Comments and Suggestions on Proposed Framework for Forecasting, Scheduling & Imbalance Handling for Renewable Energy (RE) Generating Stations based on wind and solar at Inter-State Level

Comment 1: Referring to page 5, paragraph 1; ***"It is undestood that the Renewable Energy Management Centers (REMCs) are being established and these would be equipped with advanced forecasting tools."***

> **This is just a proposal and no concrete idea as to whether it will be run by Discoms or private bodies and what their responsibilities and authorities are, who will fund such centres, both in terms of establishment and operations. What kind of staffing will be done, what should be the manpower structure and so on. It is my experience that to set up a quasi government set up it takes eons of time and success rate of such establishments is also not very high. Last time the idea of 'coordinators' was initiated and it all came to be a cropper because there was no value addition that could be expected.**

Comment 2: Referring to page 5, paragraph 2; ***"There may be a maximum of 16 revisions for each fixed one and half hour time slot starting from 00:00 hours during the day (as against 8 revisions currently allowed as per IEGC 2010)."***

It is our experience that many SLDCs neither were prepared nor receptive to work in an IT enabled environment nor were willing to see our point.

Comment 3: Referring to page 6, last paragraph; **"*If the tariffs for wind and solar generation are assumed to be in the range of ₹. 5/kWh and ₹. 7/kWh respectively"***

The importance of this is that SERCs fix tariff by their own yardsticks and may not agree with recommendations from centre. It has a big impact on the ROI. As a matter of fact, the present average tariff is found to be around ₹4.3 /KWh. The impact of the tariff on the financial burden due scheduling is quite crippling as demonstrated in table 1.

Comment 4: Referring to page 7, paragraph 3; ***"If the actual generation is in the range 88% to 100% of schedule, the wind/solar generator would pay for the shortfall energy @ ₹. 3/kWh (may be reviewed periodically by the Commission through an Order) to the DSM Pool. In addition, the wind/solar energy generator would buy RECs (equivalent to the shortfall energy) and transfer them to the buyer to enable it to fulfill its RPO obligation. Assuming the current market rate of REC at ₹. 1.50/- per unit for non-solar and ₹ 3.50 per unit, the outgo for a wind/solar energy generator [₹ 3 plus ₹ 1.50 per unit (assumed REC price) for wind energy generator and ₹ 3 plus ₹ 3.50 per unit assumed REC price for solar energy generator] would be less than what it earns based on scheduled generation [₹ 5 per unit for wind energy generator and ₹ 7 per unit for solar energy generator (assumed wind and solar tariffs respectively)], if it***

operates within 12% deviation. This is being consciously allowed to motivate the Wind/Solar energy generator to remain within the desirable band of 12% deviation. This can be treated as an incentive for better forecasting."

The price of non-Solar REC varies depending upon the demand and supply for REC's. The proposed CERC framework may engender demand for the REC's, thus increasing its price. Therefore, if it for example trades at a rate above ₹2 /KWh will dis-incentivise the Wind power producer. This is huge blow to the fundamental framework itself, because the generato₹ are at loss even when they are well within the range of ±12%.

General Comment: The REC market in India should have healthy demand. But this demand remained theoretical as many of the obligated entities didn't comply with RPO requirements, mainly due to the lack of stringent penalty mechanism. Due to this lower demand, the market has been trading at the floor price and even at this price only a small portion of total offered volume is getting cleared.

http://timesofindia.indiatimes.com/home/environment/developmental-issues/Over-1-crore-renewable-energy-certificates-unsold-at-IEX/articleshow/46812047.cms - Over 1 crore renewable energy certificates unsold at IEX (dated 5th April 2015)

The above reference, a very recent article from Indiatimes shows how the RE generators are being affected by the sluggish demand for REC's, hence linking Forecasting and scheduling of RE generators with REC-RPO mechanism is probably going to put entire investment in a quandary and seriously discourage future investments.

Comparative study between newly proposed CERC framework and Prevailing scenario:

Forecasting and scheduling has been in place for a while now and enough information has been gathered. A sample calculation has been made for a typical Windfarm (100 MW) using all the regulations of imbalance handling by assuming Tariff as ₹ 5/KWh and ₹ 4/KWh with Non-Solar REC rate as ₹ 1.5/KWh. The summary of the calculation is presented in Table 1 and Table 2.

Forecasts are made available to the generators every hour with confidence intervals of P90 to P10 or any other confidence intervals demanded by the generator. Based on past experience the generator would provide schedules to the concerned SLDC. In this exercise, we have investigated the results from a fully functional wind farm of about 100 MW for two consecutive years. We have considered one, two and three hour forecast horizons to carry out the analysis. Table 1 shows the net loss of revenue generator would suffer on account of schedules provided at different confidence limits as per the new policy proposed. Frequency is not a factor here.

It can be seen that what ever value is given as schedule, the generator is bound to lose part of his revenue. By and large P50 appears to be the best fit number to use if the tariff of of ₹4/- while attracting heavier penalties. The tariff of ₹5/- shows a trend of minimum penalty for over optimistic schedules and conservative schedules attract heavier penalties. Such a situation creates a certain bias against getting better forecasts.

Confidence interval	Period	Percentage Gain or Loss with different forecast horizons					
		3 Hour		2 Hour		1 Hour	
		Tariff @ ₹ 4/KWh	Tariff @ ₹ 5/KWh	Tariff @ ₹ 4/KWh	Tariff @ ₹ 5/KWh	Tariff @ ₹ 4/KWh	Tariff @ ₹ 5/KWh
P10	1st April 2013 to 31st March 2014	-21.4	-6.8	-20.0	-5.1	-19.4	-4.4
	1st April 2014 to 31st March 2015	-19.5	-4.0	-19.5	-4.6	-19.3	-4.3
P25	1st April 2013 to 31st March 2014	-16.9	-6.9	-15.3	-5.0	-14.5	-4.2
	1st April 2014 to 31st March 2015	-14.7	-4.2	-14.7	-4.7	-14.4	-4.3
P50	1st April 2013 to 31st March 2014	-13.6	-10.4	-11.5	-8.3	-10.4	-7.3
	1st April 2014 to 31st March 2015	-11.6	-8.5	-11.5	-8.7	-10.9	-8.1
P75	1st April 2013 to 31st March 2014	-19.6	-21.2	-17.8	-19.5	-17.0	-18.7
	1st April 2014 to 31st March 2015	-19.0	-21.0	-18.9	-20.9	-18.2	-20.2
P90	1st April 2013 to 31st March 2014	-27.9	-31.5	-26.7	-30.3	-26.1	-29.7
	1st April 2014 to 31st March 2015	-28.8	-32.6	-28.6	-32.4	-28.0	-31.9

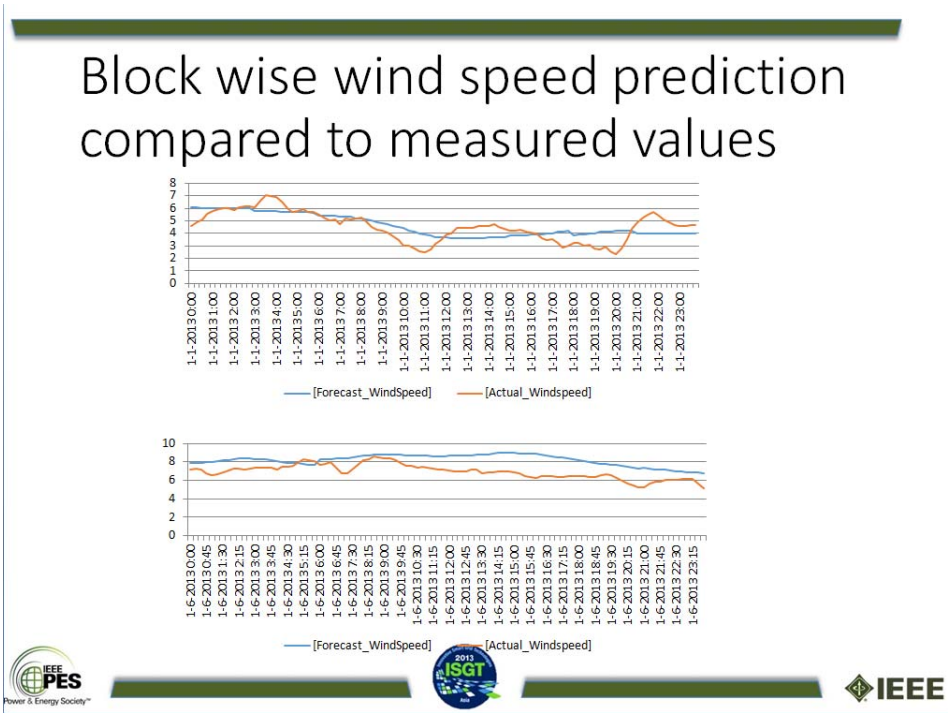
Table 1: Loss or Gain in Percentage for Different Forecast Horizons

Confidence interval	Period	Percentage Gain or Loss			
		Newly Proposed CERC Framework (3 Hour Revised)		RRF Mechanism (3 Hour Revised)	
		Tariff @ ₹ 4/KWh	Tariff @ ₹ 5/KWh	Tariff @ ₹ 4/KWh	Tariff @ ₹ 5/KWh
P10	1st April 2013 to 31st March 2014	-21.4	-6.8	11.7	8.5
	1st April 2014 to 31st March 2015	-19.5	-4.0	14.6	11.5
P25	1st April 2013 to 31st March 2014	-16.9	-6.9	6.3	4.1
	1st April 2014 to 31st March 2015	-14.7	-4.2	8.9	6.8
P50	1st April 2013 to 31st March 2014	-13.6	-10.4	-1.9	-3.0
	1st April 2014 to 31st March 2015	-11.6	-8.5	-0.3	-1.2
P75	1st April 2013 to 31st March 2014	-19.6	-21.2	-12.3	-13.5
	1st April 2014 to 31st March 2015	-19.0	-21.0	-12.3	-13.4
P90	1st April 2013 to 31st March 2014	-27.9	-31.5	-21.6	-23.7
	1st April 2014 to 31st March 2015	-28.8	-32.6	-23.0	-25.3

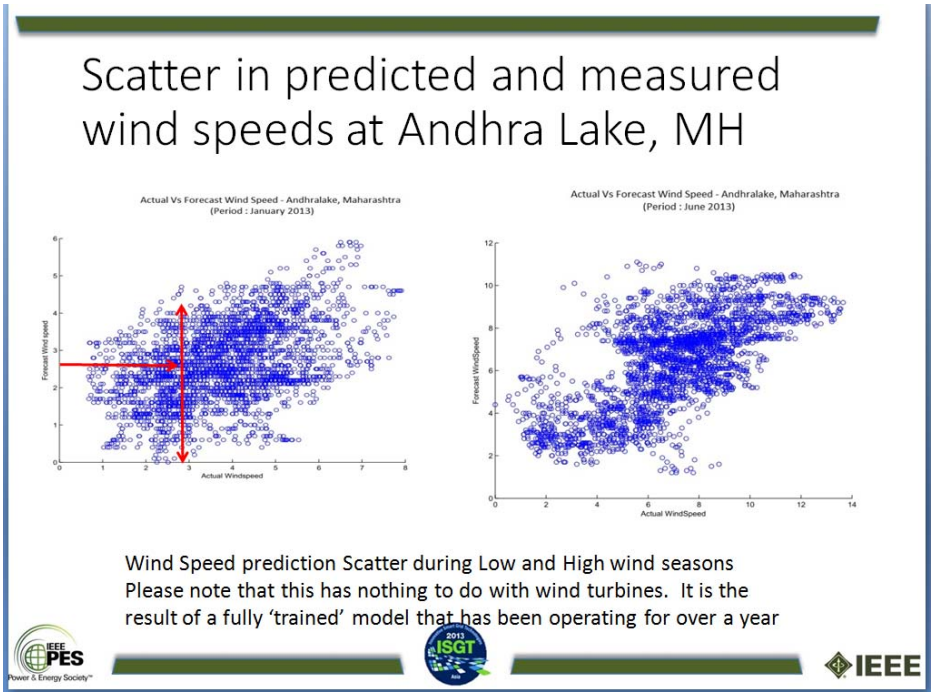
Table 2: Loss or Gain (in %) – A Comparative Analysis between RRF Mechanism and Newly Proposed CERC Framework

These comments will be incomplete if we do not make some comments about the fundamentals of wind power forecasting science that most of us would like to turn a Nelson's eye to. It is something that stands to reason. The observations given below are from actual field measurements.

Predicted wind speeds versus measured wind speeds in a typical wind farm



This kind of non conformity results in a correlation of predicted and actual wind speeds in to this situation



Important points to note are the following

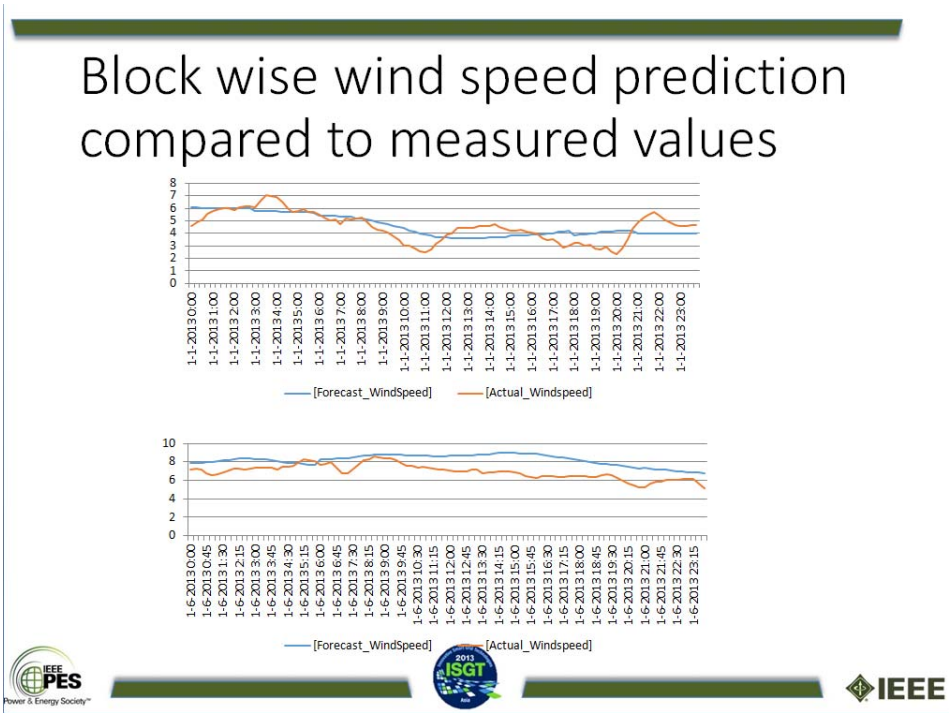
This has nothing to do with wind turbine technology. It is purely because of the issues with global circulation modelling over which wind power producer has absolutely no control for the following reasons.

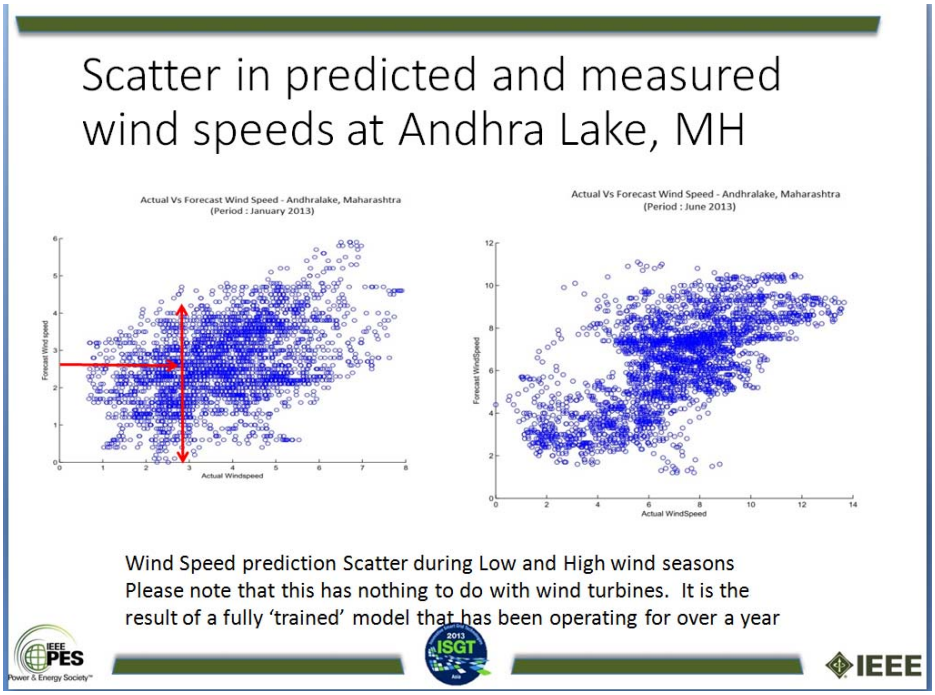
1. Existing forecasting systems are not sufficiently accurate due to a variety of reasons. Firstly it depends on Global Circulation Models which take inputs from meteorological data from all over the world and create synthetic data sets at a large number of grid points at various heights above the mean sea level for the entire earth. Where there is no data or poor quality data, the synthetic data set depends on approximations and values are asigned rather than computed. This is done in such a manner that it is somehow consistent with other data rich grid points.

2. Global circulation models use the meteorological information provided by the met departments both for calibrating and reinitializing the model run. These models are written in such a manner that they can accept any and all data sets. Indian data sets are by and large from the IMD network of observatories and meteorological stations. These stations collect meteorological information at what are known as synoptic hours (maximum of 8 readings per day in first class MET stations). Few stations keep continuous records but not shared. The automatic weather stations get purely surface data and they are not fully and properly operational. They are installed at population centres with anemometer and direction vanes at about 2 m level from ground. Such data may be useful, but cannot be employed for the forecasting purposes. At best, they can be used as indicative data.

3. Regarding forecasting, some service provider claimed that forecasts can be with 10% accuracy without defining how accuracy is calculated. This was taken as what was possible without inquiring into the matter.

4. The down scaling (that is, from the grid points - typically 250 x 250 km or finer grid to the wind farm location) is carried out by meso-scale models which also have large uncertainties. Considerable time is spent in getting what is known as an emperical relation between global data sets and wind farm specific projections. While this is sufficiently robust, the input data itself has an issue. Just to illustrate the falacy in the arguments that providing better forecasts and schedules are entirely the responsibility of wind farming community. We are presenting a couple of graphs from actual measurements:





It can be easily seen how things happen in real world. The consequence of this is that about 25 to 40% of the time one gets the for 3 hour ahead forecasts with in ± 30% of absolute error. This can only change if the meteorological data collection and analysis system changes. It is neither practical nor fair to wind power industry to expect them to produce better quality forecasts.

Better meteorological measurements (essentially carried out by IMD under Ministry of Earth Sciences) are required as this data is a primary input to the Global Circulation Models (WRF, MM5 etc.)) for initializing and reinitializing models and calibrating them. Putting the industry under a lot of pressure will never yield desired results. Nevertheless that is what is being done.

An intra-governmental discussion must be initiated to sensitize NCMRWF[1] and IMD about the need to have better quality measurements than what we have today to get better quality forecasts. As a matter of fact, they are perhaps best positioned to set up limited area high resolution(spatially and temporally) NWP processes that can resolve one of the major bottlenecks in forecasting which are not addressed by any of the currently used global circulation models. This major bottleneck has never received necessary attention. NWP outputs are refreshed once in six hours. Though most of the forecasters give 15 minutes forecasts, these numbers are based on statistically consistent sequences but not really results of any analytical equations. To run global circulation models for all regions with higher temporal and spatial resolutions is not practical at least for wind power producers. This point does not appear to have any impact among the blinkered policy makers.

Third major area that is not clearly stated by the grid managers is that their fundamental needs are to manage grid over seconds to minute balancing of grid I/O is not addressed by any of the currently practiced forecasting and scheduling processes. They are all tailored for commercial settlement. They normally use this to challenge the wind sector to provide good forecast or else...' On a number of occasions I have personally appealed to the powers that be to use efficient and automated processes for data acquisition.

[1] National Centre for Medium Range Weather Forecasting under Ministry of Earth Sciences. They are primarily engaged in short term forecasting and monsoon prediction.

Forecasting and Scheduling even at the current levels of accuracy can provide a very good basis for planning for next time blocks providing that:

1. Forecasting and scheduling on a regional basis makes better sense both scientifically and management wise.

2. wind farm wise substation data to be ported to a server at the load dispatch centre

3. forecasts for each control areas are summed up on a 15 minute block level.

4. A sample Combined display (figure 2) is to be provided for the grid manager to visually see the relationship between forecasts and actual generation and make considered decisions quite accurately. Over a short period they will know which way the generation will go and make necessary adjustments.

With the uncontrollable and unknown financial implications it was quite a hard situation. Each state had their own ways of approaching the problem. On several occasions it was suggested that the data acquisition must be an automated process and proper systems must be set up, Cyber security was quoted as the reason for not accepting information via ftp. This happens in India, which is a leader in IT! In fact data is being sent by public email systems (gmail, hotmail etc.) and no one knows if there are any DBMS that receive, analyse and archive information. Though CERC had allowed revision 8 times in their RRF mechanism, many states looked at one day ahead forecast and left it at that. In some states they did not even ask for data to be sent. I think they just use EXCEL! Unfortunately they all speak from the position of power and no one wants to take them on for the fear of inviting their wrath!

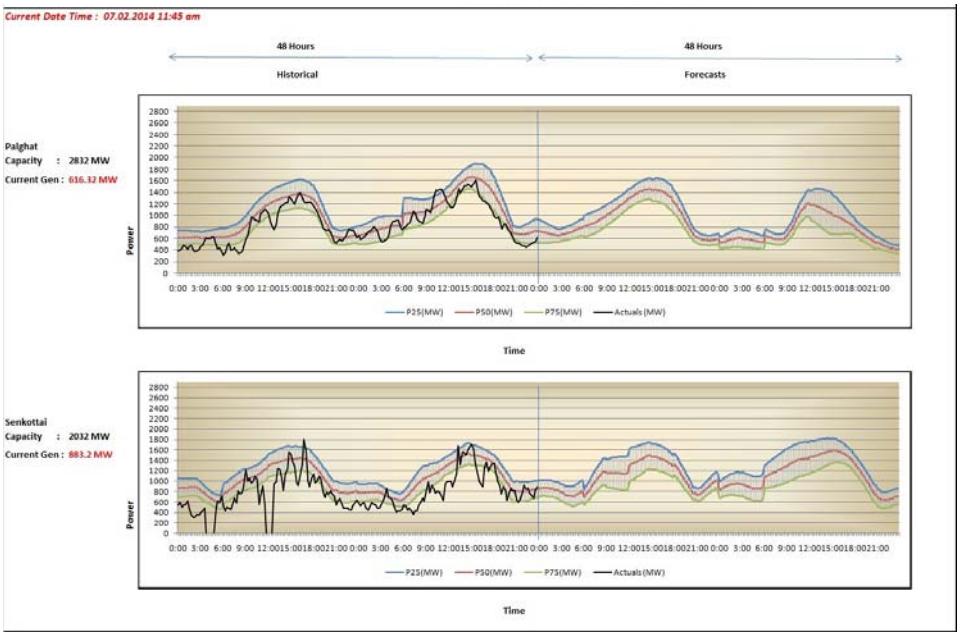


Figure 2. Possible display that can be set up at the LDC

The need of the hour is to

- We need to move away from approach of control by commerce. If the atmosphere must be cleared, the Demoiselles sword must be kept away and do what is technically needed. At this time, if a fee is charged to carry out centralized forecasting to assist the grid manager's

work, I do not think that wind investors would hesitate to participate. What everyone is afraid is about the unknown financial implications over which no one has any control.

- Support to RE should not begin and end in the preamble. It should find expression in overall energy planning.
- Compartmentalized (NIMBY) thinking must stop. (blame it on Rio..!). Even today the situation has not changed very much. They still buy much more expensive energy and reject cheaper alternatives.
- Create un-ambiguous, non-controversial set of rules for interstate and intra-state energy transport specially tailored for RE technologies. It should not be the burden of wind or solar generators. There should be good bit of transparency in the grid management with regard to RE technologies. States should have uniform policies to the extent feasible.
- Have automation that includes RE in a more efficient manner.

It is interesting to note that EU grid(3200 GW) on which 200 GW wind power is connected has a 3 GW of balancing power. This should be seen in the light of what our grid managers perceive. A recent publication prepared by NIAS[2] in collaboration with POSCO speaks of 1 GW pumped hydro to balance a 7.3 GW input from Solar and wind. I am reproducing the following text from the executive summary:

"..... we developed a method of estimating the hourly unrestricted demand and the likelihood of meeting bulk of it from conventional sources available then and the reminder from renewable sources. Our primary objective is to reduce load shedding economically and without pollution."

The mindset is: RE will always be used for meeting short falls and nothing more. This is a complete anti-thesis of public pasturing. It is a well accepted principle that RE technologies are to be used to the maximum to minimize pollution and use of polluting conventional sources must be minimized!

Respected Sir, Since I am not part of any currently circulating founts of knowledge, I thought I will share my concerns with you directly and hope to get an echo in terms of some actions in the right direction. I do not profess that I have the answers for all questions. I am just trying to bring in some reality check.

Thank you for the patient reading.

Sincerely Yours,

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cc:IWTMA

[2] Wind & Solar Energy for meeting Karnataka's future Electricity Demand, March 2015, NIAS in association with POSCO