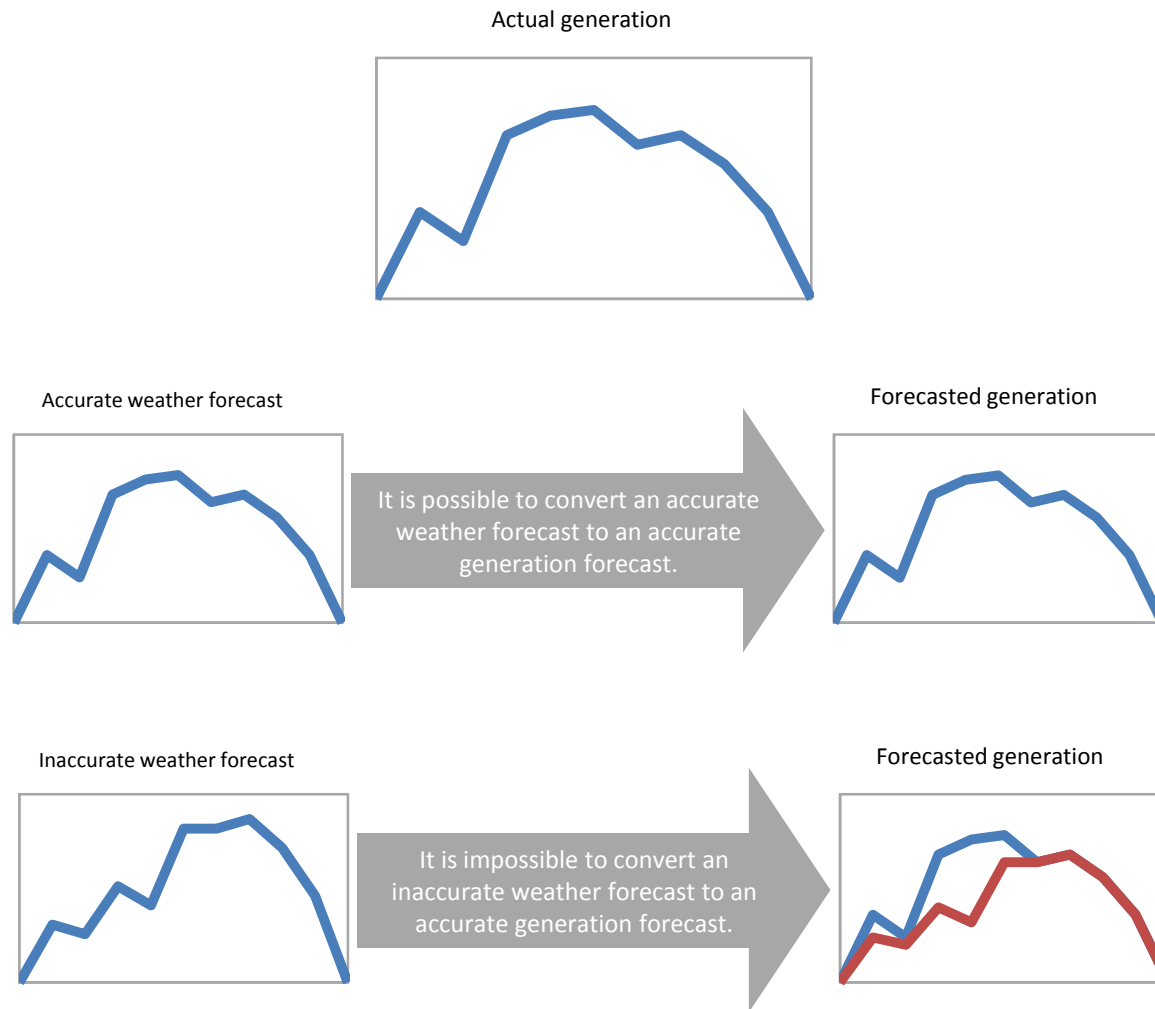
Weather and renewable energy forecasting Introduction

What goes into a renewable plant's schedule?



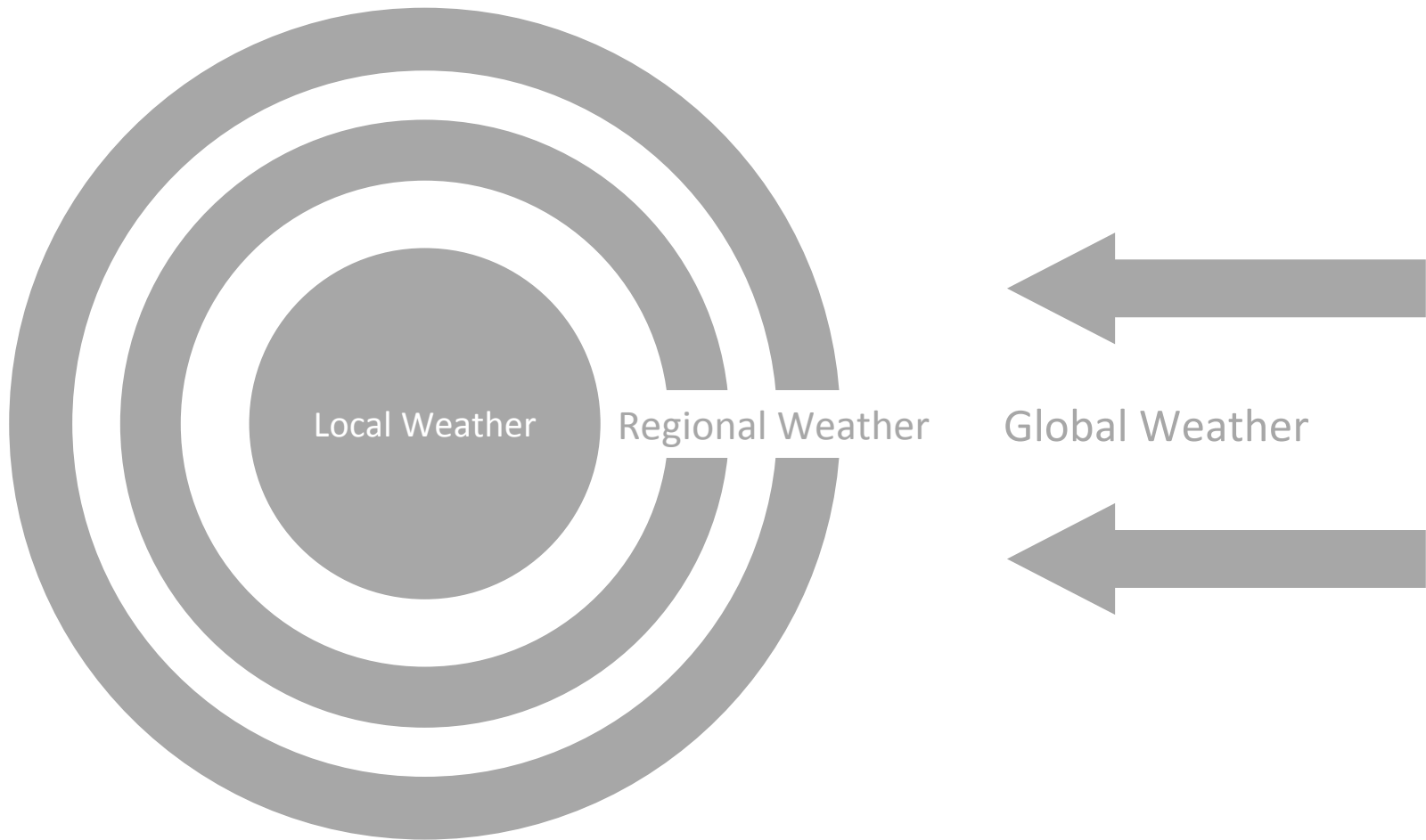
Accurate weather forecasts are the major inputs to renewable generation schedules

The major source of in-accuracy is the weather.



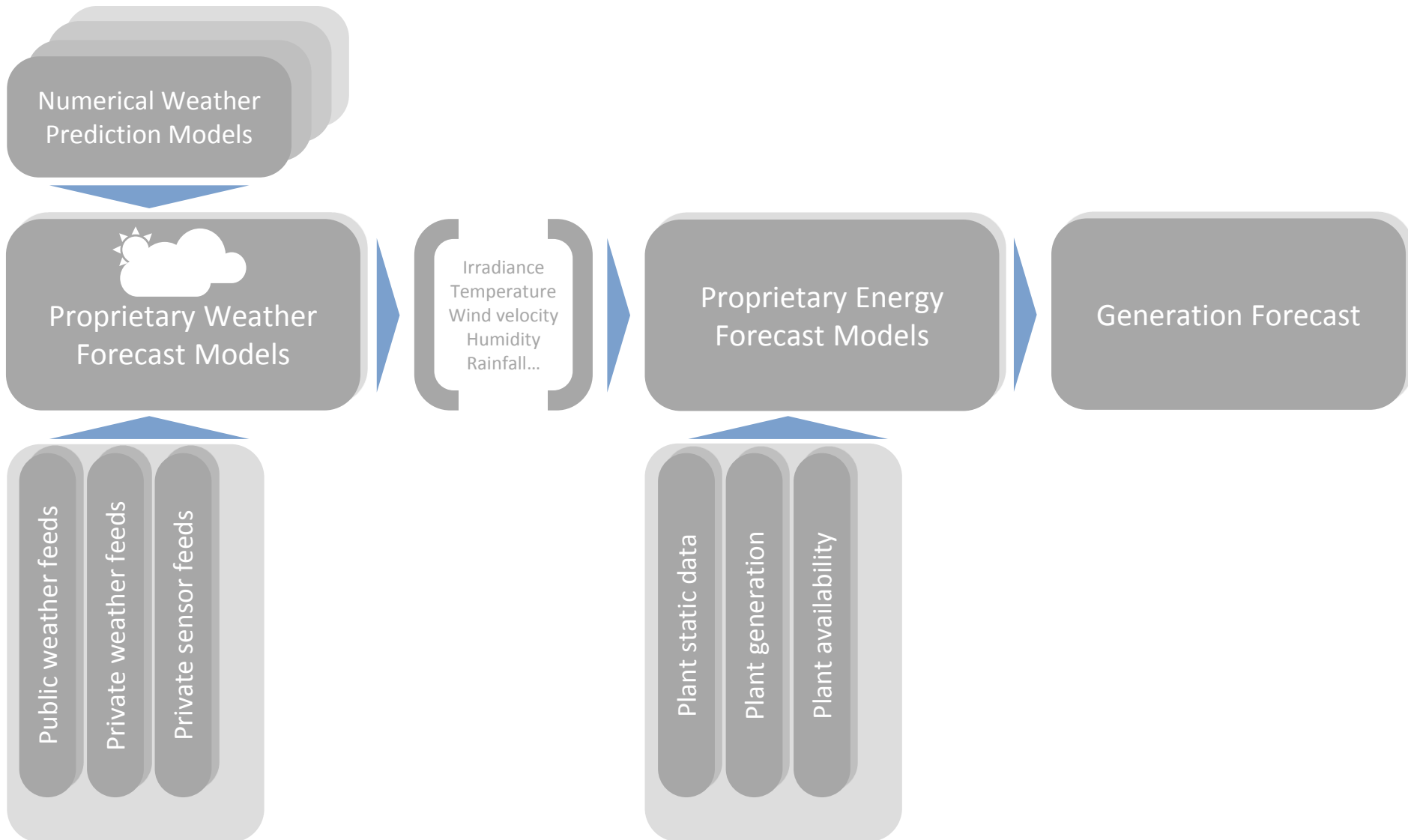
Without accurate weather forecasts, a generator cannot submit accurate schedules

There is no simple way to predict the weather.



Weather forecasting is a science involving complex local and global phenomenon

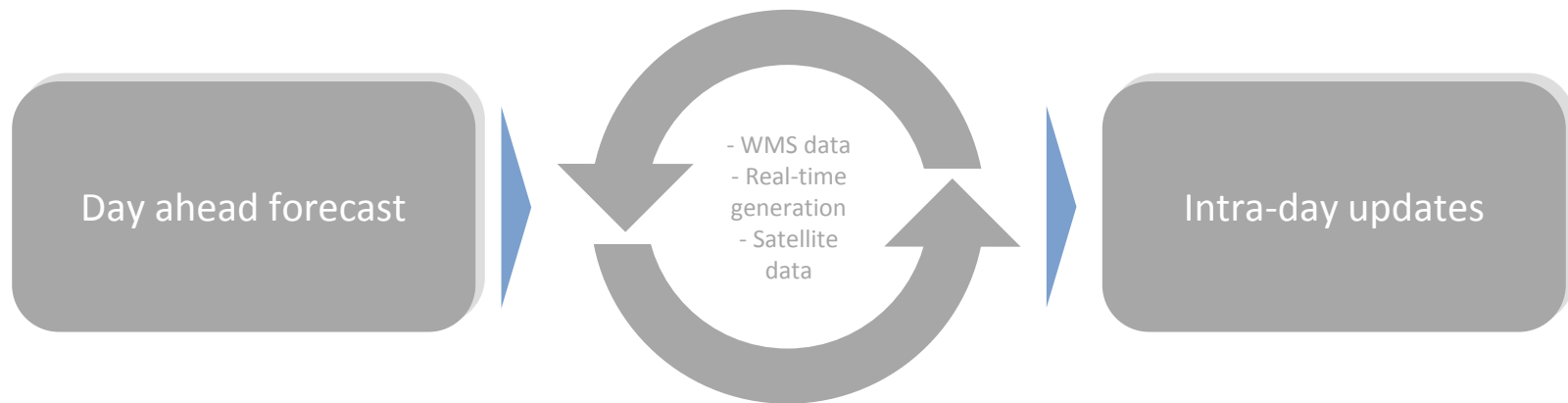
Current best forecasting methodology - Day ahead



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

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.



Better forecasts maybe possible 5-15 minutes ahead, but not allowed in DSM

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, NWP models specifically 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

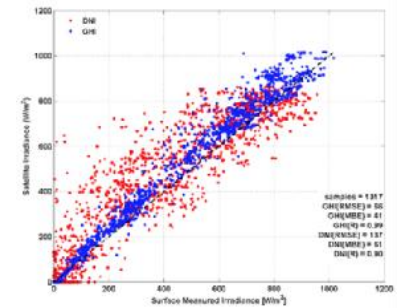
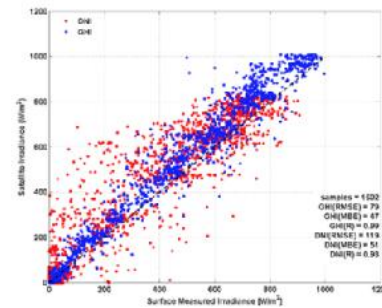
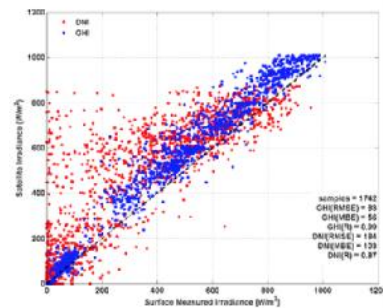
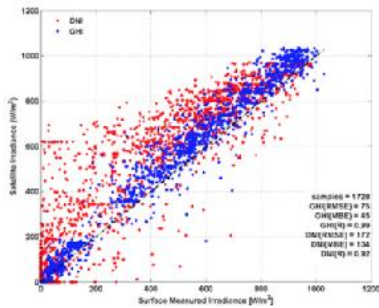
Beyond numerical weather prediction..

Satellite based forecasting -

- Weather sensing satellites have a much broader view of the earth, but their measurements also have higher inaccuracies when compared with ground based measurements
- They are useful for aerosol optical index and cloud monitoring, but due to limited resolution of non-imagery sensors, and the typical lack of depth perception reduce the value for DSM related forecasting

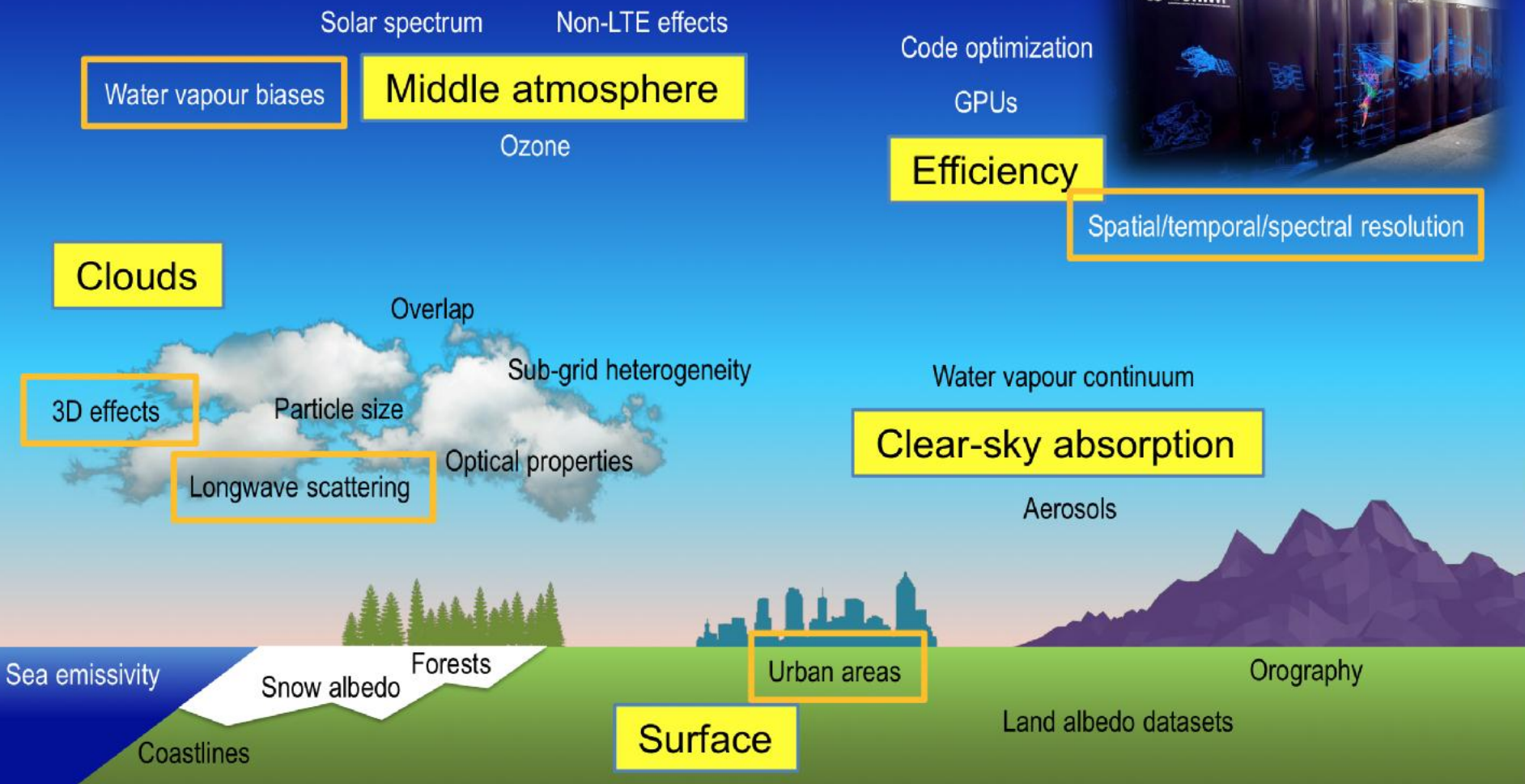
Statistical weather prediction -

- Using many years of historical site data, and custom modelling for each individual site, statistical models can achieve some level of accuracy for very short range forecasts, or in very stable weather conditions
- As a lot of data is required for modelling, they run better in urban areas than at remote solar plant locations



Challenges in radiation forecasting.

Challenges for radiation in NWP models



There are many unmeasurable variables affecting each weather parameter.

Clouds cause the largest deviations in intra-day forecasts.

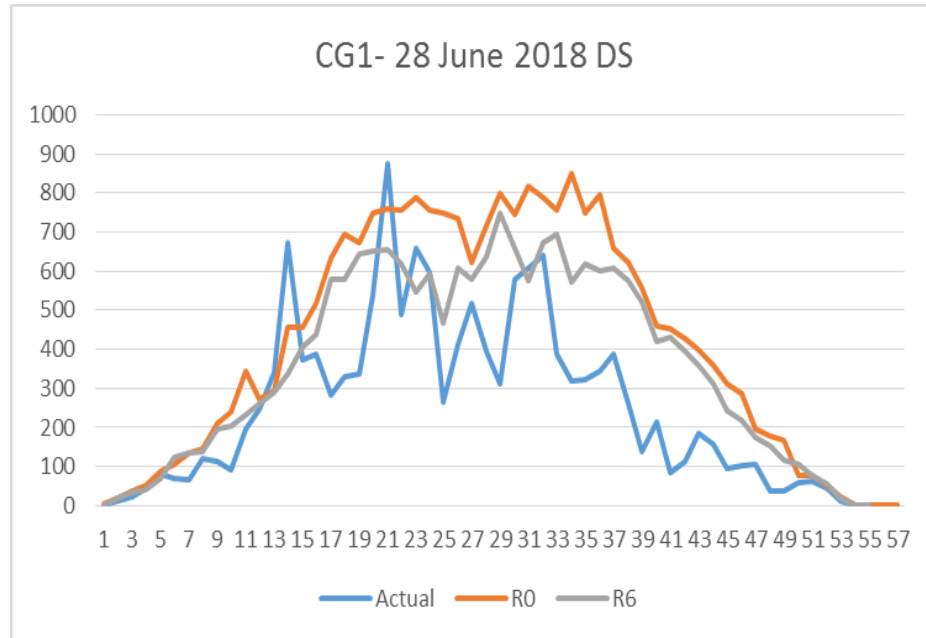
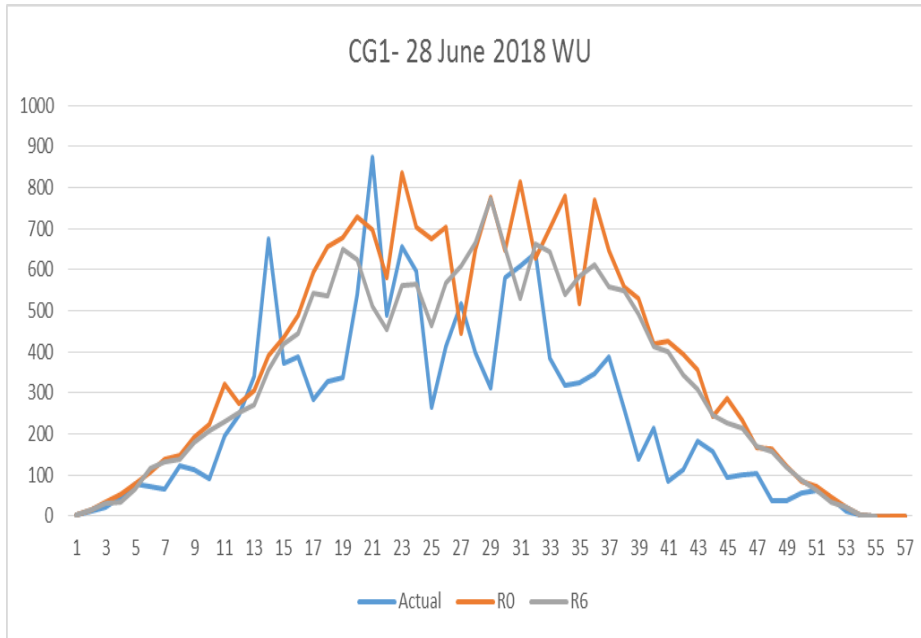


Clouds form a dynamic 3-dimensional system and are impossible to model accurately



Renewable energy forecasting
Field experience

Case study - GHI forecast accuracy

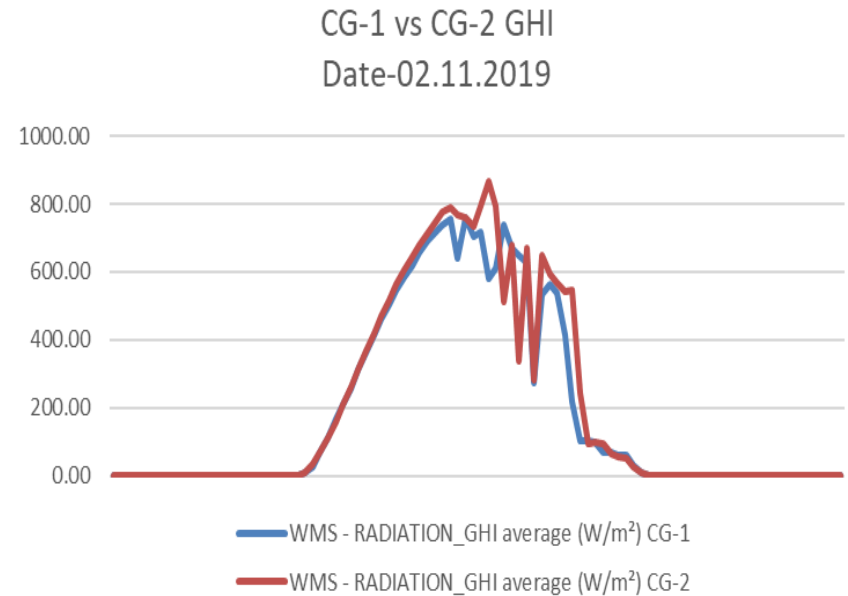
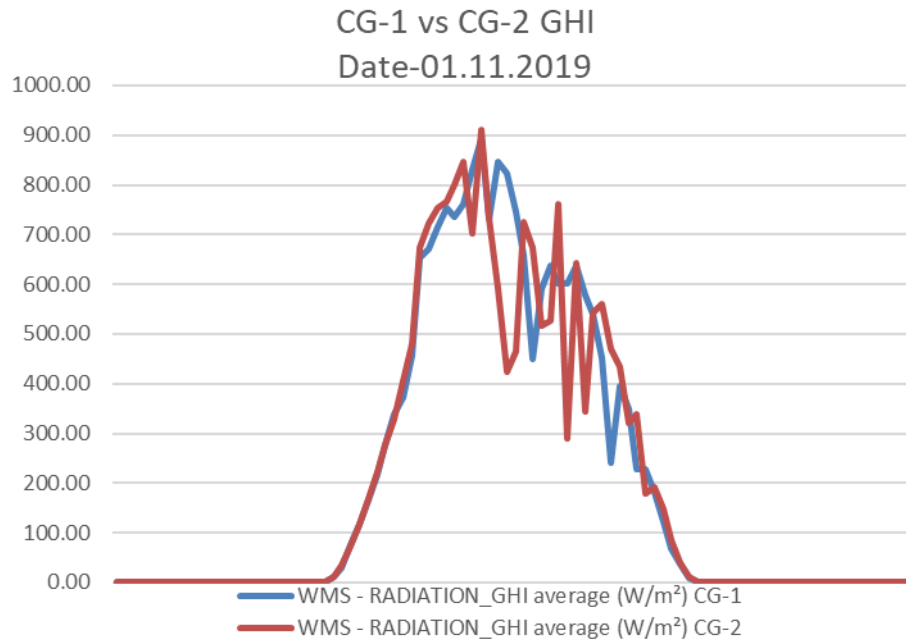


RMSE	R0	R6
Wunderground	255.93	211.46
Darksky	275.66	220.35

Provided by Climate Connect

Large difference between forecasted and actual GHI even after 6 revisions

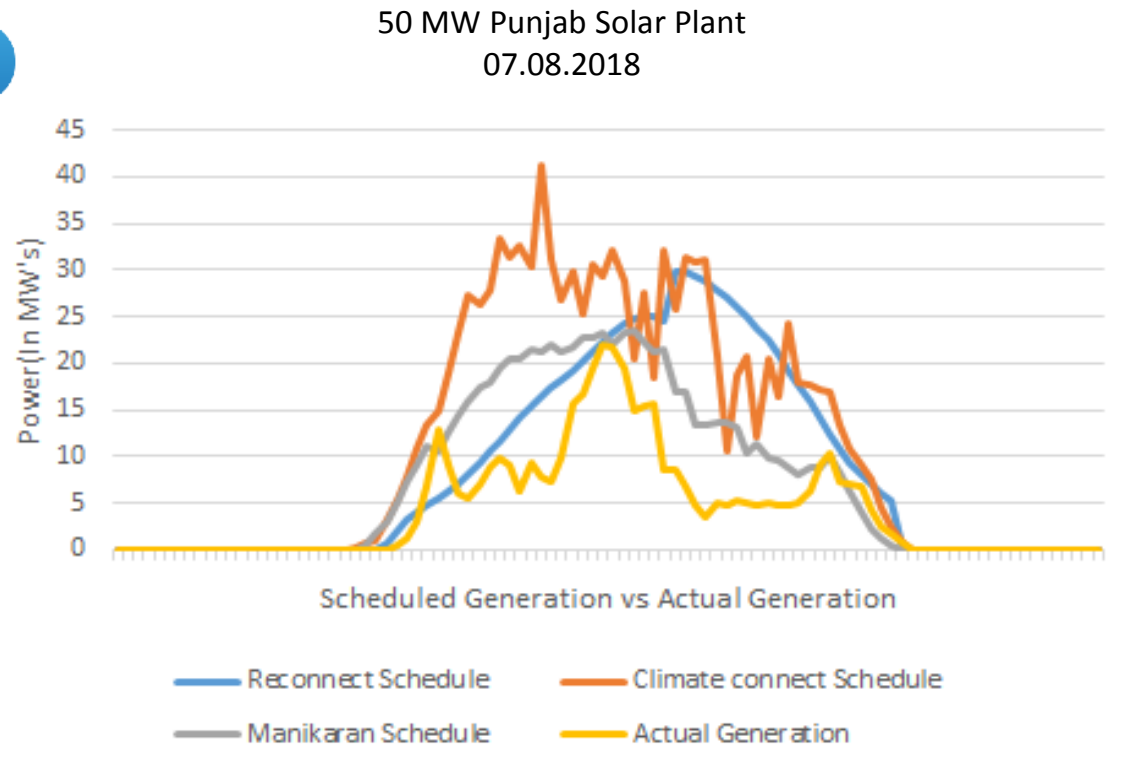
Case study - Local variations in weather



- Substantial difference in GHI recorded by 2 calibrated weather stations located 3km apart.
- Between 1st Aug 2018 to 20th July 2019 the following was noted between the two stations -
 - RMSE = 83.01
 - MAPE= 99.1%

Local weather can be extremely fickle and vary even a few kilometres apart

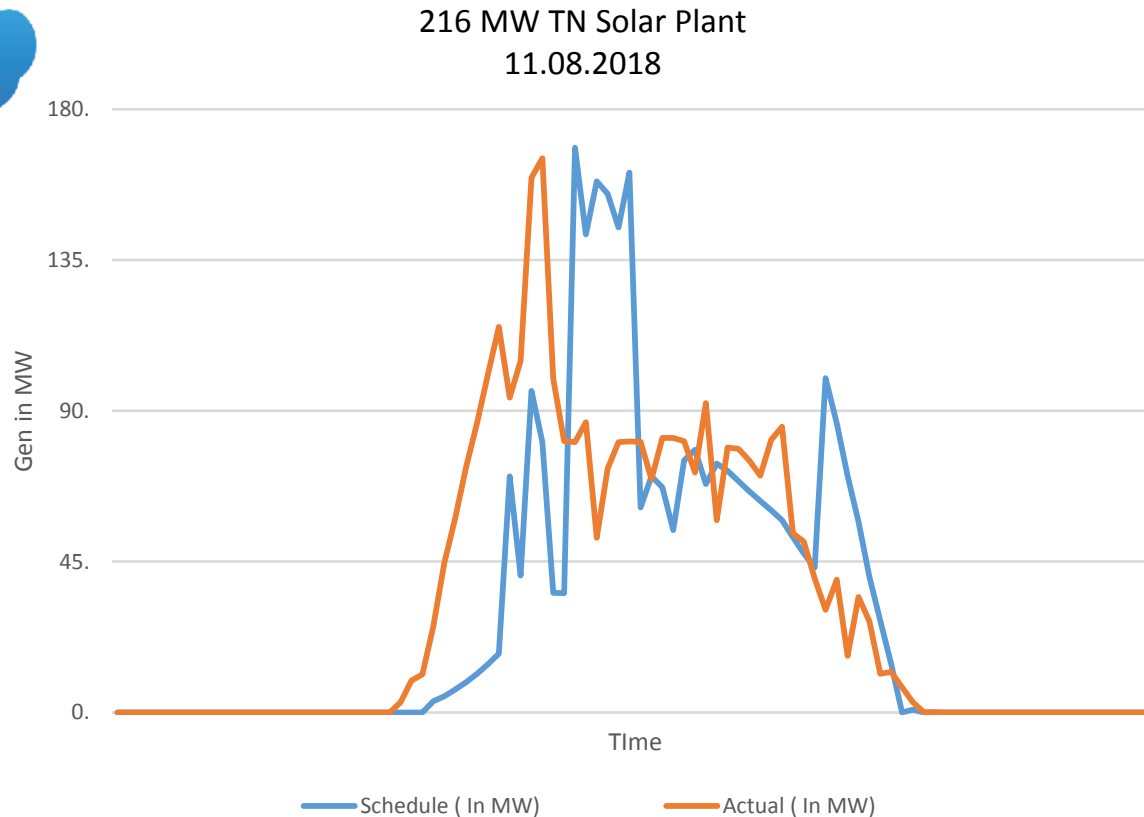
Case study - Clouds are impossible to model correctly



- Forecasting fails during cloud movement, especially for time scales as short as 15 minutes

Monsoons are especially difficult for forecasting due to heavy cloud movement

Case study - Clouds are impossible to model correctly



- Forecasting fails during cloud movement, especially for time scales as short as 15 minutes

Monsoons are especially difficult for forecasting due to heavy cloud movement

DSM Daily Report 9th July 2019

State	Plant Details	Forecasting Agency	Capacity	Scheduled Generation		Actual Generation		SCADA Availability		Deviation Penalty		Deviation Impact (As per Regulation)			Error Band- 1.10% for AP, KA, TS, MH, PU, UP 2.5% for Tamilnadu at same rates.	Remarks on Daily Deviation	Variance	
				Daily MU's	MTD MU's	Daily MU's	MTD MU's	Daily	MTD	Daily	MTD	YTD	MTD	O&M			FORECASTING	
				Rs	Rs	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh							
KA	Shorapur	Reconnect	10	0.05	0.20	0.06	0.46	100%	98%	3,209	22,558	5.83	4.54	3.69	5.93	Reconnect: Incorrect forecast	-	22,558
		Reconnect	10	0.23	1.00	0.30	2.08	100%	100%	44,282	182,960	14.57	8.79	4.99	13.17	Reconnect: Incorrect forecast	-	182,960
	Rajeshwar	Reconnect	50	0.26	1.05	0.30	2.08	100%	100%	26,559	162,378	8.74	7.86	4.61	12.16	Reconnect: Incorrect forecast	-	6,480
		Reconnect	50	0.09	0.53	0.08	0.97	84%	98%	212	2,781	0.26	0.29	6.16	1.00	Reconnect: Charges within permissible limits	-	2,781
	Periyapatna	Reconnect	20	0.14	0.51	0.08	0.97	84%	98%	11,961	83,469	14.42	4.59	4.17	15.52	Reconnect: Incorrect forecast	-	441
		Reconnect	20	0.09	0.45	0.10	0.87	100%	100%	195	441	0.20	0.05	2.42	0.36	Reconnect: Charges within permissible limits	-	731
	Bagewadi	Reconnect	20	0.09	0.42	0.09	0.64	98%	100%	-	731	0.00	0.11	3.79	0.46	Reconnect: No DSM charges	-	731
		Reconnect	20	0.10	0.52	0.09	1.02	100%	100%	183	785	0.21	0.08	2.85	0.44	Reconnect: Charges within permissible limits	-	785
	Maaluru	Reconnect	20	0.11	0.53	0.09	0.99	100%	99%	3,029	6,490	6.26	0.65	8.99	1.68	Reconnect: Incorrect forecast	-	6,480
		Reconnect	20	0.09	0.49	0.09	0.93	100%	100%	328	434	0.37	0.05	3.00	0.56	Reconnect: Charges within permissible limits	-	434
	K R Pet	Reconnect	20	0.09	0.43	0.06	0.58	100%	100%	357	2,098	0.58	0.36	0.12	1.30	Reconnect: Charges within permissible limits	-	2,098
		Reconnect	20	0.10	0.39	0.09	0.76	100%	100%	113	250	0.13	0.03	1.13	0.36	Reconnect: Charges within permissible limits	-	250
	Rammagar	Reconnect	20	0.08	0.40	0.08	0.77	100%	99%	-	490	0.00	0.06	1.88	0.50	Reconnect: No DSM charges	-	490
		Reconnect	50	0.21	0.98	0.22	2.18	98%	98%	9,531	176,292	4.38	8.09	7.02	9.78	Reconnect: Incorrect forecast	-	176,292
	Gubbi	Reconnect	20	0.10	0.40	0.09	0.78	100%	88%	655	5,929	0.72	0.76	3.02	1.18	Reconnect: Charges within permissible limits	-	5,929
		Reconnect	50	0.26	1.13	0.32	2.53	100%	97%	14,988	156,585	4.70	6.18	4.35	9.96	Reconnect: Incorrect forecast	-	156,585
	Kallur	Reconnect	50	0.27	0.97	0.31	1.95	100%	100%	8,391	123,815	2.69	6.4	5.0	10.13	Reconnect: Incorrect forecast	-	123,815
		Reconnect	40	0.11	0.63	0.18	1.50	96%	99%	6,702	71,902	3.77	4.8	4.3	8.99	Reconnect: Incorrect forecast	-	71,902
	Nalwar	Reconnect	50	0.23	1.05	0.29	2.49	98%	100%	21,098	132,364	7.16	5.1	6.0	9.24	Reconnect: Incorrect forecast	-	132,364
		Reconnect	100	0.56	2.61	0.30	2.91	100%	96%	131,356	683,551	44.51	23.5	5.3	33.33	Reconnect: Severe forecast issue	-	683,551
	Holenarasipura	Reconnect	20	0.10	0.41	0.10	0.91	100%	98%	-	8,939	0.00	0.96	4.16	2.17	Reconnect: No DSM charges	-	8,939
		Reconnect	20	0.09	0.47	0.08	0.87	100%	99%	-	2,805	0.00	0.32	4.03	1.26	Reconnect: No DSM charges	-	2,805
	Jevargi	Reconnect	20	0.08	0.36	0.09	0.81	100%	100%	215	1,534	0.23	0.7	3.5	0.83	Reconnect: Charges within permissible limits	-	1,534
		Reconnect	150	0.83	3.94	0.75	6.32	100%	99%	89,064	523,814	11.81	8.1	3.4	11.33	Reconnect: Severe forecast issue	-	523,814
	Pavagada	Reconnect	150	0.85	3.79	0.75	6.34	100%	99%	72,773	197,330	9.65	8.1	2.9	15.59	Reconnect: Incorrect forecast	-	197,330
		Reconnect	150	0.82	3.72	0.74	6.30	100%	99%	100,975	1,341,051	13.64	21.3	4.5	26.22	Reconnect: Incorrect forecast	-	1,341,051
	CG-1	Reconnect	470	0.18	0.73	0.29	2.09	100%	100%	46,240	470,032	16.14	22.53	4.58	23.33	Reconnect: Incorrect forecast	-	470,032
		Reconnect	470	0.22	0.99	0.29	2.09	100%	100%	38,412	349,598	13.41	16.78	4.85	23.31	Reconnect: Incorrect forecast	-	349,598
	CG-2	Reconnect	50	0.18	0.89	0.29	2.09	100%	100%	46,107	408,496	18.09	19.58	3.54	26.48	Reconnect: Incorrect forecast	-	408,496
		Reconnect	50	0.19	0.80	0.21	1.63	100%	100%	24,120	245,352	11.31	15.08	4.16	20.11	Reconnect: Incorrect forecast	-	245,352
	Ghani Adani	Reconnect	50	0.18	0.81	0.21	1.63	100%	100%	15,255	123,517	7.15	7.58	4.38	12.53	Reconnect: Incorrect forecast	-	123,517
		Reconnect	50	0.23	1.00	0.21	1.63	100%	100%	13,526	213,624	6.34	13.12	5.42	19.67	Reconnect: Incorrect forecast	-	213,624
AP	Manikaran	Reconnect	50	0.23	0.96	0.18	1.86	100%	89%	41,629	187,908	23.46	10.08	3.88	13.13	Manikaran: Severe forecast issue	-	187,908
		Reconnect	50	0.26	1.02	0.18	1.88	100%	89%	41,577	160,000	23.40	8.50	3.40	13.03	Manikaran: Severe forecast issue	-	160,000
RJ	Kanasar	Reconnect	20	0.29	1.43	0.34	2.22	100%	89%	11,770	478,294	4.48	21.56	5.15	28.59	Reconnect: Incorrect forecast	-	478,294
		Reconnect	20	0.13	0.69	0.11	1.22	100%	100%	-	-	0.00	0.00	2.23	0.10	Reconnect: No DSM charges	-	-
PJ	PDPL-1	Reconnect	50	0.12	0.65	0.11	1.22	100%	100%	17	8,187	0.02	0.67	2.19	1.03	Reconnect: Charges within permissible limits	-	-
		Reconnect	50	0.27	1.48	0.30	2.78	100%	100%	1,577	72,994	0.53	2.62	5.95	4.92	Reconnect: Charges within permissible limits	-	-
UP	Mahoba	Reconnect	50	0.21	1.15	0.30	2.78	100%	100%	7,503	144,487	2.54	5.19	6.83	9.95	Reconnect: Incorrect forecast	-	-
		Reconnect	50	0.30	1.74	0.30	2.78	100%	100%	4,403	84,809	1.49	3.05	3.76	4.79	Reconnect: Incorrect forecast	-	-
GJ	Bitta	Reconnect	50	0.27	1.50	0.30	2.78	100%	100%	1,666	157,576	0.56	5.46	5.22	8.34	Reconnect: Charges within permissible limits	-	-
		Reconnect	50	0.22	1.16	0.30	1.91	100%	100%	7,503	575,899	2.54	30.08	11.21	40.62	Reconnect: Incorrect forecast	-	-
TN	RSPL	Reconnect	72	0.30	1.68	0.30	2.82	100%	100%	3,388	153,483	1.11	5.43	4.42	7.21	Reconnect: Incorrect forecast	-	-
		Reconnect	72	0.10	1.47	0.10	2.11	100%	100%	1,108	253,339	1.10	11.16	3.22	5.28	Reconnect: Incorrect forecast	-	-
MH	KREL	Reconnect	72	0.10	1.56	0.10	2.11	100%	100%	344	209,039	0.34	9.92	2.98	19.89	Manikaran: Charges within permissible limits	-	-
		Reconnect	72	0.10	1.28	0.10	2.11	100%	100%	286	180,855	0.29	8.58	8.97	13.32	Reconnect: Charges within permissible limits	-	-
GJ	RSPD	Reconnect	40	0.34	1.80	0.36	2.62	100%	-	-	358,570	0.00	13.70	2.37	12.84	Reconnect: No DSM charges	-	-
		Reconnect	40	0.17	0.87	0.19	1.70	100%	100%	7,949	55,847	4.11	1.29	2.14	NA	Reconnect: Incorrect forecast	-	-
UP	KSPD	Reconnect	40	0.15	0.86	0.19	1.70	100%	100%	8,874	69,812	4.71	4.11	2.44	NA	Reconnect: Incorrect forecast	-	-
		Reconnect	40	0.17	0.77	0.19	1.70	100%	100%	4,087	60,439	2.17	1.56	2.95	NA	Reconnect: Incorrect forecast	-	-
TN	RREL	Reconnect	72	0.32	1.66	0.36	3.23	99%	98%	9,686	123,352	2.66	3.31	4.26	6.84	Reconnect: Incorrect forecast	-	-
		Reconnect	72	0.34	1.83	0.36	3.23	99%	98%	6,132	109,246	1.63	3.36	2.96	6.81	Reconnect: Incorrect forecast	-	-
GJ	KSPD	Reconnect	216	0.41	4.47	0.36	3.23	99%	98%	6,743	449,969	1.85	13.82	7.68	17.98	Reconnect: No DSM charges	-	-
		Reconnect	216	0.37	1.90	0.36	3.23	99%	98%	4,931	112,344	1.35	1.47	2.85	5.86	Reconnect: Incorrect forecast	-	-
UP	AGEFL	Reconnect	216	0.32	1.66	0.36	3.21	96%	96%	9,227	128,038	2.53	1.98	4.73	6.72	Reconnect: Incorrect forecast	-	-
		Reconnect	216	0.41	4.48	0.36	3.21	96%	96%	8,075	457,194	2.22	14.21	8.69	18.49	Reconnect: Incorrect forecast	-	-
TN	KSPD	Reconnect	216	0.37	1.89	0.36	3.21	96%	96%	4,959	109,798	1.36	1.42	1.26	5.88	Reconnect: Incorrect forecast	-	-
		Reconnect	216	0.23	1.65	0.25	2.79	56%	84%	9,519	314,918	3.78	11.29	4.03	15.56	Reconnect: Incorrect forecast	-	-
GJ	DCR	Reconnect	50	0.30	3.82	0.25	2.79	56%	84%	11,391	381,428	4.50	13.84	8.38	17.75	Reconnect: Incorrect forecast	-	-
		Reconnect	50	0.25	1.96	0.25	2.79	56%	84%	6,798	80,578	2.68	2.89	2.71	6.26	Reconnect: Incorrect forecast	-	-
UP	Open	Reconnect	50	0.94	5.07	1.08	9.70	100%	100%	21,086	250,621	1.95	2.58	2.93	4.88	Reconnect: Incorrect forecast	-	-
		Reconnect	50	1.24	13.46	1.08	9.70	100%	100%	14,845	250,621	1.37	2.58	2.23	4.88	Reconnect: Incorrect forecast	-	-
GJ	Rajmal(Wind)	Reconnect	18	1.10	5.63	1.08	9.70	100%	100%	9,872	185,241	0.91	1.91	2.26	3.96	Manikaran: Charges within permissible limits	-	-
		Reconnect	18	0.94	3.09	1.08	7.54	DNA	74%	25,154	235,082	2.33	1.12	3.57	5.61	Reconnect: Incorrect forecast	-	-
TN	Sudra(Wind)	Reconnect	18	1.24	4.59	1.08	7.54	DNA	74%	965,112	965,112	30.88	32.89	19.07	19.59	Reconnect: Severe forecast issue	-	-
		Reconnect	18	1.08	3.56	1.08	7.54	DNA	74%	289,236	289,236	1.37	1.57	2.40	3.54	Reconnect: Incorrect forecast	-	-
UP	DCR	Reconnect	50	0.25	0.96													

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State	Plant Details	Forecasting Agency	Capacity	Scheduled Generation		Actual Generation		SCADA Availability		Deviation Penalty		Deviation Impact (As per Regulation)			Error Band- 1.0% for AP, KA,TS,MH, PU,UP 2.5% for Tamilnadu at same rates.	Remarks on Daily Deviation	Variance		
				Daily MU's	MTD MU's	Daily MU's	MTD MU's	Daily	MTD	Daily	MTD	YTD	MTD	O&M			FORECASTING		
				Rs	Rs	Rs	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh								
KA	Shorapur	Reconnect	10	0.03	0.43	0.03	0.50	91%	98%	2,437	25,305	6.97	5.68	3.71	5.63	Reconnect: Incorrect forecast	-	25,305	
		Reconnect	10	0.25	2.13	0.27	2.35	100%	100%	2,509	185,469	0.94	7.89	4.98	11.87	Reconnect: Incorrect forecast	-	185,469	
	Rajeshwar	Reconnect	50	0.22	2.13	0.27	2.35	100%	100%	9,747	172,125	8.64	7.32	4.60	11.37	Reconnect: Incorrect forecast	-		
		Reconnect	50	0.09	1.04	0.10	1.07	100%	98%	-	2,781	0.00	0.26	6.12	0.96	Reconnect: Charges within permissible limits	-	2,781	
	Periyapatna	Reconnect	20	0.07	1.07	0.10	1.07	100%	98%	16,450	99,918	16.72	5.33	4.26	16.56	Reconnect: Incorrect forecast	-		
		Reconnect	20	0.08	0.90	0.08	0.96	100%	100%	234	675	0.28	0.07	2.40	0.39	Reconnect: Charges within permissible limits	-	675	
	Bagewadi	Reconnect	20	0.08	0.73	0.09	0.73	98%	100%	-	731	0.00	0.10	3.76	0.48	Reconnect: Charges within permissible limits	-	731	
		Reconnect	20	0.08	1.03	0.11	1.13	100%	100%	530	1,315	0.43	0.12	2.83	0.46	Reconnect: Charges within permissible limits	-	1,315	
	Maaluru	Reconnect	20	0.08	1.03	0.10	1.09	100%	99%	892	7,173	0.69	0.69	8.06	1.58	Reconnect: Incorrect forecast	-	7,173	
		Reconnect	20	0.07	0.95	0.09	1.03	100%	100%	523	957	0.56	0.09	2.98	0.58	Reconnect: Charges within permissible limits	-	957	
	K R Pet	Reconnect	20	0.07	0.88	0.06	0.64	100%	100%	2	2,099	0.00	0.33	0.12	1.25	Reconnect: Incorrect forecast	-	2,099	
		Reconnect	20	0.08	0.84	0.08	0.84	100%	100%	81	331	0.10	0.04	1.11	0.40	Reconnect: Charges within permissible limits	-	331	
	Rammagar	Reconnect	20	0.07	0.79	0.08	0.85	100%	99%	-	490	0.00	0.06	1.84	0.50	Reconnect: Charges within permissible limits	-	490	
		Reconnect	20	0.19	2.02	0.20	2.38	99%	98%	1,009	177,301	0.50	7.45	6.97	8.96	Reconnect: Incorrect forecast	-	177,301	
	Gubbi	Reconnect	20	0.07	0.88	0.09	0.87	100%	89%	393	6,322	0.44	0.73	4.98	1.14	Reconnect: Incorrect forecast	-	6,322	
		Reconnect	20	0.20	2.28	0.24	2.78	100%	97%	10,512	167,097	4.31	6.02	4.35	9.30	Reconnect: Incorrect forecast	-	167,097	
	Yathal	Reconnect	50	0.26	2.19	0.26	2.21	100%	100%	14,351	138,165	5.98	6.3	5.0	8.96	Reconnect: Incorrect forecast	-	138,165	
		Reconnect	50	0.13	1.34	0.16	1.66	100%	99%	1,388	73,290	0.85	4.4	4.2	8.12	Reconnect: Incorrect forecast	-	73,290	
	Maskal	Reconnect	40	0.13	1.34	0.16	1.66	100%	99%	1,388	73,290	0.85	4.4	4.2	8.12	Reconnect: Incorrect forecast	-	73,290	
		Reconnect	40	0.26	2.25	0.27	2.76	96%	99%	15,157	147,522	5.58	5.1	6.0	6.33	Reconnect: Incorrect forecast	-	147,522	
	Nalwar	Reconnect	100	0.44	5.22	0.23	3.14	100%	96%	101,760	785,311	44.23	25.0	5.5	30.91	Reconnect: Severe forecast issue	-	785,311	
		Reconnect	20	0.07	0.88	0.08	1.00	100%	98%	721	9,660	0.85	0.97	4.14	2.04	Reconnect: Incorrect forecast	-	9,660	
	Byadagi	Reconnect	20	0.06	0.91	0.08	0.94	100%	99%	834	3,639	1.07	0.39	4.01	1.21	Reconnect: Incorrect forecast	-	3,639	
		Reconnect	20	0.08	0.76	0.10	0.91	100%	100%	-	1,534	0.00	0.7	3.5	0.79	Reconnect: Charges within permissible limits	-	1,534	
	Jevargi	Reconnect	20	0.79	6.37	0.94	7.26	100%	99%	25,061	548,874	2.67	7.6	3.4	10.82	Reconnect: Incorrect forecast	-		
		Reconnect	20	0.57	7.33	0.94	7.26	100%	99%	87,342	278,868	8.32	3.8	3.0	15.56	Reconnect: Incorrect forecast	-	278,868	
	Pavagada	Reconnect	150	0.74	7.41	0.94	7.26	100%	99%	20,480	313,305	2.19	4.3	3.4	6.91	Reconnect: Incorrect forecast	-		
		Reconnect	150	0.26	1.61	0.22	2.31	100%	100%	15,102	485,134	6.87	21.04	4.59	27.56	Reconnect: Incorrect forecast	-	485,134	
	CG-1	Reconnect	50	0.28	2.08	0.22	2.31	100%	100%	25,662	375,260	11.67	16.27	4.90	22.66	Reconnect: Incorrect forecast	-		
		Reconnect	50	0.23	1.79	0.22	2.31	100%	100%	11,103	419,598	5.05	18.19	3.54	23.98	Reconnect: Incorrect forecast	-		
	CG-2	Reconnect	50	0.25	1.75	0.22	1.85	100%	100%	9,305	254,656	4.18	13.75	4.16	18.63	Reconnect: Incorrect forecast	-	254,656	
		Reconnect	50	0.22	1.69	0.22	1.85	100%	100%	16,176	139,693	7.23	7.54	4.40	11.07	Reconnect: Incorrect forecast	-		
	Ghani Adani	Reconnect	50	0.28	2.11	0.22	1.85	100%	100%	31,405	245,029	14.04	13.23	5.48	19.62	Reconnect: Incorrect forecast	-		
		Reconnect	50	0.25	2.12	0.24	2.12	100%	90%	6,641	161,674	2.74	7.61	3.75	12.42	Reconnect: Incorrect forecast	-	161,674	
	AP	Ghani Adani	Reconnect	50	0.23	2.27	0.24	2.12	100%	90%	24,638	184,638	10.18	8.69	3.44	11.58	Reconnect: Incorrect forecast	-	
			Reconnect	50	0.26	2.77	0.24	2.12	100%	90%	7,816	455,537	8.23	21.44	5.09	28.47	Reconnect: Incorrect forecast	-	
	RJ	Kanasar	Reconnect	20	0.14	1.35	0.13	1.35	100%	100%	-	-	0.00	0.00	2.21	0.11	Reconnect: Charges within permissible limits	-	-
			Reconnect	20	0.13	1.30	0.13	1.35	100%	100%	-	8,187	0.00	0.61	2.17	0.93	Reconnect: Charges within permissible limits	-	-
	PJ	PDPL-1	Reconnect	50	0.23	2.81	0.24	3.02	100%	100%	-	72,994	0.00	2.41	5.91	4.54	Reconnect: Incorrect forecast	-	-
			Reconnect	50	0.21	2.24	0.24	3.02	100%	100%	-	144,487	0.00	4.78	6.71	9.17	Reconnect: Incorrect forecast	-	-
	UP	Mahoba	Reconnect	50	0.29	3.26	0.24	3.02	100%	100%	2,332	87,141	0.97	2.88	3.74	4.67	Reconnect: Incorrect forecast	-	-
			Reconnect	50	0.23	2.84	0.24	3.02	100%	100%	-	157,576	0.00	5.22	5.19	7.70	Reconnect: Incorrect forecast	-	-
	GJ	Bitta	Reconnect	40	0.21	2.25	0.24	3.02	100%	100%	-	227,242	0.00	7.52	7.71	12.62	Reconnect: Incorrect forecast	-	-
			Reconnect	40	0.29	3.18	0.24	3.02	100%	100%	2,575	159,819	1.08	3.29	4.43	7.27	Reconnect: Incorrect forecast	-	-
	TN	RREL	Reconnect	72	0.13	2.25	0.09	2.20	99%	100%	2,912	234,349	3.67	10.64	3.20	15.29	Reconnect: Incorrect forecast	-	-
Reconnect			72	0.10	2.49	0.09	2.20	99%	100%	1,235	210,274	1.30	9.55	2.97	19.24	Reconnect: Incorrect forecast	-	-	
MH	KSP	Reconnect	216	0.10	2.05	0.09	2.20	99%	100%	1,140	181,995	1.20	6.26	8.95	12.89	Reconnect: Incorrect forecast	-	-	
		Reconnect	216	0.08	3.33	0.09	2.20	99%	100%	5,154	735,019	5.64	33.38	3.56	43.32	Reconnect: Incorrect forecast	-	-	
TG	Open	Reconnect	50	0.17	1.72	0.20	1.89	100%	100%	5,841	61,688	2.95	1.28	2.15	NA	Reconnect: Incorrect forecast	-	-	
		Reconnect	50	0.15	1.59	0.19	1.89	100%	100%	9,811	79,623	5.08	4.21	2.50	NA	Reconnect: Incorrect forecast	-	-	
GJ	Bitta	Reconnect	40	0.14	1.56	0.19	1.89	100%	100%	16,415	76,854	8.50	4.07	3.00	NA	Reconnect: Incorrect forecast	-	-	
		Reconnect	40	0.34	3.32	0.26	3.49	97%	98%	43,331	166,683	16.99	4.79	4.38	6.37	Reconnect: Incorrect forecast	-	-	
RJ	RSPL	Reconnect	72	0.32	3.60	0.26	3.49	97%	98%	28,678	134,425	11.84	3.82	3.03	6.03	Reconnect: Incorrect forecast	-	-	
		Reconnect	72	0.42	4.89	0.26	3.49	97%	98%	67,415	517,384	26.43	14.83	7.98	16.66	Reconnect: Incorrect forecast	-	-	
TN	RREL	Reconnect	72	0.36	3.72	0.26	3.49	97%	98%	41,725	154,069	16.36	4.43	2.94	5.43	Reconnect: Incorrect forecast	-	-	
		Reconnect	72	0.33	3.32	0.25	3.46	96%	96%	44,239	172,277	17.76	4.58	4.42	6.26	Reconnect: Incorrect forecast	-	-	
MH	KSP	Reconnect	216	0.42	4.91	0.25	3.46	96%	96%	71,118	528,313	28.59	15.26	9.06	19.69	Reconnect: Incorrect forecast	-	-	
		Reconnect	216	0.36	3.71	0.25	3.46	96%	96%	47,840	157,618	19.23	4.35	3.17	7.20	Reconnect: Incorrect forecast	-	-	
TG	Open	Reconnect	50	0.23	3.22	0.25	3.03	100%	85%	46,977	355,595	10.53	11.72	4.11	14.22	Reconnect: Incorrect forecast	-	-	
		Reconnect	50	0.42	4.25	0.25	3.03	100%	85%	75,102	426,526	10.94	15.98	4.72	15.37	Reconnect: Incorrect forecast	-	-	
RJ	KSP	Reconnect	216	0.37	3.32	0.25	3.03	100%	85%	45,164	129,743	19.98	4.28	2.83	7.81	Reconnect: Incorrect forecast	-	-	
		Reconnect	216	1.00	10.03	0.79	10.49	100%	100%	73,393	324,015	9.27	1.69	2.98	4.52	Reconnect: Incorrect forecast	-	-	
TG	Open	Reconnect	50	1.27	14.73	0.79	10.49	100%	100%	174,155	324,015	22.10	3.69	2.36	4.52	Reconnect: Incorrect forecast	-	-	
		Reconnect	50	1.07	11.04	0.79	10.49	100%	100%	85,743	270,984	10.88	2.58	2.32	4.86	Reconnect: Incorrect forecast	-	-	
RJ	KSP	Reconnect	216	1.61	8.04	0.82	8.36	DNA	76%	116,194	378,211	14.23	4.53	3.68	5.53	Reconnect: Incorrect forecast	-	-	
		Reconnect	216	1.27	11.62	0.82	8.36	DNA	76%	1,142,602	1,142,602	19.97	13.97	19.27	19.10	Reconnect: Incorrect forecast	-	-	
TG	Open	Reconnect	50	1.06	9.01	0.82	8.36	DNA	76%	105,818	378,211	11.84	4.82	2.81	6.03	Reconnect: Incorrect forecast	-		

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State	Plant Details	Forecasting Agency	Capacity	Scheduled Generation		Actual Generation		SCADA Availability		Deviation Penalty		Deviation Impact (As per Regulation)			Error Band- 1.10% for AP, KA, TS, MH, PU, UP 2.5% for Tamilnadu at same rates.	Remarks on Daily Deviation	Variance		
				Daily MU's	MTD MU's	Daily MU's	MTD MU's	Daily	MTD	Daily	MTD	YTD	MTD	O&M			FORECASTING		
				Rs	Rs	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh	Paise/kwh								
KA	Shorapur	Reconnect	10	0.05	0.54	0.04	0.60	100%	98%	4,140	32,272	9.70	5.54	3.75	9.07	Reconnect: Incorrect forecast	-	32,272	
		Reconnect	10	0.28	2.66	0.26	2.83	100%	100%	11,851	203,656	4.62	7.35	4.94	8.88	Reconnect: Incorrect forecast	-	203,656	
	Rajeshwar	Enercast	50	0.28	2.64	0.26	2.83	100%	100%	20,354	202,202	7.88	7.35	4.63	11.34	Enercast: Incorrect forecast	-	-	
		Reconnect	20	0.11	1.23	0.13	1.31	98%	98%	22	3,678	0.02	0.28	6.03	0.90	Reconnect: Charges within permissible limits	-	3,678	
	Periyapatna	Enercast	20	0.12	1.31	0.13	1.31	98%	98%	3,652	87,604	2.86	4.70	4.09	11.13	Enercast: Incorrect forecast	-	-	
		Reconnect	20	0.08	1.06	0.11	1.15	99%	100%	1,234	1,234	0.24	0.11	2.37	0.45	Reconnect: Charges within permissible limits	-	1,234	
	Bagewadi	Reconnect	20	0.08	0.89	0.07	0.88	100%	100%	-	751	0.00	0.09	3.72	0.51	Reconnect: No DSM charges	-	751	
		Reconnect	20	0.11	1.24	0.13	1.36	100%	100%	15	1,586	0.01	1.13	2.78	0.49	Reconnect: Charges within permissible limits	-	1,586	
	Maaluru	Reconnect	20	0.10	1.21	0.09	1.27	100%	99%	1,500	9,522	1.65	0.75	8.80	1.48	Reconnect: Incorrect forecast	-	9,522	
		Reconnect	20	0.11	1.15	0.12	1.25	100%	100%	-	957	0.00	0.08	2.92	0.59	Reconnect: No DSM charges	-	957	
	K R Pet	Reconnect	20	0.09	1.04	0.08	0.80	100%	100%	-	2,279	0.00	0.28	0.12	1.14	Reconnect: No DSM charges	-	2,279	
		Reconnect	20	0.10	1.02	0.10	1.03	100%	100%	-	331	0.00	0.03	1.05	0.42	Reconnect: No DSM charges	-	331	
	Gubbi	Reconnect	20	0.07	0.92	0.10	1.04	96%	99%	628	1,117	0.64	0.11	1.76	0.53	Reconnect: Charges within permissible limits	-	1,117	
		Reconnect	50	0.26	2.48	0.27	2.91	98%	98%	16,645	204,588	6.08	7.02	6.94	11.22	Reconnect: Incorrect forecast	-	204,588	
	Magadi	Reconnect	20	0.10	1.05	0.11	1.04	100%	91%	377	6,763	0.34	0.65	4.91	1.08	Reconnect: Charges within permissible limits	-	6,763	
		Reconnect	50	0.27	2.75	0.22	3.25	100%	97%	19,899	219,569	9.13	6.75	4.44	7.82	Reconnect: Incorrect forecast	-	219,569	
	Yathal	Reconnect	50	0.30	2.77	0.29	2.74	100%	100%	33,842	179,989	11.77	6.8	5.1	7.27	Reconnect: Incorrect forecast	-	179,989	
		Reconnect	40	0.19	1.67	0.18	2.07	100%	99%	2,334	100,143	1.29	4.8	4.3	6.60	Reconnect: Incorrect forecast	-	100,143	
	Nalwar	Reconnect	50	0.28	2.81	0.23	3.33	100%	99%	27,817	199,474	12.26	6.0	6.1	6.98	Reconnect: Incorrect forecast	-	199,474	
		Reconnect	100	0.55	6.28	0.35	3.75	100%	96%	61,090	947,755	17.26	25.3	5.7	35.50	Reconnect: Incorrect forecast	-	947,755	
	Holenarasipura	Reconnect	20	0.11	1.08	0.12	1.22	100%	99%	-	9,678	0.00	0.79	4.06	1.76	Reconnect: No DSM charges	-	9,678	
		Reconnect	20	0.10	1.08	0.10	1.11	100%	99%	-	3,639	0.00	0.33	1.95	1.11	Reconnect: No DSM charges	-	3,639	
	Byadagi	Reconnect	20	0.10	0.94	0.09	1.10	100%	100%	-	1,759	0.00	0.7	3.4	0.75	Reconnect: No DSM charges	-	1,759	
		Reconnect	20	0.78	7.94	0.85	9.03	100%	99%	21,467	595,166	2.53	6.6	3.4	5.56	Reconnect: Incorrect forecast	-	-	
	Pavagada	Enercast	150	0.88	8.56	0.85	9.03	100%	99%	51,478	398,536	6.68	4.4	3.1	14.55	Enercast: Incorrect forecast	-	398,536	
		Reconnect	20	0.86	9.10	0.85	9.03	100%	99%	16,259	380,221	1.91	4.2	3.4	6.81	Reconnect: Incorrect forecast	-	-	
	CG-1	Enercast	20	0.28	2.12	0.34	2.92	100%	100%	2,780	495,468	0.82	18.97	4.54	22.33	Enercast: Charges within permissible limits	-	495,468	
		Reconnect	20	0.32	2.67	0.34	2.92	100%	100%	434	378,732	0.13	12.97	4.82	18.25	Reconnect: Charges within permissible limits	-	-	
	CG-2	Reconnect	50	0.31	2.38	0.34	2.92	100%	100%	1,904	429,829	0.56	14.72	3.47	18.97	Reconnect: Charges within permissible limits	-	-	
		Reconnect	50	0.33	2.34	0.35	2.45	100%	100%	3,126	272,704	0.90	11.14	4.14	15.12	Reconnect: Charges within permissible limits	-	272,704	
	AP	Ghani Adani	Reconnect	50	0.31	2.26	0.35	2.45	100%	100%	2,137	156,192	0.62	6.38	4.37	8.41	Reconnect: Charges within permissible limits	-	-
			Reconnect	50	0.33	2.71	0.35	2.45	100%	100%	904	253,908	0.26	10.37	5.41	15.58	Reconnect: Charges within permissible limits	-	-
RJ	Kanasar	Manikaran	50	0.29	2.65	0.29	2.70	100%	92%	16,461	198,059	5.71	7.34	3.80	11.93	Manikaran: Incorrect forecast	-	198,059	
		Reconnect	50	0.27	2.81	0.30	2.70	100%	92%	13,240	207,202	4.48	7.66	3.41	9.14	Reconnect: Incorrect forecast	-	-	
PJ	PDPL-1	Enercast	50	0.30	3.35	0.36	2.85	100%	92%	18,297	260,317	5.07	9.13	4.33	23.79	Enercast: Incorrect forecast	-	-	
		Reconnect	20	0.12	1.61	0.09	1.55	100%	100%	-	-	0.00	0.00	2.18	0.18	Reconnect: No DSM charges	-	-	
UP	Mahoba	Reconnect	50	0.12	1.55	0.09	1.55	100%	100%	5,987	16,426	6.38	1.06	2.20	1.83	Reconnect: Incorrect forecast	-	-	
		Reconnect	50	0.26	3.32	0.19	3.43	100%	100%	11,645	91,400	6.24	2.67	5.89	4.88	Reconnect: Incorrect forecast	-	-	
GJ	Bitta	Manikaran	50	0.22	2.70	0.19	3.43	100%	100%	5,350	155,182	2.87	4.53	6.59	8.61	Manikaran: Incorrect forecast	-	-	
		Reconnect	50	0.26	3.79	0.19	3.43	100%	100%	17,399	110,995	9.32	3.24	3.76	5.23	Reconnect: Incorrect forecast	-	-	
TN	RREL	Manikaran	50	0.26	3.35	0.19	3.42	100%	100%	14,253	178,674	7.70	5.22	5.19	6.81	Manikaran: Incorrect forecast	-	-	
		Reconnect	50	0.22	2.72	0.19	3.21	100%	100%	5,350	407,359	2.87	12.70	8.92	18.69	Reconnect: Incorrect forecast	-	-	
MH	Kilaj	Manikaran	50	0.26	3.70	0.19	3.43	100%	100%	14,469	180,148	7.84	3.25	4.42	7.21	Manikaran: Incorrect forecast	-	-	
		Reconnect	50	0.33	2.81	0.34	2.72	71%	97%	5,125	243,697	1.50	6.55	3.18	12.40	Reconnect: Incorrect forecast	-	-	
TG	DCR	Manikaran	50	0.25	2.94	0.34	2.72	71%	97%	30,309	240,765	6.86	8.84	3.02	17.36	Manikaran: Incorrect forecast	-	-	
		Reconnect	50	0.31	2.52	0.34	2.72	71%	97%	3,384	186,154	0.99	6.88	3.86	16.92	Reconnect: Charges within permissible limits	-	-	
GJ	RSPL	Enercast	40	0.33	2.54	0.34	2.72	71%	97%	2,074	180,129	0.61	6.31	1.82	16.31	Enercast: Charges within permissible limits	-	-	
		Reconnect	40	0.18	2.05	0.19	2.28	100%	100%	6,153	83,224	3.37	1.65	2.20	NA	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	40	0.19	1.96	0.19	2.27	100%	100%	6,843	93,275	3.67	4.11	2.55	NA	Manikaran: Incorrect forecast	-	-	
		Reconnect	40	0.15	1.67	0.19	2.27	100%	100%	6,860	94,950	3.68	4.19	3.03	NA	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Enercast	72	0.37	4.00	0.39	4.22	97%	98%	10,455	187,462	2.69	4.44	4.91	9.32	Enercast: Incorrect forecast	-	-	
		Reconnect	72	0.39	4.30	0.39	4.22	97%	98%	10,393	193,965	2.75	4.67	4.03	6.58	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Enercast	72	0.48	5.77	0.39	4.22	97%	98%	28,935	553,027	2.48	13.13	7.88	15.72	Enercast: Incorrect forecast	-	-	
		Reconnect	72	0.37	4.44	0.39	4.22	97%	98%	8,964	169,553	2.31	4.02	2.93	4.43	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Enercast	72	0.36	3.99	0.37	4.18	98%	96%	11,019	194,002	2.95	4.64	4.79	5.21	Enercast: Incorrect forecast	-	-	
		Reconnect	72	0.49	5.79	0.37	4.18	98%	96%	35,465	572,562	3.48	13.71	8.91	17.83	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	72	0.36	4.42	0.37	4.18	98%	96%	8,331	171,282	2.23	4.10	3.91	6.81	Manikaran: Incorrect forecast	-	-	
		Reconnect	72	0.37	3.89	0.38	3.75	100%	88%	8,325	379,426	2.21	10.12	4.05	11.12	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	72	0.49	5.12	0.38	3.75	100%	88%	39,005	593,639	10.87	11.43	6.63	15.61	Manikaran: Incorrect forecast	-	-	
		Reconnect	72	0.37	4.04	0.38	3.75	100%	88%	8,662	145,896	2.30	3.89	2.82	7.18	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	216	1.10	12.05	1.16	12.65	100%	100%	10,830	378,810	0.93	2.99	2.97	5.43	Reconnect: Charges within permissible limits	-	-	
		Reconnect	216	1.46	17.37	1.16	12.65	100%	100%	58,958	1,420,390	5.07	13.23	4.75	15.39	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	216	1.08	13.13	1.16	12.65	100%	100%	9,938	301,632	0.85	2.38	2.30	4.59	Manikaran: Charges within permissible limits	-	-	
		Reconnect	216	1.11	10.07	1.14	10.51	DNA	79%	37,579	444,061	3.29	4.22	3.67	4.42	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	216	1.46	14.26	1.14	10.51	DNA	79%	99,592	1,262,450	6.26	12.01	18.99	15.92	Reconnect: Incorrect forecast	-	-	
		Reconnect	216	1.10	11.16	1.14	10.51	DNA	79%	47,217	318,336	1.89	4.57	2.48	4.48	Reconnect: Incorrect forecast	-	-	
GJ	KREL	Manikaran	50	0.31	2.79	0.31	2.64</												

DSM Daily Report 15th July 2019

State	Plant Details	Forecasting Agency	Capacity	Scheduled Generation		Actual Generation		SCADA Availability		Deviation Penalty		Deviation Impact (As per Regulation)			Error Band- 1.0% for AP, KA, TS, MH, PU, UP 2.5% for Tamilnadu at same rates.	Remarks on Daily Deviation	Variance		
				Daily MU's	MTD MU's	Daily MU's	MTD MU's	Daily	MTD	Daily Rs	MTD Rs	Daily Paise/kwh	MTD Paise/kwh	YTD Paise/kwh			MTD Paise/kwh	O&M	FORECASTING
KA	Shorapur	Reconnect	10	0.06	0.70	0.06	0.79	100%	98%	3,760	38,401	6.59	4.68	3.74	6.43	Reconnect: Incorrect forecast	-	38,401	
		Reconnect		0.35	3.63	0.39	3.96	100%	100%	5,579	244,682	1.42	8.18	4.90	9.94	Reconnect: Incorrect forecast	-	244,682	
	Rajeshwar	Enercast	50	0.37	3.69	0.39	3.96	100%	100%	2,783	229,333	0.71	3.78	4.55	9.52	Enercast: Charges within permissible limits	-	-	
		Reconnect		0.10	1.55	0.12	1.64	98%	99%	210	4,221	0.18	0.26	5.88	1.36	Reconnect: Charges within permissible limits	-	4,221	
	Periyapatna	Enercast	20	0.11	1.65	0.12	1.64	98%	99%	8,449	123,813	7.29	7.56	4.26	12.33	Enercast: Incorrect forecast	-	-	
		Reconnect		20	0.08	1.32	0.10	1.46	99%	100%	-	1,321	0.00	0.09	2.30	0.92	Reconnect: No DSM charges	-	1,321
	Bagewadi	Reconnect	20	0.09	1.16	0.11	1.19	100%	100%	269	1,020	0.24	0.09	3.63	0.63	Reconnect: Charges within permissible limits	-	1,020	
		Reconnect		20	0.12	1.57	0.14	1.71	100%	100%	64	2,992	0.04	0.17	2.71	1.01	Reconnect: Charges within permissible limits	-	2,992
	Maaluru	Reconnect	20	0.09	1.52	0.11	1.61	100%	99%	2,640	12,292	2.48	0.78	4.89	2.99	Reconnect: Incorrect forecast	-	12,292	
		Reconnect		20	0.10	1.45	0.11	1.58	100%	100%	29	985	0.03	0.06	2.85	0.80	Reconnect: Charges within permissible limits	-	985
	K R Pet	Reconnect	20	0.09	1.31	0.07	1.00	100%	100%	-	2,456	0.00	0.24	0.11	1.84	Reconnect: No DSM charges	-	2,456	
		Reconnect		20	0.08	1.29	0.11	1.34	100%	100%	-	1,095	0.00	0.08	2.98	0.67	Reconnect: No DSM charges	-	1,095
	Channappattana	Reconnect	20	0.08	1.16	0.09	1.30	96%	99%	-	1,117	0.00	0.09	3.69	0.57	Reconnect: No DSM charges	-	1,117	
		Reconnect		50	0.25	3.22	0.32	3.76	98%	98%	42,771	298,290	13.57	7.93	7.05	12.28	Reconnect: Incorrect forecast	-	298,290
	Gubbi	Reconnect	20	0.10	1.36	0.10	1.36	100%	93%	2,386	9,403	2.47	0.89	4.80	2.95	Reconnect: Incorrect forecast	-	9,403	
		Reconnect		50	0.32	3.67	0.34	4.21	100%	97%	16,844	260,423	4.87	6.19	4.43	10.07	Reconnect: Incorrect forecast	-	260,423
	Yathal	Reconnect	50	0.27	3.66	0.29	3.71	100%	100%	23,013	225,859	8.04	6.1	5.1	9.91	Reconnect: Incorrect forecast	-	225,859	
		Reconnect		40	0.20	2.23	0.19	2.74	100%	99%	5,646	133,298	2.94	4.3	4.3	8.89	Reconnect: Incorrect forecast	-	133,298
	Nalwar	Reconnect	50	0.31	3.74	0.23	4.22	100%	100%	47,933	257,993	20.49	6.1	6.1	9.91	Reconnect: Severe forecast issue	-	257,993	
		Reconnect		100	0.50	7.77	0.33	4.75	100%	96%	49,657	1,062,767	14.94	22.4	5.8	31.96	Reconnect: Severe forecast issue	-	1,062,767
	Madhuvanahalli	Reconnect	20	0.11	1.41	0.12	1.58	100%	99%	157	9,834	0.13	0.62	3.94	1.68	Reconnect: Charges within permissible limits	-	9,834	
		Reconnect		20	0.10	1.39	0.11	1.41	100%	100%	-	4,108	0.00	0.29	3.45	1.32	Reconnect: No DSM charges	-	4,108
	Holenarasipura	Reconnect	20	0.11	1.26	0.11	1.43	100%	100%	533	2,293	0.47	0.7	3.3	0.98	Reconnect: Charges within permissible limits	-	2,293	
		Reconnect		150	0.89	10.59	0.96	11.65	100%	99%	76,171	839,076	7.94	7.2	3.5	16.28	Reconnect: Incorrect forecast	-	-
	Pavagada	Enercast	150	0.91	11.68	0.96	11.65	100%	99%	62,795	674,248	6.54	5.8	3.3	14.90	Enercast: Incorrect forecast	-	674,248	
		Reconnect		150	0.99	11.67	0.96	11.65	100%	99%	64,342	460,735	6.70	4.0	3.4	6.36	Reconnect: Incorrect forecast	-	-
	CG-1	Enercast	50	0.31	3.02	0.38	3.96	100%	100%	5,876	525,519	1.55	13.28	4.49	18.13	Enercast: Incorrect forecast	-	525,519	
		Reconnect		50	0.35	3.66	0.36	3.96	100%	100%	1,406	389,193	0.39	9.82	4.70	14.04	Reconnect: Charges within permissible limits	-	-
	CG-2	Enercast	50	0.37	3.43	0.36	3.96	100%	100%	4,662	443,656	1.29	11.20	3.34	15.59	Enercast: Incorrect forecast	-	-	
		Reconnect		50	0.34	3.34	0.33	3.44	100%	100%	26,526	320,288	8.11	9.31	4.16	13.00	Reconnect: Incorrect forecast	-	320,288
	Ghani Adani	Reconnect	50	0.34	3.28	0.33	3.44	100%	100%	2,324	176,995	0.71	5.14	4.31	8.31	Reconnect: Charges within permissible limits	-	-	
		Reconnect		50	0.36	3.72	0.33	3.44	100%	100%	25,711	294,539	7.86	8.58	5.37	12.78	Reconnect: Incorrect forecast	-	-
	AP	Manikaran	50	0.25	3.44	0.24	3.40	100%	93%	25,254	290,811	10.63	8.55	4.02	13.40	Manikaran: Incorrect forecast	-	290,811	
		Reconnect		50	0.26	3.59	0.24	3.40	100%	93%	35,037	298,217	14.74	8.77	3.58	13.38	Reconnect: Incorrect forecast	-	-
	RJ	Enercast	20	0.32	4.26	0.24	3.40	100%	93%	45,693	366,588	19.23	16.78	4.40	23.67	Enercast: Incorrect forecast	-	-	
Reconnect			20	0.12	1.97	0.08	1.81	100%	100%	2,506	2,506	3.13	0.14	2.15	0.31	Reconnect: Incorrect forecast	-	2,506	
Kanasar	Reconnect	20	0.11	1.90	0.08	1.81	100%	100%	13,823	37,189	17.26	2.05	2.30	3.35	Reconnect: Incorrect forecast	-	-		
	Reconnect		50	0.21	4.02	0.15	3.95	100%	100%	29,524	148,127	16.41	8.75	5.97	6.50	Reconnect: Incorrect forecast	-	-	
PDPL-1	Reconnect	50	0.22	3.34	0.15	3.95	100%	100%	41,163	214,053	27.52	5.41	6.76	9.66	Reconnect: Incorrect forecast	-	-		
	Reconnect		50	0.19	4.37	0.15	3.95	100%	100%	26,380	161,092	17.34	4.07	3.85	6.61	Reconnect: Incorrect forecast	-	-	
PJ	Manikaran	50	0.21	4.05	0.15	3.94	100%	100%	26,873	234,337	17.87	3.95	5.27	9.08	Reconnect: Incorrect forecast	-	-		
	Reconnect		50	0.22	3.36	0.15	3.94	100%	100%	41,163	303,619	27.52	7.71	7.75	15.58	Reconnect: Incorrect forecast	-	-	
UP	Manikaran	50	0.18	4.28	0.15	3.94	100%	100%	36,535	242,221	16.43	8.15	4.53	9.90	Manikaran: Incorrect forecast	-	-		
	Reconnect		50	0.36	3.17	0.34	3.06	71%	98%	1,908	245,605	0.56	0.61	3.15	11.58	Reconnect: Charges within permissible limits	-	-	
Mahoba	Manikaran	50	0.37	3.30	0.34	3.06	71%	98%	2,431	243,106	0.71	7.93	2.99	15.64	Manikaran: Charges within permissible limits	-	-		
	Reconnect		50	0.34	2.86	0.34	3.06	71%	98%	1,460	187,614	0.43	6.12	8.80	9.91	Reconnect: Charges within permissible limits	-	-	
GJ	Enercast	40	0.34	2.86	0.34	3.06	71%	98%	532	178,347	0.16	3.32	1.79	9.28	Enercast: Charges within permissible limits	-	-		
	Reconnect		40	0.17	2.55	0.17	2.79	100%	100%	6,188	101,783	3.64	1.64	2.23	NA	Reconnect: Incorrect forecast	-	-	
Bitta	Manikaran	40	0.18	2.51	0.17	2.79	100%	100%	4,621	108,075	2.71	1.87	2.57	NA	Manikaran: Incorrect forecast	-	-		
	Reconnect		40	0.15	2.29	0.17	2.79	100%	100%	6,538	118,023	3.84	4.22	3.06	NA	Reconnect: Incorrect forecast	-	-	
RSPL	Reconnect	72	0.34	5.10	0.32	5.13	97%	98%	4,720	305,774	1.46	3.98	4.02	9.02	Reconnect: Incorrect forecast	-	-		
	Reconnect		72	0.35	5.35	0.32	5.13	97%	98%	6,249	242,629	2.07	4.77	3.17	8.40	Reconnect: Incorrect forecast	-	-	
KREL	Enercast	72	0.49	7.15	0.32	5.13	97%	98%	46,312	758,897	18.33	34.78	8.69	13.12	Enercast: Incorrect forecast	-	-		
	Reconnect		72	0.33	5.49	0.32	5.13	97%	98%	15,725	284,673	4.86	5.55	3.15	8.31	Reconnect: Incorrect forecast	-	-	
TN	Manikaran	72	0.35	5.07	0.33	5.09	98%	97%	4,438	307,029	1.35	6.03	4.97	9.09	Reconnect: Incorrect forecast	-	-		
	Reconnect		72	0.49	7.17	0.33	5.09	98%	97%	42,560	778,656	12.96	15.30	9.73	13.63	Reconnect: Incorrect forecast	-	-	
RREL	Manikaran	72	0.34	5.49	0.33	5.09	98%	97%	16,245	285,120	4.98	5.69	3.58	9.37	Manikaran: Incorrect forecast	-	-		
	Reconnect		72	0.35	4.97	0.33	4.67	100%	90%	3,757	492,475	1.12	10.35	4.30	14.61	Reconnect: Incorrect forecast	-	-	
KSPL	Manikaran	216	0.49	6.51	0.33	4.67	100%	90%	42,781	701,098	12.99	15.02	10.33	15.38	Reconnect: Incorrect forecast	-	-		
	Reconnect		216	1.02	15.28	0.98	15.48	100%	100%	14,887	644,915	1.52	4.17	3.13	6.79	Reconnect: Incorrect forecast	-	-	
Open	Manikaran	50	1.46	21.52	0.98	15.48	100%	100%	145,547	1,949,140	14.88	13.59	5.60	16.82	Reconnect: Incorrect forecast	-	-		
	Reconnect		50	1.02	16.34	0.98	15.48	100%	100%	38,377	556,514	3.93	3.60	2.47	6.02	Reconnect: Incorrect forecast	-	-	
AGETL	Manikaran	216	1.01	13.13	0.99	13.22	DNA	83%	18,842	751,307	1.90	3.68	3.85	8.88	Reconnect: Incorrect forecast	-	-		
	Reconnect		216	1.46	18.42	0.99	13.22	DNA	83%	142,500	1,876,164	18.40	14.21	19.88	18.49	Reconnect: Incorrect forecast	-	-	
TLG	Manikaran	50	1.01	14.13	0.99	13.22	DNA	83%	876	491,999	4.97	4.97	2.75	9.22	Reconnect: Incorrect forecast	-	-		
	Reconnect		50	0.28	3.61	0.27	3.58	100%	94%	5,335	233,227	2.00	6.51	4.25	10.88	Reconnect: Incorrect forecast	-	-	



DSM regulations in India
Lack of uniformity

DSM regulations in India

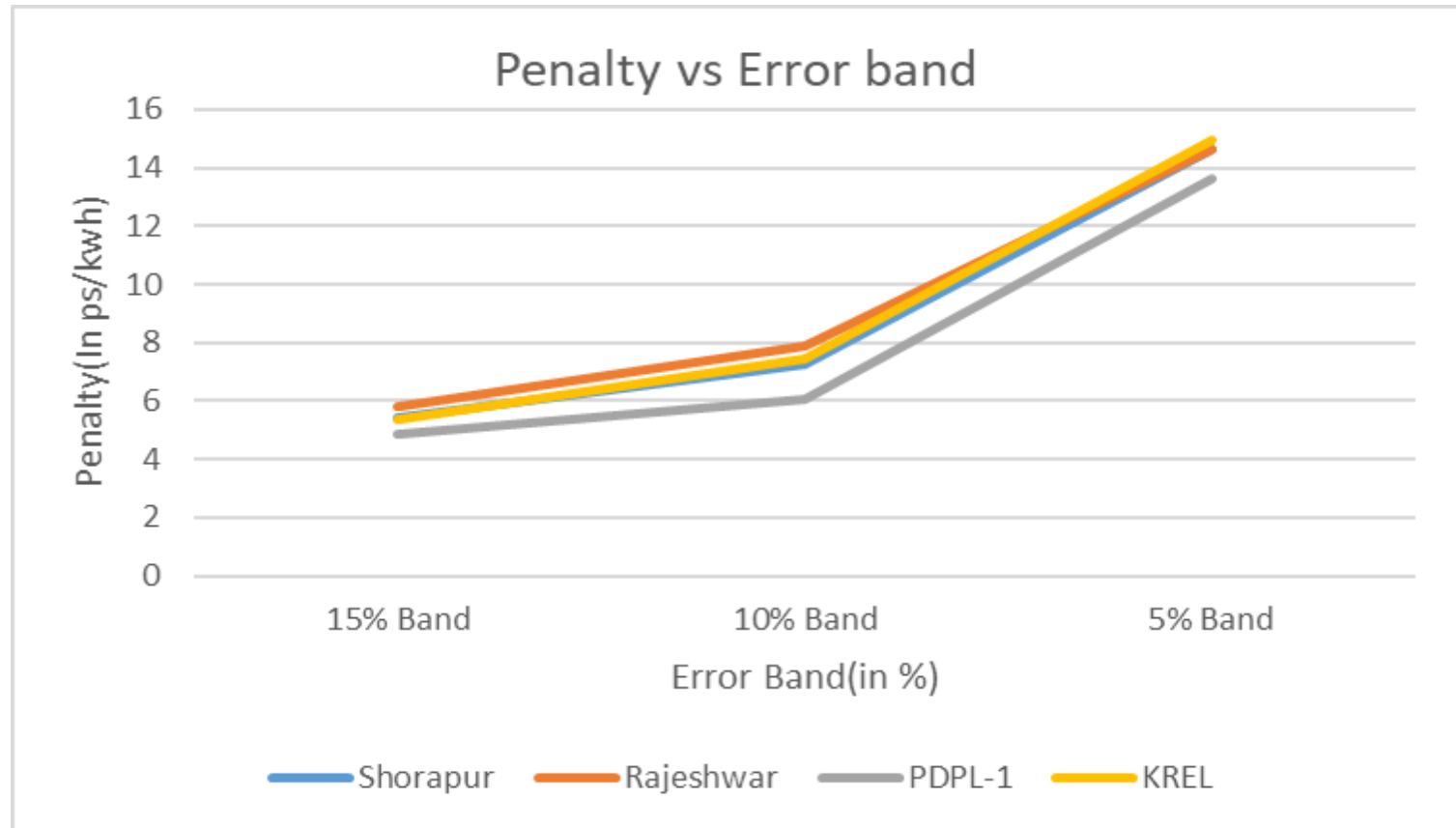
Regulations	Applicability	Aggregation of multiple PSS	Error Based on	Permissible Deviation	Charges on Deviation	Revisions permitted	Implementation procedure status
For - Model Regulations	All	Yes	Available Capacity	+/- 15% Old +/- 10% New	Fixed rate of Rs./Unit	Every 1.5 hours	NA
CERC Inter State DSM 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

DSM regulations in India

Regulations	Applicability	Aggregation of multiple PSS	Error Based on	Permissible Deviation	Charges on Deviation	Revisions permitted	Implementation procedure status
Punjab	$\geq 5\text{MW}$	No	Available Capacity	15% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Draft Procedure issued
Jharkhand	$\geq 5\text{MW}$	Yes	Available Capacity	15% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Not issued
Gujarat	$\geq 1\text{MW}$	No	Available Capacity	+/-12% for Wind and +/-7% for Solar	Fixed Rat of Rs/unit	Every 1.5Hours	Draft Procedure issued
Uttar Pradesh	$\geq 5\text{MW}$	No	Available Capacity	15% for all	% of PPA	Every 1.5Hours	Not issued
Tamil Nadu	$\geq 1\text{MW}$	No	Available Capacity	10% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Draft Procedure issued
Haryana	$\geq 1\text{MW}$	No	Available Capacity	10% for all	Fixed Rate of Rs/unit	Every 1.5Hours	Not issued

State regulations vary between states, and deviate from FOR/CERC recommendations

Case study - Reducing the deviation band from 15% to 05%



Current weather forecasting technology doesn't even support the 15% deviation band

Rajasthan - DSM for wind and solar

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.

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.

Maharashtra - Petition by NSEFI 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



Policy Recommendations

Performance for Solar Projects in Karnataka

Plant Name	Cap (In MW)	Penalty(in Paise/kwh) MTD									Penalty Aggregation(In ps/kwh) YTD	Penalty(In ps/kwh)YTD
		May-18	June-18	July-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19		
Shorapur	20	6.70	9.24	12.31	13.75	8.81	4.04	3.23	2.70	0.50	0.07	6.81
Rajeshwar	50	17.38	9.29	12.01	11.79	14.54	3.54	4.36	6.98	4.82		9.41
Periyapatna	20	10.85	15.09	12.51	14.64	5.76	7.67	4.28	4.14	1.02		8.44
T Narsipura	20	2.82	9.43	6.77	8.47	2.97	4.47	5.52	3.09	2.08		5.07
Bagewadi	20	4.72	9.09	8.10	12.57	8.51	7.88	6.40	2.94	0.61		6.76
Maaluru	20	13.35	8.68	13.67	10.36	11.31	7.07	7.20	4.52	2.53		8.74
Tiptur	20	DNA	DNA	DNA	9.47	11.77	6.55	3.56	4.66	2.13		6.36
K R Pet	20	6.01	9.20	11.11	10.70	6.16	3.96	3.68	3.67	0.89		6.15
Ramnagar	20	DNA	DNA	9.88	22.73	0.13	25.35	6.36	3.11	5.95		10.50
Channapattana	20	DNA	12.27	15.78	11.42	9.09	4.49	4.41	4.50	1.41		7.92
Gubbi	20	10.10	4.34	7.08	9.60	8.60	3.84	1.69	2.00	5.09		5.82
Kallur	50	DNA	0.46	5.76	12.70	14.04	7.52	5.21	3.10	2.80		6.45
Magadi	20	DNA	DNA	12.69	40.08	6.01	4.05	4.97	5.15	1.98		10.70
Yatnal	50	5.51	7.21	12.88	13.75	10.64	3.07	3.75	2.18	1.71		6.74
Maskal	50	9.90	10.40	15.90	14.59	7.35	2.29	1.99	5.14	1.79		7.70
Nalwar	40	8.00	8.70	14.60	14.32	11.45	5.18	3.66	4.60	1.04		7.95
Yadgir	50	8.70	11.90	9.00	11.72	9.76	6.27	7.50	3.79	3.45		8.01
Madhuhavali	100	2.20	6.40	8.40	10.06	6.18	5.88	6.82	5.25	1.17		
Holenarasipura	20	5.79	6.60	7.62	8.35	7.44	4.63	4.45	3.60	1.36		5.82
Byadagi	20	3.91	10.04	10.55	9.42	5.57	6.67	3.68	7.99	5.04		5.54
Jevargi	20	7.00	9.90	14.20	13.99	7.19	3.84	3.71	3.00	0.66	6.99	
											7.06	

Aggregated Penalty in ps/kwh, SCADA Availability- 100%

Note : Portfolio considered for Aggregation is of 2000MW at QCA level.

Uniform DSM (Frequency linked UI) across all generation across states/regions

- ❑ RLDC's/SLDC's to bifurcate net DSM account at State/Regional level due to -
 1. Deviation on the demand side
 2. Deviation on the generation side
 - a. Deviation on account of conventional plants
 - b. Deviation on account of renewable plants

- ❑ Deviation on account of renewable plants can be apportioned as per below mechanisms-
 1. Weighted based on Connected capacity (MW)
 2. Weighted based on Actual generation (kwh)
 3. Weighted based on the %Error in schedule (% Error)
 4. Weighted based on the frequency based DSM charges applicable at plant level.

Central forecasting instead of decentralised

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.

Separate DSM for RE plants (wind and solar)

❑ 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.

Separate DSM for RE plants (wind and solar)

❑ 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

- ❑ Currently **only a penalising mechanism exists** for deviation by RE generators, whereas in case of Thermal power, deviation is incentivised if it supports grid stability. Similar treatment to be extended to the RE power under DSM Regulation.

Separate DSM for RE plants (wind and solar)

- ❑ **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 RE plants (wind and solar)

❑ 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.

- Levy of irrational DSM charge will further burden the RE generator, which in turn will be built up in the Tariff quoted in case of new plant and old plant will claim in the 'Change in Law' under the PPA in the states in which regulation are notified post effective date.
- Rather than being a threat to grid , RE plants can provide valuable ancillary services like immediate frequency and quick ramp-up in case of shortfall.



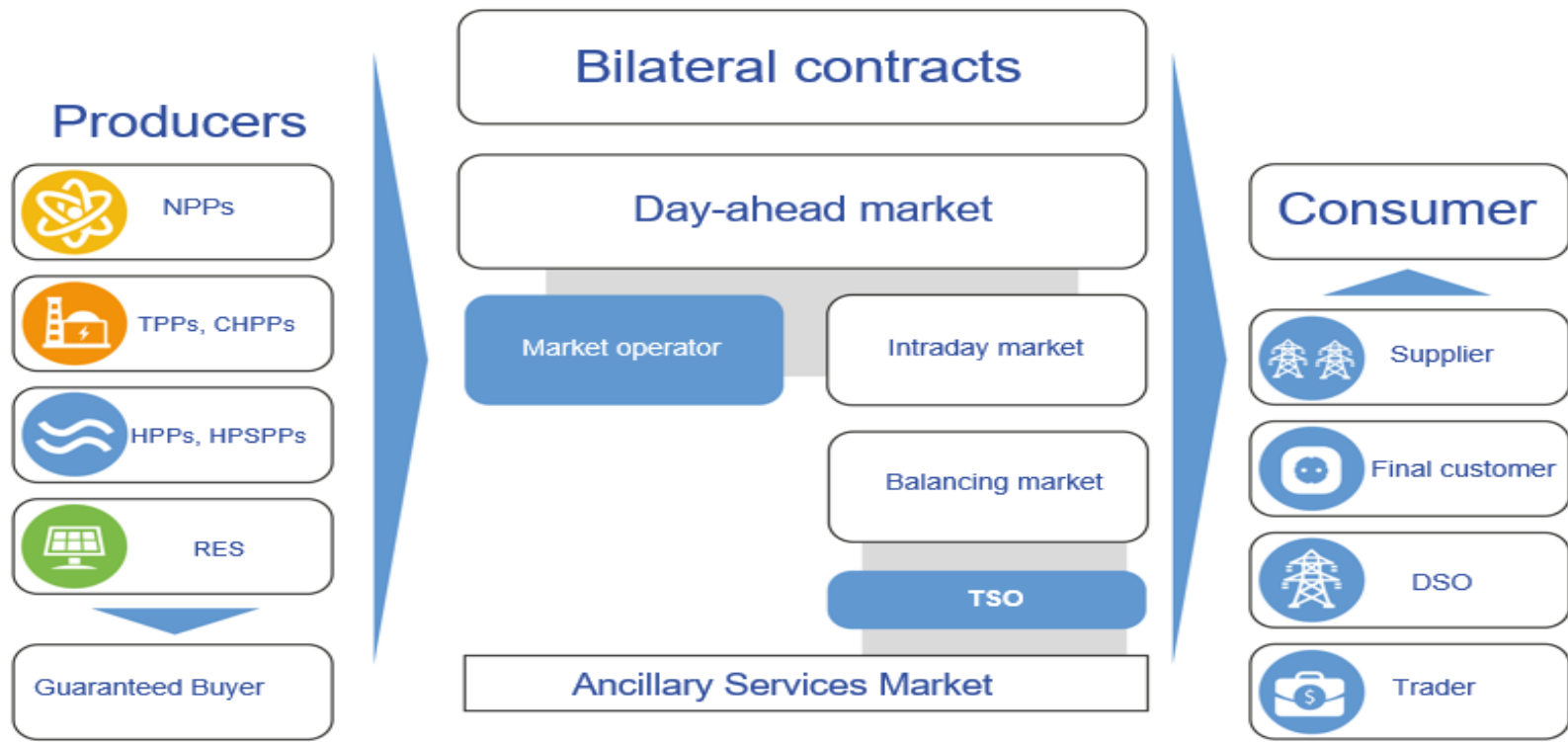
Thank you

National Solar Energy Federation of India



Anexe Global Market Mechanisms

European Energy Markets- Market Mechanism



1. Day ahead Markets-

- Auctions takes place every day (for 24 hrs interval) for trading the following day.
- Gate closure time varies from 11AM to 3PM day-ahead for different European countries.

2. Intraday Markets:

- They operate after the gate closure of day ahead markets
- Gate closure time ranges from 5-60 Mins for different countries before final operating hour.

European Energy Markets-Market Mechanism

2. Intra day markets contd...

- They are further categorized in to two for different European countries:-
 - Discrete- Combined price of bids from various generators are obtained and the lowest offered price is cleared 1st. Eg- Spain, Italy and Portugal.
 - Continuous- Operates on 1st come 1st serve basis. Eg-Belgium, Netherland, Sweden, Norway and Denmark.

3. Balancing Markets-

- The uncertainties in electricity trading are adjusted through balancing markets, where in imbalances are settled through following price system:-
 - Two price system- Different pricing for aggravating and reducing imbalance.
 - Single price system- Same price for aggravating and reducing imbalance.

European Energy Markets- Imbalance calculations for Generator and Consumer

Country	Day ahead Markets (Schedule Granulite)	TSOs	IB Settlement	Imbalance settlement for Renewable Energy Sources	Imbalance Positions for generation and consumption
Spain	60 Mins	Red Eléctrica de España	Two price system	Imbalance is calculated at the TSO level	Separate imbalance position for Generation and consumption
France	30 Mins	RTE France	Single pricing system	Imbalance settlement is exempted for Renewable Energy Sources	Same imbalance position for Generation and consumption
Belgium	15 Mins	ELIA	two price system	Imbalance is calculated at the TSO level	Same imbalance position for Generation and consumption
Netherland	15 Mins	TenneT	Single pricing system		
Germany	15 Mins	50 Hz,			
Austria	15 Mins	TRANSNETBW GmbH			
Poland	15 Mins	PSE	two price system		
Italy		TERNA	two price system	Imbalance is Calculated for each consumption or production unit	NA
Portugal		REN	NA	Imbalance is calculated by imbalance area.	NA
Sweden	60 Mins	Svenska kraftnat	Two pricing for generation and single pricing for consumption	Imbalance calculated at the TSO level	Separate imbalance position for Generation and consumption
Norway	60 Mins	Statnett			
Denmark	60 Mins	Energinet			

European Energy Markets- Exemptions for Renewable Energy source in imbalance settlements

- Renewable energy sources are exempted from paying imbalance charges for following countries in Europe:-
 - 1.France
 - 2.Slovakia
 - 3.Hungary
 - 4.Lithuania
 - 5.Serbia
 - 6.Monaco

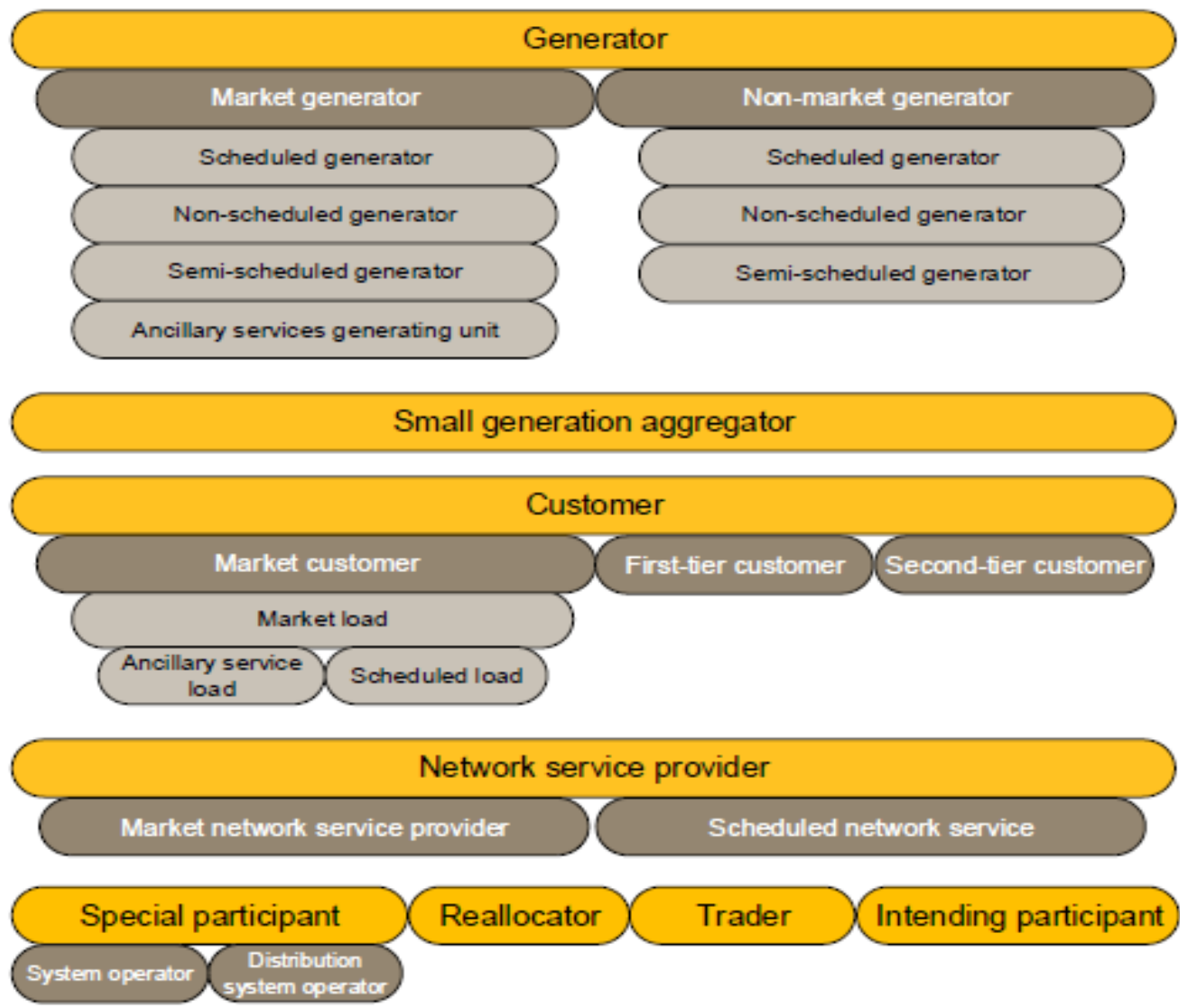
California Forecasting and Scheduling

Name	Type	Resolution / # of stations	Time step	Real Time?	Accuracy for GHI
GOES	Satellite	1 km	15 min	Yes	Low
NOAA ISIS	Ground GHI, DNI, DIF	1 (Hanford)	3 min	Yes	Medium – High
NREL MIDC	Ground GHI, DIF	2 (LA, Rancho Cordova)	1 min	Yes (30 min)	Medium – High
CIMIS	Ground GHI	134	1 h	No (1x / day download)	Medium
NOAA ASOS	Cloud height and density	82 (airports)	10 min	Yes	Low
CSI PBI	PV output, some GHI	>2070	15 min	No, NDA required ¹	Low
UCSD Sky Imager	Sky Image	50 m	30 sec	Yes	Low

- In California state , the Root mean square error of at least 20% and as high as 40-60% has been seen while using the NWP forecasting model inspite of having their regional forecasting models which converts NWP data to Higher Resolution.
- Solar forecast quality dramatically improves when several sites are aggregated over a region (e.g. Lorenz et al. 2009), because average cloudiness in a region can be forecast more accurately than cloudiness at a particular site

In California there is no mechanism as such to penalize wind and solar generators. Although they are required to provide forecast day ahead forecasts on hourly basis in 5 mins interval for UT projects, but is an estimate only not the contractual obligation.

Australia-Energy Markets:-Market Mechanism



- Broad categories of Australian Market:-
1. Market Based- Buy - sell from/to TSOs.
 2. Non- Market Based- Buy sell from/to retailers/consumers directly.

Market Operator- Australian Electricity Market Operator(AEMO)
 Governing rules for market operations- Whole sale electricity rules-2004

Australia-Energy Markets:-Types of Generators and Customers

Generator Types:-

- Scheduled Generators-
 - Generator having capacity >30 MW
 - Participates in central dispatch process by AEMO
- Unscheduled Generators-
 - Generator having capacity <30MW.
 - Doesn't participate in central dispatch process and its generation is for local use.
- Semi Scheduled Generators-
 - Generator is considered semi scheduled if he doesn't fall in above categories.
 - AEMO can limit their power in response to network constraints.

Consumer Types-

- Retailers
- End users

All retailers and end users shall be registered as market consumer to buy power from spot markets. End users buying power from retailers are again categorized into 1st tier, 2nd tier customers.

Australia-Energy Markets-Energy Forecasting

- Projected assessment of system adequacy (PASA) is a tool Managed by AEMO
- PASA manages the forecast of overall balance of supply and demand for electricity.
- Inputs to PASA-
 - *Bids from market participants which includes forecasts for each 5 mins interval on day ahead basis.*
 - *Past and current demand trend from customers.*
- PASA creates its own forecast as reference for Generator forecasts and clear the bids of generators based on the merit order and the market demand.
- If Generator feel they need to alter generation, they can rebid generation volume but not price to actual time of dispatch.
- **No penalties are payable by generators for deviation against schedule.**

Payment Mechanism:-

Region	Capacity charges	Energy charges
Western Australia	Yes	Yes
Eastern Australia	Not applicable	Yes

Table- Charges for power sale

- Payment for the bids cleared are done on –
 - Capacity charges(fixed charges for an available capacity).
 - Energy charges(based on energy produced).
- The above charges for are applicable to different regions as per above table.

Wind and Solar Power Forecasting Practice in Germany :

GIZ Report : An Indo German Technical Cooperation

- The German power transmission system is subdivided into four areas, each of them run by one of the TSOs Tennet, Amprion, 50Hertz, and TransnetBW. As they are responsible for grid operation within their respective control area they also are demanding for high-quality RE forecasts for these given areas.
- The Renewable power generators are must-run-plants according to the Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG). Due to the EEG system, single power producers are not in need of having high-quality forecasts, to be precise, of no forecasts at all. The need for forecasting then is purely due to economic constraints.
- TSOs have set up their own forecasts to validate the forecasting agencies accuracy. As mentioned in GIZ Report ,**Although all the RE forecast systems are capable of delivering forecasts on any spatial scale down to single generation plants, the majority of today's services –and all forecasts serving control zone operation – is providing regional forecast products. Single site forecasting yields much poorer performance figures in terms of accuracy.**

Regional Level forecasting yields higher accuracy