Chapter - IV

Wind Power

1. Introduction

India is a wind-rich country with quality, harvestable wind potential. Monsoon patterns and geography of India play a major role in the Indian wind climatology structure. Indian geography - a mixture of elevated plateau, hill blocks, passes and coastal plains, aid the monsoons, especially the Southwest monsoon to earn harvestable wind potential. Due to this, States like Andhra Pradesh, Gujarat, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu are endowed with rich wind energy potential. Wind power is the fastest growing Renewable Energy (RE) source in India. With an installed capacity of about 21,137 MW as of March 2014, it constitutes 67 *per cent* of the total RE capacity in India.

2. Assessment of Wind Potential

National Institute for Wind Energy[1] (NIWE) in association with Riso DTU, Denmark has developed Numerical Wind Atlas[2] of India at 50 metre (m) and 80 m mast[3] height which was published in April 2010. The Wind Resource Assessment (WRA) programme was an ongoing activity being co-ordinated by the NIWE in association with State Nodal Agencies (SNAs).

2.1. At 50 meters mast height

For estimating potential at 50 m height, the WRA covered 28 States and three Union Territories (UTs) and involved establishment of about 789 Wind Monitoring Stations (WMS). The total wind energy potential at 50 m mast height was estimated at 49,130 MW.

2.2. At 80 meters and 100 meters mast height

NIWE had commissioned 73 numbers of 100 m high meteorological masts with multilevel measurements in seven windy States to validate and fine-tune the 80 m wind Atlas and estimate and validate potential at 100 m height.

MNRE had also formulated (July 2014) a new scheme for implementation of WRA in uncovered/new areas to assess the realistic potential at 100 m level in 500 new stations across the country. It was to be implemented through NIWE in Public-Private Partnership mode, in association with SNAs and private developers, which was yet to start.

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1 Formerly Centre for Wind Energy Technology, Chennai.

2 Numerical wind atlas methodologies have been devised to solve the issue of insufficient wind measurements. One such methodology is the KAMM/WAsP method developed at Riso National Laboratory, Denmark. Karlsruhe Atmospheric Mesoscale Model (KAMM) and Wind Atlas Analysis and Application Program (WAsP) are used to model the effects on the wind flow over India using modeling domains.

3 Height of pole used for wind studies before a wind turbine generator is erected in its place.

2.3. State Nodal Agency initiatives

During the test check of the records of 24 SNAs, Audit observed that some SNAs in collaboration with NIWE attempted to undertake wind resource assessment with varying degree of success. Audit findings in this regard are reported below.

2.3.1. Jharkhand

Jharkhand Renewable Energy Development Agency (JREDA) in consultation with NIWE had identified eight[4] locations for setting up Wind Monitoring Stations (WMS) which were approved by MNRE. Audit observed that NIWE could not assess the wind potential due to: (i) non furnishing of Wind monitoring data continuously by JREDA for one year as required from WMS at three locations[5]; (ii) At Sakhuapani the WMS could not be operated as the mast was placed at a higher level than required height of 50 m; (iii) WMS at Parasnath and Jhumra hills could not be established for want of forest clearances; and (iv) WMS at Kurta and Hadari in Hazaribagh district could not be established as JREDA did not initiate action for setting up of WMS within three months of issue of instruction (June 2014) by NIWE. In this regard JREDA also furnished bank details to NIWE in January 2015, after a delay of four months, for receipt of first installment of funds.

2.3.2. Bihar

Bihar Renewable Energy Development Agency (BREDA) commissioned (February 2009) three[6] WMS for ₹ 4.50 lakh in consultation with NIWE but these were closed in 2010-11 without submission of any report by NIWE. Three[7] other sites were commissioned but no feasibility or data analysis report was given by NIWE. The SNA stated that there was nothing mentioned in the scheme about giving or buying the report.

3. Potential, target and achievements

3.1. Targets and achievements of MNRE

The targets and achievements of MNRE under the 11th Five Year Plan (FYP) and 12th FYP upto 2014 are given in Table 14 below:

[4] Netarhat (Lohardaga) and Pithoria (Simdega) in 2003-04, Sakhuapani (Gumla) and Metramata (Simdega) in 2005-06, Parasnath and Jhumra hills (Giridih) in 2008-09 and Kurta and Hadri in Ichack (Hazaribag) in 2013-14.

[5] Metramata, Netarhat and Pithoria.

[6] Kaimur, Lalganj and Simultala.

[7] Bodh Gaya (K P Nagar), Motihari (Chikni) and Munger (Shankarpur).

Table 14: Targets and achievement under 11th and 12th FYP

S.No.	Year	Target (in MW)	Achievement (in MW)	Excess(+)/ Shortfall(-) (in *per cent*)
11th Five Year Plan Period (2007-12)				
1	2007-08	1,500	1,663	+11
2	2008-09	2,000	1,485	-26
3	2009-10	2,500	1,565	-37
4	2010-11	2,000	2,349	+17
5	2011-12	2,400	3,197	+33
	Total	10,400	10,259	
12th Five Year Plan Period (upto 2014)				
6	2012-13	2,500	1,700	-32
7	2013-14	2,500	2,079	-17
	Total	5,000	3,779	
	Grand Total	**15,400**	**14,038**	

Source: MNRE. However, data on State wise capacity installed between 2007 and 2014 given by MNRE in Table 15 under para 3 is 14,046 MW as compared with 14,038 MW reported as achievement under 11th and 12th FYPs.

3.1.1. Target setting and achievement under 11th FYP

At the commencement of the 11th FYP period, the wind power capacity installed in the county was 7,091 MW. During the 11th FYP period (2007-12) the target of wind power capacity addition was set at 10,400 MW which was 21 *per cent* of the potential at 50 m mast height. Against a target of 10,400 MW, the achievement in wind power capacity addition was 10,259 MW. As a result of the 11th FYP achievement, and to ensure effective exploitation of wind energy resource, the 12th FYP target has been kept at 15,000 MW which was roughly 1.5 times the 11th FYP target.

As can be seen from Table 14, from 2007 to 2014, in four years there was a shortfall in achievement of the target and in three years there was an excess, and overall there was a shortfall of nine *per cent*. The shortfall in achievement of targets set for the first two years of 12th FYP (2012 to 2014) was 24 *per cent*.

MNRE stated (October 2014) that after the withdrawal of Accelerated Depreciation (AD) scheme by the Ministry of Finance w.e.f. April 2012 the capacity addition gradually decreased in this sector. MNRE further stated (July 2015) that the target for 11th FYP period was originally 10,400 MW which was reduced to 9,000 MW at mid-term appraisal stage.

3.1.2. State wise target and achievement

State wise wind potential of India at 80 m and 50 m mast height as assessed by NIWE, and targets fixed for creation of installed capacity between 2007 and 2014 and the installed capacity as on 31 March 2014 is given in Table 15 below:

Table 15: Wind potential, target and installed capacity

(in MW)

S. No.	State/ Union Territory	Estimated potential		Targets fixed (2007-14)	Installed capacity			Installed capacity as a percentage of potential	
		at 50 m[8]	at 80 m[9] (2010)		Prior to 2007	Between 2007-14	As on 31.3.14	50 m	80 m
1	Andaman & Nicobar Islands	2	365	NA	Nil	Nil	Nil	Nil	Nil
2	Andhra Pradesh	5,394	14,497	NF	123	624	747	14	5
3	Arunachal Pradesh	201	236	NF	Nil	Nil	Nil	Nil	Nil
4	Assam	53	112	NF	Nil	Nil	Nil	Nil	Nil
5	Bihar	NE	144	NF	Nil	Nil	Nil	Nil	Nil
6	Chhattisgarh	23	314	NF	Nil	Nil	Nil	Nil	Nil
7	Diu & Daman	NA	4	NA	Nil	Nil	Nil	Nil	Nil
8	Gujarat	10,609	35,071	NF	637	2,818	3,455	33	10
9	Haryana	NA	93	NF	Nil	Nil	Nil	Nil	Nil
10	Himachal Pradesh	20	64	NF	Nil	Nil	Nil	Nil	Nil
11	Jammu & Kashmir	5,311	5,685	NF	Nil	Nil	Nil	Nil	Nil
12	Jharkhand	NE	91	NF	Nil	Nil	Nil	Nil	Nil
13	Karnataka	8,591	13,593	2,969	822	1,497	2,319	27	17
14	Kerala	790	837	NF	2	33	35	4	4
15	Lakshadweep	16	16	NA	Nil	Nil	Nil	Nil	Nil
16	Madhya Pradesh	920	2,931	3,259	56	367	423	46	14
17	Maharashtra	5,439	5,961	2,100	1,487	2,610	4,097	75	68
18	Manipur	7	56	NA	Nil	Nil	Nil	Nil	Nil
19	Meghalaya	44	82	NF	Nil	Nil	Nil	Nil	Nil
20	Mizoram	NA	NA	NA	NA	NA	NA	NA	NA
21	Nagaland	3	16	NF	Nil	Nil	Nil	Nil	Nil
22	Odisha	910	1,384	NF	Nil	Nil	Nil	Nil	Nil
23	Puducherry	NA	120	NA	Nil	Nil	Nil	Nil	Nil
24	Punjab	NA	NA	NF	Nil	Nil	Nil	Nil	Nil
25	Rajasthan	5,005	5,050	1,400	470	2,316	2,786	56	46
26	Sikkim	98	98	NF	Nil	Nil	Nil	Nil	Nil
27	Tamil Nadu	5,374	14,152	2,400	3,494	3,777	7,271	135	51
28	Uttar Pradesh	137	1,260	NF	Nil	Nil	Nil	Nil	Nil
29	Uttarakhand	161	534	2	Nil	Nil	Nil	Nil	Nil
30	West Bengal	22	22	75	Nil	Nil	Nil	Nil	Nil
31	Others	NA	NA	NA	NA	4	4	NA	NA
	Total	**49,130**	**1,02,788**	**12,205**	**7,091**	**14,046**	**21,137**	**43**	**20**

NA – Not Available; NE- Not Estimated, NF- Not Fixed
Source: MNRE.

[8] The 50 m map was prepared and published in April 2010 after validation.
[9] At 80 m, the estimated potential is to be validated through field measurements.

It is evident from Table 15 above that against an estimated potential of 49,130 MW at 50 m mast height and 1,02,788 MW at 80 m mast height, the installed capacity was 21,137 MW[10] which was 43 *per cent* of the potential at 50 m height and 21 *per cent* of potential at 80 m height. MNRE did not have details of the mast heights at which the capacities had been installed, for better analysis of the extent to which potential had been exploited.

Based on analysis of the data at Table 14 and 15, the following observations are made:

i. Data of targets and achievement, both State-wise and under 11th and 12th FYP, was collected from MNRE. However, discrepancies in the two sets of data were noted. As per State-wise breakup (Table 15), the target for the period 2007-14 for each States aggregated to 12,205 MW whereas for the 11th FYP period and from 2012 to 2014 under the 12th FYP (Table 14) the target was 15,400 MW. Similarly, achievement as per Table 15 for the period 2007-14 was 14,046 MW whereas as per Table 14 it was 14,038 MW, a nominal difference of eight MW.

ii. MNRE did not provide any record based on which FYP targets were set and State wise breakups of the targets. No records were shown to Audit that inputs have been taken from the States in setting these targets. As can be seen from Table 15 above, 17 States (of which three States[11] alone had over 50 *per cent* of the wind energy potential[12], had not fixed any targets during the period 2007-14. Moreover, there was a discrepancy of 3,195 MW in the State-wise targets and FYP targets for the same period (refer point i above). From these observations it appeared that the targets had been routinely set by MNRE without proper planning, analysis, involvement of and communication with the States.

    MNRE stated (May 2015) that it does not fix State wise targets, rather it had a single national target. It further stated that few States based on their own performance, kept annual targets which were same or different from the national targets and this happened because of the fact that Wind Power Projects (WPP) were taken up with private sector investment. Ministry's reply needs to be viewed in the context that MNRE and the States with rich potential of wind energy should work in tandem to ensure significant exploitation of potential for meeting national goals.

iii. At the stage of framing targets for 11th FYP, the wind resource assessment was available at only 50 m mast height and the target set was 21 *per cent* of capacity. By 2010, the India wind Atlas estimated the potential at 80 m mast height at 1,02,788 MW and also the technology to exploit the wind energy at this height was available in the country. It was observed in audit, that the targets set for capacity addition in 12th FYP were a modest 15 *per cent* of potential, which was not adequate to translate Government intent and priority in promoting renewable energy sources as a significant component of the energy mix of the country and a necessity for ensuring its energy security and adhering to

[10] However, as per the records furnished by individual SNAs, the installed capacity totaled to 20,564 MW. The difference was largely in the installed capacity in Madhya Pradesh as recorded in MNRE i.e. 424 MW whereas as per the SNA records, it was only 52 MW.

[11] Andhra Pradesh, Gujarat and Jammu & Kashmir.

[12] At 80 m mast height.

the targets set for 2020 in the NAPCC regarding proportion of RE sources in the electricity consumed in the country.

MNRE stated (May 2015) that the targets were not kept only in view of potential availability. Annual targets were set depending upon feasibility of exploitation of the available potential in a particular year depending upon policy environment and market conditions for bringing private sector investments.

MNRE's reply highlights the need for strategic planning if significant progress had to be made in the Renewable Energy sector since there will always be competing needs and the Government must prioritise this sector both in policy formulation and development strategy.

3.2. MNRE programmes for promotion of wind energy

MNRE from time to time brought out different programmes to promote development of wind energy in the country. The incentives were in form of Generation Based Incentive (GBI) or Accelerated Depreciation (AD) under the Income Tax Act 1961. The programmes and the audit finding on the implementation of each are given below:

3.2.1. Demonstration project

i. MNRE (December 2006) launched Demonstration project for State Governments, for promotion of grid interactive power projects. Capacity of each eligible project was to be greater than 500 kW; not more than one *per cent* of technical potential of State or six MW whichever was less; and in the States where commercial activity had not taken off.

   Under this scheme an aggregate capacity of 71 MW was installed at 33 locations in nine States through State Governments/ SNAs or State Electricity Boards. After December 2006 no new project had been established. However, it was observed that in four[13] States more than six MW was commissioned contrary to eligibility criteria.

ii. MNRE (July 2008) launched the Demonstration programme for the independent power producers with minimum installed capacity of five MW. The scheme was not applicable for captive consumption, third party sale, merchant[14] plants etc.

   Under this scheme, four[15] companies installed 48.9 MW capacity in three States[16]. The GBI of ₹ 27.52 crore had been released by MNRE to IREDA till March 2014 under this scheme and all the UCs had been received.

[13] Gujarat (17.30 MW), Karnataka (7.10 MW), Maharashtra (8.40 MW) and Tamil Nadu (19.40 MW).
[14] A merchant power plant is funded by investors and sells electricity in the competitive wholesale power market.
[15] M/s Generacion Eolica India Ltd, M/s Green Infra Wind Energy Ltd, M/s CLP India Pvt Ltd and M/s Simran Wind Power Pvt Ltd.
[16] Gujarat, Karnataka and Tamil Nadu.

3.2.2. Generation Based Incentive (GBI)

i. MNRE launched GBI scheme (GBI-I) (December 2009) for the 11th FYP with the objective of enhancing generation of electricity from grid connected wind power projects and to encourage investment by project proponents who would not avail of Accelerated Depreciation under the IT Act for making investments in wind power projects.

ii. MNRE further extended (September 2013) retrospectively from April 2012 the scheme (GBI-II) for continuation of GBI during for the 12th FYP period with the same objectives.

Audit observed that under the GBI-I scheme, 167 projects of 2,230 MW capacity were registered. Under GBI-II scheme, 176 projects of 2,749.40 MW had been registered till September 2014.

3.2.3. Accelerated Depreciation (AD)

The installation of commercial wind power projects along with energy from other RE resources had been promoted by MNRE since the early 1990s through fiscal incentives also which included Accelerated Depreciation (AD) under the Income Tax Act 1961. Under the AD provision investors were allowed to claim 80 *per cent* of the gross block as depreciation in the first year of installation of a project. This substantially reduced their stated income for income tax purposes during the year, thereby deferring income tax payout. This provision was attractive to companies, investors and captive users because of the tax planning opportunity it provided and simultaneously encouraged the development of the wind power projects. The scheme was discontinued from April 2012 and re-introduced in April 2014. As per data provided by IREDA the total capacity addition made under AD scheme till March 2014 was 15,818[17] MW.

3.2.3.1. Affect of discontinuation of AD and GBI

Both the schemes i.e. GBI and AD, were discontinued from April 2012. GBI was discontinued because it was only for the 11th FYP period and MNRE could not ensure that it seamlessly continued in the 12th FYP. It was re-introduced (September 2013) retrospectively from April 2012. AD provision was also not continued in 2012-13 and 2013-14 due to reservations expressed by Central Board of Direct Taxes, Ministry of Finance (MoF).

In order to analyse the impact of discontinuation of the incentives for one and half years (GBI) and two years (AD), Audit attempted to collect data of projects installed under each category from MNRE. MNRE could not provide list of projects commissioned under AD and GBI mode to Audit. It stated that the benefit of AD was given to the developers under the provisions of the Income Tax Act, 1961 and MNRE had no details of the projects installed under AD scheme. Consequently, Audit obtained list of projects installed under GBI scheme from IREDA and the capacity installed through AD was calculated by deducting the capacity installed under GBI from the total installed capacity data provided by MNRE. The data is given in Table 16 below:

[17] Based on calculation discussed in para 3.2.3.1.

Table 16: Year wise capacity addition under the AD Scheme

(in MW)

Year	Total Capacity	Through GBI	Through AD[18]
Pre 2009	10,239	120	10,119
2009-10	1,565	138	1,427
2010-11	2,349	603	1,746
2011-12	3,197	1,490	1,707
2012-13	1,700	1,398	302
2013-14	2,079	1,562	517
Total	**21,129**	**5,311**	**15,818**

Source: MNRE and IREDA. However, data on capacity installed given by MNRE in Table 15 under para 3 is 21,137 MW as compared with 21,129 MW reported as achievement under 11th and 12th FYPs.

As can be seen from Table 16, between 2009-10 and 2011-12, the capacity addition increased considerably both under GBI and AD category. AD was the preferred category, whereas GBI was also catching up. In the year 2011-12, the capacity addition crossed 3,000 MW.

Post withdrawal of GBI and AD, the capacity addition in this sector was only 3,779 MW (2,960 MW through GBI and 819 MW through AD) during 2012-14, against a target of 5,000 MW. Hence, there is a strong indication that the break in incentive due to policy reversal in 2012-14 did adversely affect capacity addition.

MNRE (July 2013) moved a Cabinet note seeking reintroduction of both GBI as well AD incentives for the wind energy sector. Central Board of Direct Taxes (CBDT) under Ministry of Finance (MoF) objected to AD scheme. The Department of Revenue, MoF, expressed reservations on the proposal to re-introduce AD on the ground of revenue foregone and also the AD benefit being front loaded in the first year. They also expressed apprehension regarding double benefit, both under AD and GBI, being availed by some developers even though they were mutually exclusive schemes. MNRE had pointed out that benefit of AD was being provided to all other RE sources and in many other sectors also, and therefore it would be unfair to discriminate against wind energy sector. MNRE also pointed out that there was a provision in the GBI scheme that the wind power developers should be registered with IREDA, they would have to prove that they are not taking benefits of AD and IREDA would build safeguards in the implementation process to avoid misuse of incentives. But these were not implemented for want of notification from the Department of Revenue.

Audit found that:

i. As per study[19] conducted (February 2012) by MNRE, out of the target of 15,000 MW for the 12th FYP, 6,000 MW would have come from AD route. The taxes[20] foregone by the Government, on NPV[21] basis, due to no investment because of absence of AD was

[18] In the years 2012-14, there was no capacity addition under AD. The capacity shown may pertain to captive users, third party sale, GBI etc. GBI was restored in September 2013 with retrospective effect from April 2012 and the developers who installed wind power plants during this period are opting for GBI.

[19] CRISIL Risk and Infrastructure Solutions Ltd.

[20] Minimum Alternate Tax, Central Sales Tax and Service Tax.

[21] Net Present Value.

₹ 6,741 crore and the income tax deferment, on NPV basis would have been ₹ 5,606 crore. Hence, there would have been benefit of revenue to the Government to the tune of ₹ 1,135 crore. Also, the financial liability of GBI would decrease from ₹ 16,354 crore to ₹ 11,164 crore. Still, AD was withdrawn at the behest of CBDT, MoF.

ii. Further on the issue of misuse of the GBI and AD scheme, Audit found that the list of developers claiming GBI was forwarded by MNRE to CBDT in January 2013 for their verification to rule out the suspicion of double benefit being availed. Audit enquired from CBDT of its action and findings on the list of developers. CBDT stated (April 2014) that the field offices were asked to verify the claims and one firm had claimed additional depreciation for the Assessment Year 2011-12 and later on the assessee revised the return. It further stated that no other discrepancy was reported relating to availing of GBI and AD in a mutually exclusive manner.

iii. It was also observed that after expressing reservations on the reintroduction of AD in 2013, MoF reintroduced AD benefit for the wind energy developers in the Finance Bill 2014. Audit sought the documents justifying reintroduction of AD after it had once been rejected, from CBDT (December 2014). CBDT stated (April 2015) that the proposal of introducing certain safeguards to address the concerns was not found acceptable and it was felt that monitoring of such a scheme would not be feasible.

The fact remains that the AD scheme was reintroduced September 2014 onward after a gap of over two years, CBDT's concerns notwithstanding. Also, the AD benefit was being provided to all other RE sources and in many other sectors, and was withdrawn only for wind energy sector.

MNRE stated (July 2015) that IREDA has taken adequate safeguards to ensure that GBI is provided to only those developers who do not avail AD benefit by checking their Income Tax returns.

3.2.3.2. Proposed checks for AD by MNRE not taken into consideration by the Ministry of Finance

Audit examination revealed that in order to make AD more transparent and to address MoF concern of the misuse of AD, MNRE had proposed the following checks:

- All the developers should be registered with IREDA, and the AD would be allowed in tax assessment by MoF only after certificate from IREDA that GBI had not been claimed.
- The ownership of the wind turbine cannot be transferred within three years of commissioning.
- The capacity utilization factor of the AD projects should be minimum of 15 *per cent* per year for a minimum of three years.
- AD would be made available for a maximum capex of wind power project which will be linked with CERC norms.

MoF did not take these into considerations and withdrew the AD scheme (March 2012). Also, MoF/CBDT had not issued any notification, to include these checks, while re-introducing the AD scheme (September 2014).

Audit scrutiny in Maharashtra revealed instances when the developers had been paid GBI without ensuring production of required certificate to the effect the Accelerated Depreciation benefit had not been availed of. The details are given in the box below.

Excess payment to wind generator without Accelerated Depreciation certificate

In Maharashtra, as per Energy Purchase Agreement (EPA) executed with the developer a certificate from Chartered Accountant /IT Department had to be submitted within two years from the date of Commercial Operation (COD) that the AD has not been availed.

Audit observed that that wind generators of Satara, Pune, and Nandurbar (March 2012) had not submitted the certificate for AD to Maharashtra State Electricity Distribution Company Limited (MSEDCL) even after two years from the date of COD.

Even in the absence of the certificate, payment was made by MSEDCL at higher rate in respect of 595 million units purchased during April 2010 to March 2014 resulting in possible excess payment of ₹ 78.31 crore.

MSEDCL stated (December 2014) that this was being verified for taking necessary action as per EPA.

MNRE (April/May 2015) did not comment on the issue and stated that inputs from MSEDCL through Maharashtra Energy Development Agency were awaited. The fact remains that the AD was reintroduced in 2014, the reservations notwithstanding, but the safeguards proposed are yet to be notified.

3.2.4. Lack of competitive bidding for allotment of wind energy projects

Wind energy constitutes around 67 *per cent* of installed RE capacity in the country. Audit observed that

i. There was no competition in the wind energy sector either with respect to tariff fixation (unlike JNNSM under solar energy) or with respect to allocation of sites to the developers (as in the case of SHP).

   MNRE stated (May 2015) that in solar energy, the cost per MW came down substantially due to realistic estimate in India and also due to cost reduction internationally during the last few years. In case of wind energy, the cost corrections have already taken place in the last 20 years. It further stated that wind being relatively more variable in nature, competitive bidding route may not lead to better results because it may not be possible to correctly estimate the generation and grid availability at a particular site. MNRE reply should be considered in the context of the need to address problems linked with infirm nature of wind energy in terms of accurate forecasting, maintaining grid discipline and adequate evacuation infrastructure which are plaguing the sector. These issues have been discussed in para 4.4.

ii. The guidelines issued by MNRE in June 2008 on wind measurement involving private sector stipulated that private developers should establish wind farms on lands categorised as wind farmable site within three years[22] of issue of No Objection Certificate (NOC) by the respective SNA. The guidelines further stipulated that in cases where no development takes place even after the prescribed period of three/five years, the SNA would be at liberty to invite bids for setting up wind power projects from others. When such sites are declared open for others, all data of the site would be treated as part of NIWE knowledge bank and would be given in the normal list of potential stations by NIWE. Audit observed that out of 572 stations in which private promoters conducted measurement, 32 stations were identified as potential sites for setting up wind farms. As these sites had not been developed within the extended time frame of five years, NIWE should have included them in the normal list of potential stations as stipulated in the Ministry's guidelines. This deprived potential developers of the opportunity for planning and establishing wind farm. NIWE stated (May 2013) that such sites would be listed after discussion with the concerned SNAs and MNRE.

4. State wise analysis

4.1. Potential and installed capacity

Based on the wind energy potential assessed in the 31 States/UTs listed in the Table 15 above, Audit identified that four[23] States were endowed with 75 *per cent* of the wind energy potential in the country at 80 m mast height and six[24] States with 22 *per cent* of the wind potential. Together, these ten States were endowed with 97 *per cent* of the country's wind potential. In order to tap the wind energy, it was necessary to focus on developing the resource in these States.

Table 17: Estimated potential and installed capacity (Grid connected) for the States endowed with 97 *per cent* of the country's wind energy potential, as of March 2014

(in MW)

S. No.	State	Estimated potential at 80 m height	Installed capacity	Percent installed
High[25] potential States with 75 *per cent* wind energy potential				
1	Gujarat	35,071	3,455	10
2	Andhra Pradesh	14,497	747	5
3	Tamil Nadu	14,152	7,271	51
4	Karnataka	13,593	2,319	17
	Total	**77,313**	**13,792**	**18**

[22] The period of three years could be extended upto five years in cases of circumstances beyond the control of the developer.
[23] Andhra Pradesh, Gujarat, Karnataka and Tamil Nadu.
[24] Jammu & Kashmir, Madhya Pradesh, Maharashtra, Odisha, Rajasthan and Uttar Pradesh.
[25] States with estimated potential higher than 10,000 MW.

S. No.	State	Estimated potential at 80 m height	Installed capacity	Percent installed
Medium[26] potential States with 22 *per cent* wind energy potential				
5	Maharashtra	5,961	4,097	68
6	Jammu & Kashmir	5,685	Nil	Nil
7	Rajasthan	5,050	2,786	46
8	Madhya Pradesh	2,931	423	14
9	Odisha	1,384	Nil	Nil
10	Uttar Pradesh	1,260	Nil	Nil
	Total	**22,271**	**7,306**	**33**

Source: MNRE

i. The installed capacity in these ten States varied from zero to 68 *per cent* of the potential. Maharashtra had the highest exploitation of the wind energy potential at 68 *per cent* followed by Tamil Nadu at 51 *per cent* and Rajasthan at 46 *per cent*. Jammu & Kashmir, Odisha and Uttar Pradesh had not exploited the potential at all. More significantly, of the four high potential States, three i.e. Gujarat, Andhra Pradesh and Karnataka had very low rates of exploitation of their wind energy potential, ranging from five to 17 *per cent*. Thus, unless MNRE and the State Governments of these high potential States prioritise exploitation and development of the wind energy, the impact of the progress made in the sector will remain insignificant.

ii. While the overarching policy and incentives offered by Government of India to promote wind energy across these States remained common, the comparative and varied development of wind energy in these States was dependent on factors such as State policies, evacuation infrastructure, tariff fixed by the State Electricity Regulatory Commission, Plant Load Factor (PLF) generated because of wind speeds, enforcement of Renewable Purchase Obligation (RPO)/ Renewable Energy Certificate (REC) etc. An analysis of the conditions prevailing in these ten high potential States is discussed below:

4.2. Policy, Planning and implementation

In order to give impetus to development of a particular activity, it is important that the Government policy on the activity be clearly articulated. This should then be followed up with proper planning, target setting and monitoring of implementation. The State wise findings in this regards are given below:

[26] States with estimated potential between 10,000 MW and 1,000 MW.

Andhra Pradesh

The new Wind Policy 2008 was favorable to the developers. But, NREDCAP[27], the nodal agency had only one officer looking after renewable sources of energy, with limited support and no access to specialists. Lack of reliable information, even to the regulators, on different parameters affecting energy tariffs also had its impact on tariff determination.

MNRE stated (July 2015) that APERC has issued the preferential generic levelised tariff for 25 years for wind power generation projects in the State on 31 March 2015.

Gujarat

The State had the maximum estimated wind energy potential at 35,071 MW. So far it had installed capacity of 3,455 MW which was the third highest in the country. However, in terms of percentage of the potential, the installed capacity was 10 *per cent* of the estimated potential. While the State Government did frame a wind energy policy in 2007 and revised it in 2013, it did not set any targets for creation of capacity between 2007-14. This is indicative of comparatively lower priority and focus of the State Government in developing this source of energy. Being the highest potential State, it was imperative that it lead in terms of exploitation of potential capacity to meaningfully contribute towards meeting the Nation's commitment to Renewable Energy.

MNRE stated (July 2015) that the State had been consistently providing investor friendly wind power policies to facilitate setting up of wind power projects in the State with seven *per cent* RPO for the year 2015-16 which reiterate the commitment of the State Government towards promotion of wind power in the State.

Karnataka

Against a target of creating installed capacity of 2,969 MW in 2007-14, only 1,497 MW was created due to difficulties in getting statutory clearances. It was seen in audit that 18 wind projects allotted for a total 475 MW were pending for clearances. Three projects totaling 33 MW were pending for allocation of Revenue land and 15 projects totaling 442 MW were pending for clearance from the Forest Department. This was despite the fact that the State RE Policy 2009-14 envisaged that Karnataka Renewable Energy Development Limited (KREDL) would obtain all statutory clearances from different departments beforehand and offer such lands for Renewable Energy Project development. KREDL was to pursue with the departments and co-ordinate approvals and clearances within 90 days from all departments / agencies and 120 days in case of Forest clearance.

Jammu & Kashmir, Odisha and Uttar Pradesh

These three States set little priority in developing wind energy potential, as was indicated by the absence of both a Government policy and targets, and failed to exploit this resource.

Madhya Pradesh

The State could achieve only 367 MW capacity creation against a target of 3,259 MW during 2007-14. No specific reasons for such substantial under achievement were found on record.

[27] New and Renewable Energy Corporation of Andhra Pradesh Ltd.

Maharashtra
The State leads the high potential States in its performance in terms of percentage of potential exploited (68 *per cent*) and ranks second in terms of capacity creation. While it did not formulate a separate policy for wind energy, a combination of targets, attractive tariffs[28] and adequate evacuation infrastructure contributed to the commendable performance.
Rajasthan
The Wind Energy Policy of 2012, which envisaged selection of power producers on basis of competitive bidding, was stayed by the Rajasthan High Court. Thereafter, Government of Rajasthan amended (March 2014) the policy and allowed preferential tariff determined by the Rajasthan Electricity Regulatory Commission (RERC) for the years 2013-14 to 2015-16 but during the year 2013-14 only 98.80 MW could be added.
Tamil Nadu
About 60 *per cent* of small wind turbines (<400 kW) that had been installed before the year 2000 were operating with PLF ranging from 10 to 15 *per cent*, whereas the new technology wind turbines could operate at a PLF range of 27 to 32 *per cent* on the same sites. There was no policy for repowering of these old turbines which resulted in fall in efficiency of these windmills over the years. The issue has been discussed in detail in para 5.

MNRE stated (May 2015) that the inputs from State Agencies were awaited. It further stated that the State specific achievements were not only dependent on Central Government incentives and these were mainly dependent upon wind regime, State government policies, grid infrastructure availability and investor-friendliness of the State and private sector investment but the reply is silent on planning, target setting and monitoring of implementation of the scheme.

4.3. Tariff

4.3.1. Comparison between CERC and SERC tariffs

CERC (Terms and Conditions for Tariff determination from RE Sources) Regulations 2012, provide for terms and conditions and the procedure for determination of tariff for RE generating stations. The Regulations enjoin upon CERC to determine the generic tariff on the basis of the *suo-motu* petition, for RE technologies for which norms have been provided in the RE Tariff Regulations.

CERC had subsequently issued generic *suo-motu* tariff orders applicable for RE projects commissioned during first, second and third year of the control period (i.e. 2012-13, 2013-14 and 2014-15). The tariff was fixed by CERC on the basis of power generation capacity, capital cost, debt-equity, depreciation, operation & maintenance expenses etc.

Zonal tariff are fixed by CERC for wind energy, based on the Capacity Utilization Factor (CUF) depending on the wind zone as per NIWE. The zone wise tariff fixed by CERC is given in Table 18.

[28] Refer para 4.3.1 and 4.3.2.

Table 18: Zone wise tariff fixed by CERC

Wind Zone	Wind Density (in Watt/ sqm)	CUF (in *per cent*)	2012-13		2013-14	
			Levelised Tariff (₹/kWh)	Levelised Tariff after adjusting AD benefits (₹/kWh)	Levelised Tariff (₹/kWh)	Levelised Tariff after adjusting AD benefits (₹/kWh)
Zone 1	Upto 200	20	5.96	5.36	6.29	5.80
Zone 2	201-250	22	5.42	4.87	5.72	5.27
Zone 3	251-300	25	4.77	4.29	5.03	4.64
Zone 4	301-400	30	3.97	3.57	4.19	3.86
Zone 5	Above 400	32	3.73	3.35	3.93	3.62

In the States, the tariff for the wind power projects are fixed by the SERC based on the factors such as capital cost, return on investment, debt equity ratio, interest on loan, depreciation, operation and maintenance charges, CUF, sharing of CDM benefits, subsidy given by Central/ State Government, useful life etc.

Table 19 gives the details of tariff fixed in the ten high potential States by their respective SERC's.

Table 19: Tariff related details in ten States with highest wind energy potential.

S. No.	State	Potential exploited	Tariff (₹ per Unit)	CUF (in *per cent*)	Installable Potential (in *per cent*)			
					Zone 1	Zone 2	Zone 3	Zone 4
1	Andhra Pradesh	5	4.70	24.50	92	6	2	0
2	Gujarat	10	4.15	23	92	8	0	0
3	Jammu & Kashmir	Nil	Not fixed	Not fixed	9	25	0	66
4	Karnataka	17	4.20	26.50	97	1	2	0
5	Maharashtra	68	Zonal[29]	22	98	2	0	0
6	Madhya Pradesh	14	5.92	22.50	100	0	0	0
7	Odisha	Nil	5.31	-	100	0	0	0
8	Rajasthan	46	5.72[30] & 5.44	21 & 20	100	0	0	0
9	Tamil Nadu	51	3.51	27.50	100	0	0	0
10	Uttar Pradesh	Nil	4.02	-	100	0	0	0

On principle, tariff decreases as the CUF increases i.e. tariff was highest for Zone 1 and lowest for Zone 4. Table 19 shows that States like Andhra Pradesh, Gujarat, Karnataka, Kerala, Tamil Nadu and Uttar Pradesh had most of their wind potential in wind Zone 1, but they had fixed tariff much lower than the CERC tariff for the Zone. States like Maharashtra, Madhya Pradesh and Rajasthan have relatively high tariff to compensate project developers

[29] Zone 1 - ₹ 5.81, Zone 2 - ₹ 5.05, Zone 3 - ₹ 4.31, and Zone 4 - ₹ 3.88.
[30] For Barmer, Jaisalmer and Jodhpur.

for low CUF, making it attractive. Maharashtra and Rajasthan were the only States to fix zone wise tariff as per CERC norms.

MNRE stated (July 2015) that the tariff fixation was done by the State Energy Regulatory Commissions (SERCs). In many cases the State Regulatory Commission does not fix tariff as per the CERC Guidelines due to various reasons including financial health of Discoms.

4.3.2. Revision of tariff

Table 20: Status of revision of tariff in ten States with highest wind energy potential.

S.No.	State	Tariff (₹ per Unit)	Revision of Tariff (2007-14)
1	Andhra Pradesh	4.70	Tariff revised in 2008-09 and 2011-12
2	Gujarat	4.15	Tariff revised in 2008-09 and 2011-12
3	Jammu & Kashmir	Not fixed	Not fixed.
4	Karnataka	4.20	Not revised since 2008-09
5	Maharashtra	Zonal[31] ranging from 5.81 to 3.88	Regularly revised zone wise every year
6	Madhya Pradesh	5.92	Regularly revised every year
7	Odisha	5.31	Not revised since 2010-11
8	Rajasthan	5.72[32] & 5.44	Regularly revised since 2008-09
9	Tamil Nadu	3.51	Regularly revised since 2009-10
10	Uttar Pradesh	4.02	Regularly revised since 2008-09

Audit observed that CERC had been regularly revising the indicative tariff fixed by it for the wind energy projects. But most of the States as given in the table above had not revised the tariff. States like Andhra Pradesh, Gujarat, Karnataka, Odisha, Tamil Nadu and Uttar Pradesh have not revised the tariff regularly. On the other hand it was observed that Maharashtra has regularly revised the zone wise tariff.

MNRE while accepting the audit observation stated (May 2015) that State Regulatory Bodies are not revising the tariff as per the CERC guidelines on regular basis and this was one of the short-comings of the wind sector.

4.3.3. Non execution of Energy Purchase Agreement (EPA) with generators

In Maharashtra, as per Citizens' Charter of Maharashtra State Energy Distribution Corporation Ltd (MSEDCL) the EPA had to be executed within a period of 15 days after receipt of the proposal from the Generators.

MSEDCL received (July 2013 to May 2014) proposals from 106 wind energy generators for execution of EPA. However, MSEDCL had not executed EPA, resulting in delay ranging from 26 to 334 days from the date of receipt of proposed EPA (June 2014).

[31] Zone 1 - ₹ 5.81, Zone 2 - ₹ 5.05, Zone 3 - ₹ 4.31, and Zone 4 - ₹ 3.88.
[32] For Barmer, Jaisalmer and Jodhpur.

Audit observed that six wind projects pertaining to Satara and Sangli Circles had generated 52.99 MUs from the date of commissioning and fed the same into MSEDCL grid upto 31 May 2014. However, MSEDCL had not paid an amount of ₹ 30.79[33] crore to the generating companies for the energy supplied.

MSEDCL stated (Dec 2014) that due to pendency of litigations, the signing of EPAs was delayed during 2013-14. The fact remains that MSEDCL has not adhered to the terms of the Citizens' Charter issued by itself under approval of Maharashtra Energy Regulatory Commission (MERC). MNRE stated (July 2015) that the reply from States was awaited.

4.4. Evacuation

4.4.1. Background

Central Electricity Authority (CEA) has envisaged a capacity addition from RE sources during the 12th FYP to be about 32,000 MW which was likely to come up in eight States i.e. Andhra Pradesh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharashtra, Rajasthan and Tamil Nadu and out of which 30,000 MW was expected to come from solar and wind energy.

Gujarat, Tamil Nadu and Rajasthan had substantial percentages 18 *per cent*, 40.5 *per cent* and 26 *per cent* of the RE in their total installed capacity respectively, predominant of which was wind and solar. The other States with substantial RE capacity were Maharashtra and Karnataka.

The interstate and inter regional transmission infrastructure was being developed and it was expected that all the five electrical regions of India would be synchronously connected by 2014. The transmission system costing about ₹ 32,000 crore had been planned to cater the needs of about 32,000 MW RE capacity addition program for the 12th FYP (2012-17). These systems include both intra state and interstate transmission system of 132 kV, 220 kV, 400 kV and 765 kV voltage levels. Presently, the Southern grid is not synchronized fully with the National Grid to evacuate wind power to other States or to other regions.

The transmission planning in the country was done through a coordinated process with the participation of CEA, Central Transmission Utility (POWERGRID) and the State Transmission Utilities.

The all India grid was divided into 28 control areas interconnected with each other through interstate transmission links and high capacity corridors. Each State had its own generation sources in addition to the shared generation resources called interstate generating stations.

4.4.2. Green Energy corridor

A report `Transmission Plan for Envisaged Renewable Capacity'[34] of PGCIL was released (September 2012) to evolve intra/ inter State transmission system for strengthening adoption/ transfer of RE power within State/ outside State called the Green Energy Corridor.

[33] 52.99 MUs x ₹ 5.81/unit.

[34] Prepared after consultation with MNRE/ Ministry of Power / Planning Commission/ CERC/ CEA/ Forum of Regulators

The report also included proposals regarding other real time monitoring and control infrastructures required for supply balancing mechanism to address intermittency and variability aspects of RE generation, estimated capex requirement, financing strategy etc. Ministry of Power conveyed (February 2014) its approval for implementation of Inter State Transmission Schemes (ISTS), setting of RE Monitoring Centers and control infrastructure by PGCIL for Green Energy Corridor. PGCIL had conveyed (October 2014) that Green Energy Corridor-ISTS was to be commissioned progressively from 2017.

4.4.3. Deficient transmission infrastructure in Tamil Nadu

Tamil Nadu has the largest installed capacity based on wind energy at 7,271 MW. Tamil Nadu Energy Regulatory Commission (TNERC) in its tariff order (May 2006) ordered creation of enough transmission infrastructures in the critical areas of wind energy generation on urgent basis.

It was observed that neither Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)[35] nor Tamil Nadu Transmission Corporation Limited (TANTRANSCO)[36] were able to create adequate transmission infrastructure facilities or utilise the existing facilities effectively. During high wind season, the transmission lines were congested leading to problems of voltage stability and power quality. There was no common spinning reserve[37] maintained with other States in the region to fully utilize the heavy wind generation.

Audit further observed:

i. That there was no long-term transmission planning process to incorporate transmission and evacuation requirements of wind energy. Wind energy projects had low gestation periods which led to rapid increase of installed capacity over the years, there was no matching creation of grid infrastructure resulting in bottlenecks in evacuation of the generated energy.

ii. Examination of substation facilities for evacuation of wind power that existed in 2008-09 and the additional capacity that was created upto 2013-14 indicated that as on 31 March 2014, against the installed capacity of 7,271 MW, TANGEDCO had transmission facility for only 6,085.96 MW leaving a shortfall of 1,185.04 MW.

iii. To evacuate the entire energy from the wind energy generating areas of Tirunelveli, Udumalpet and Theni in the southern parts of the State to the distant load centres in northern parts of the State, establishment of 400 kV substations was essential. A backbone transmission network from Kayathar in the Tirunelveli area to Ottiyambakkam (Sholinganallur) near Chennai in the northern part of the State for a route length of 709 km estimated to cost ₹ 2,200 crore was proposed for implementation during the 12th FYP period. The work was scheduled to be completed by 2014 to help evacuation of power during the 2014 season. It was however observed that as of June 2014, the work had not been completed. The

[35] Responsible for energy distribution.
[36] Responsible for creating evacuation facility.
[37] The spinning reserve is the extra generating capacity that is available by increasing the power output of generators that are already connected to the power system.

allied substation works at Kanarpatti was also pending. The works were under various stages of completion.

MNRE stated (May 2015) that in some cases, the utility was not able to provide timely evacuation facilities for new projects as they have financial constraints to augment the grid and that the States were trying to improve the situation. The reply was indicative of the fact that there were bottlenecks on transmission and evacuation requirements of wind energy.

The impact of inadequate infrastructure on development of the wind energy in various States is given in box below:

Projects pending for want of evacuation infrastructure

In Andhra Pradesh 118 projects of 3,972.67 MW had been sanctioned till 31 March 2014. Audit observed that 63 projects with a capacity of 3,074.50 MW are pending for want of power evacuation facility[38]. Some of the projects are pending since November 2000. State transmission utilities have sought funds to the extent of ₹ 3,058.46 crore from MNRE which are yet to be sanctioned by MNRE.

MNRE stated (July 2015) that Transmission Corporation of Andhra Pradesh Limited (APTRANSCO) had taken up strengthening of transmission infrastructure in two phases for evacuation of 3,150 MW capacity with estimated cost of ₹ 3,373 crores in Ananthapur, Kurnool and YSR Kadapa Districts, where maximum potential was available, by installing three 400 kV and nine 220 kV sub stations and proposals were submitted by APTRANSCO for sanction of 40 *per cent* matching grant under National Clean Energy Fund.

Power backed down

In Tamil Nadu the quantum of wind power backed down was 6,018.43 MUs during 2007-2014, the maximum backing down being in 2012-13 (1,155.27 MUs) and 2013-14 (3,419.85 MUs). This resulted in loss of revenue to the extent of ₹ 2,040.25 crore[39] during the period.

MNRE stated (July 2015) that due to variable nature of wind energy and lack of scheduling and forecasting mechanism, wind power projects are, sometimes, backed down. State Governments are bringing regulations for scheduling and forecasting. NIWE with VORTEX of Spain, in association with Indian Wind Power Association (IWPA) and TANGEDCO was working on a pilot project for scheduling and forecasting. However the fact remained there was loss of power to be fed into the grid and the revenue could not be made good.

Under achievement of generation due to lesser evacuation capacity

In Maharashtra transmission facilities for evacuation of 255 MW were approved (July 2006) for M/s Suzlon Energy Limited at Ghatnandre, Dist Sangli. However, due to unresolved Right of Way and problems in evacuation, the Company issued final connectivity (November 2013) only to the extent of 231.50 MW rendering 23.50 MW of identified potential wasteful. This resulted in unachieved generation of 13.724 MUs and consequent loss of revenue of ₹ 7.97[40] crore to the RE sector in the State.

[38] Out of 63 projects, 24 projects were held up due to non allotment of revenue land also.
[39] Calculated at the 20 years average tariff of ₹ 3.39 per unit as per TNERC's wind energy tariff order of 2009.
[40] ₹ 5.81 x 23.50 MW x 1,000 x 24 x 365 x 4 months/12 months x 20 *per cent* CUF.

Applications pending for issue of grid connectivity

In Maharashtra, the State Transmission Utility had to dispose of the applications for grid connectivity within 45 days from the date of receipt of application. Audit observed that 74 applications for grid connectivity involving 4,304[41] MW were pending with Maharashtra State Electricity Transmission Company Limited (MSETCL) (March 2014) from March 2012 onwards. In addition, in respect of seven projects involving 1,025 MW, though the company had received MEDA's recommendation letter, the cases were pending for want of applications from the developers.

4.4.4. Reimbursement of evacuation expenditure

The Maharashtra Government declared (October 2008) that the RE developer shall be eligible for refund of expenditure on evacuation infrastructure[42]. Audit observed that

i. 16 eligible applications of 397 MW for ₹ 55.08 crore were pending for reimbursement of evacuation expenditure from MSETCL. MSEDCL had also not reimbursed ₹ 17.16 crore to developers in Satara, Pune Rural and Sangli circles.

   In reply, MSEDCL stated (Dec 2014) that if reimbursement was made, then the same shall have to be included in the tariff petition and the common consumers would have to suffer the ultimate burden. The reply was not tenable as the action of MSEDCL was not in keeping with Government Policy and reimbursement of cost of creating evacuation infrastructure would have reduced the capital cost of the producer.

ii. Expenditure on power evacuation in respect of 1,110 wind energy project commissioned and operationalised between 2007 and 2014 had not been reimbursed to the project owners. It was also observed that no expenditure was incurred on construction of approach roads to these 1,110 projects, which was also confirmed by the departmental officials during the joint physical verification of all selected projects.

iii. MSETCL had also approved payment of centage charges[43] amounting to ₹ 7.80 crore, as a component of capital expenditure, which was not eligible for reimbursement.

   MSETCL stated (July 2014) that centages form part of developer's capital expenditure. Reply was not acceptable as the entire capital expenditure was covered in the item wise audited statement of amount spent by the developers.

iv. Test check of records in MSEDCL revealed that at the time of approving the estimates for the cost of the evacuation lines to be constructed by the respective Generator/ Developer, different methods of arriving at the approved cost were employed by different Circles/ Division offices:

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[41] Solar 1,348 MW, Bagasse 288 MW, SHP 17.50 MW, Wind 2,650.50 MW.

[42] The RE developer shall be eligible for refund of actual expenditure on evacuation infrastructure or the sanctioned estimate approved by MSEDCL/MSETCL or the amount as specified in the policy, whichever is lower after one year from the date of commissioning of evacuation arrangement; the expenditure to be shared equally by SNA and MSEDCL/MSETCL

[43] At the rate of 10.75 *per cent*. Centage charges are prescribed for approval of layouts and sub-division of sites.

- In Satara and Pune Circles only material and labour elements were considered for approving the estimates.

- In Dhule and Nandurbar circles, the estimates included an additional five *per cent* for transportation cost (Dhule) and 10 *per cent* Lattitude[44] charge (Nandurbar). In Nandurbar circle, additional cost elements such as Service Tax, insurance, contractors' profit, contractors' supervision, contingencies, head office supervision, escalation etc. were also included in the estimate amount.

- Supervision charges were calculated at the rate of 15 *per* cent of labour charges in Nandurbar whereas it was calculated at the rate of 1.3 *per cent* of material and labour charges in other circles.

MSEDCL stated (Dec 2014) that necessary instructions had been issued for framing the estimates as per MSEDCL standard procedure.

v. The reimbursement of 50 *per cent* of the eligible amount of evacuation expenditure in five annual installments had to commence after one year from the date of commissioning of the evacuation facility. In MSETCL, there were delays in reimbursement ranging from one to six years in 10 cases.

4.4.5. Synchronisation of generation and maintenance of grid discipline

4.4.5.1. Accurate prediction of wind power

The variability of RE power can be addressed through improved forecasting techniques, which are still evolving. When the percentage of RE becomes significant, special attention needs to be paid to accurately forecast their output.

i. RE Management Centers not set up in SLDCs:

To enable accurate forecasting and scheduling, RE Management Centers were expected to be set up in the State Load Dispatch Centers (SLDCs). It was observed (September 2014) that, no such centre had been set up in the States.

ii. Non-scientific methods for calculation of wind power

Wind power was scheduled by averaging the previous two days availability and no scientific methods were used to arrive at correct wind forecast for the day ahead.

4.4.5.2. Maintenance of grid discipline

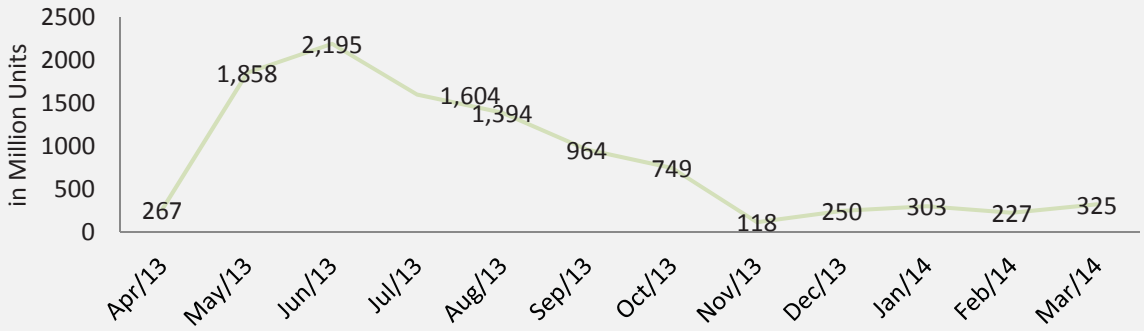
CERC amended the Indian Electricity Grid Code (IEGC) in April 2010 to allow flexibility in scheduling and despatch of wind energy. The new grid code of CERC mandated that all new renewable energy power sources of 10 MW and above and connected to the grid at 33 kV and above should schedule power generation and provide a forecast to the system operator. The code provided that a +/- 30 *per cent* variation between scheduled and actual

[44] Charges levied by MSEDCL.

power injection would not attract any penalty for the wind developer[45]. Any variation beyond +/- 30 *per cent* would be to the account of the developers. Therefore, good short-term[46] forecasting facilities of renewable energy, especially for wind power, using modern tools were necessary to reduce forecasting errors and reduce the impact of Unscheduled Interchange (UI) penalties.

The peak wind season in Tamil Nadu was from June to September. During this period, wind energy contributed about 30-35 *per cent* of the energy consumption in the State. Chart 4 below indicates month-wise wind generation in the State during 2013-14[47]:

Chart 4:Month wise wind energy generation during 2013-14



As seen above, the generation pattern of wind power was infirm varying from about 2,200 MW (high-wind season) to about 118 MW (low-wind season), and even during high wind season, the generation, at times tapered down to 320 MW or less from a high of 2,170 MW within a day. Due to wide variations in wind generation within short periods, the grid got affected due to voltage control and transient stability. The variable generation led to overloading of transformers and main transmission lines which required high capacity of strengthening of transmission network. As the conventional hydro source available in Tamil Nadu to compensate the wind generation loss was very limited, the vagaries of wind generation had serious bearing on the availability and supply of power in Tamil Nadu. Because of the constraints in transmission system and to contain the frequency within the bandwidth as per the Indian Grid Code, TANGEDCO had to either back down wind generation during excess generation or in cases of drop in wind generation resort to either overdrawal of power from the regional grid or resorted to unplanned load shedding. The detail has been reported in para 4.4.3.

It was observed that, in Tamil Nadu, there were individual generators with capacities of 250 kW also. Sub-regulation 23 of regulation 6.5 of the new Grid code provided that for capacity below 10 MW and for old wind farms, scheduling of wind energy could be mutually decided between the wind generator and the transmission or distribution utility as the case may be if there was no existing agreement to the contrary. Since forecasting and scheduling by all wind generators was required to ensure better operational decision making and ensure secure grid operation, implementation of the new mechanism in Tamil Nadu could be

[45] With host States taking all the Unscheduled Interchange (UI) liabilities through Renewable Regulatory Fund.
[46] Day-ahead and three hour ahead.
[47] Southern Regional Power Committee's monthly progress report for 2013-14.

carried out only by mutual agreement. As of September 2014, there had been no agreement between the wind developers and the State utility to this effect. Even though the code focused on the problems faced by the States having huge infirm power, since it was applicable only in respect of the new generators who are coming into the grid, there was not much benefit for TANTRANSCO as the State has almost reached saturation level in wind capacity at 50 m mast height. TANTRANSCO was yet (September 2014) to set up Renewable Energy Management Centres in the State Load Despatch Centre which would have enabled accurate forecasting and scheduling.

5. Repowering of the wind power projects

Repowering could lead to better utilization of wind-rich sites through the installation of latest technology wind turbine models available and improve the capacity utilization factor to 25-30 *per cent*[48]. Also, the total cost of repowering a site was 20 *per cent* lower than a Greenfield[49] installation. Moreover, the process does not require any permits or approvals.

The return on investment could be considerably improved by repowering of old wind sites-through an increase in energy generation, higher tariff and the REC mechanism. In addition, repowering would reduce the noise produced by turbine operations and facilitate grid integration as the modern turbines comply with grid code standards as well as demonstrate improved performance under erratic grid conditions.

Over 4,600 turbines rated below 500 kW and operational for more than 10/12 years were ideal for repowering. These turbines have an aggregate capacity of 1.6 Giga Watt, which is over 9 *per cent* of the total installed capacity and located at sites with excellent wind conditions. Most of the turbines were installed a decade ago under power purchase agreements that were signed for 20 to 25 years. Old projects aggregating 500-1,000 MW could be repowered with high levels of success.

MNRE while agreeing with the issue of repowering the wind power projects raised by Audit stated in October 2014 that many wind turbines installed in the earlier years have completed up to 15 years out of the theoretical life of 20 years of turbines. It further stated that due to the advancement in technology, higher hub heights and larger rotor diameters, there was a good scope of repowering the old wind turbines of few kW size into MW size. The Ministry also stated that it had not conducted any study to arrive at the figure.

MNRE further clarified that some major issues like signing of new PPAs, permission from adjoining project owner, use of land, requirement of micro-sitting[50] (in Tamil Nadu), ownership of land and multiple owner of project are involved in repowering the wind projects and it has not yet issued any scheme on repowering of wind power projects.

[48] Almost two to three times the current plant load factor (PLF) of old turbines
[49] Structures in an area where no previous facilities exist.
[50] Wind farm micro sitting- a method which could calculate the wind farm velocity.

6. Other audit findings on implementation of wind energy projects in States

Andhra Pradesh

6.1. Government land not returned after reduction in capacity

NREDCAP entered (May 1994) into a MoU with a wind energy developer (M/s Andhra Sugars Ltd.) to set up wind mill of 10 MW at Ramagiri in Ananthpur and alienated 73.86 acres of land to the developer. The developer executed the works for 2.025 MW and did not develop capacity of 7.975 MW. As per MNRE norms 15.54 acre of government land should have been returned, which had not been done.

Rajasthan

6.2. Non-recovery of extension fees

Clause 15.3 of the Policy for promoting Generation of Electricity through Non-Conventional Energy Sources 2004 of Rajasthan, provides that Wind Energy Projects should be completed within six to 24 months from the date of allocation of capacity by Rajasthan Renewable Energy Corporation Limited (RRECL). Extension would be granted for prescribed period along with extension fees payable.

Audit observed that in three projects of M/s Enercon (India) Limited, the extension fees of ₹2.90 crore was not recovered by RRECL.

6.3. Non recovery of processing fee on re-registration

Clause 15.1 and 15.2 of the Policy for promoting Generation of Electricity through Non-Conventional Energy Sources 2004 of Rajasthan stipulated that the Developer/Power producer would deposit a refundable amount at ₹ five lakh per MW with RRECL as security deposit within 30 days from the date of capacity allocation and if the security amount was not deposited within the time specified, the approval of the State Level Empowered Committee (SLEC) shall stand withdrawn and priority shall be accorded to the next applicant. For re-submission of the case to SLEC for project approval, the applicant will have to re-register the case, along with the processing fee, within the next 30 days, failing which the land allotted shall also stand cancelled.

Audit observed that in five[51] cases processing fees amounting to ₹ 1.04 crore was not recovered on re-registration.

6.4. Non obtaining/non-forfeiture of Security Deposit

Clause 15.1 & 15.2 of Non Conventional Energy Sources Policy 2004 stipulated that in case of wind energy projects the Developer/Power producer would deposit a refundable amount

[51] M/s Enercon India Ltd, M/s Vish Wind Infrastructure (two cases), M/s Gujarat Fluorochemical and M/s Veer Energy Infrastructure.

at ₹5.00 lakh per MW with the Company as security deposit within 30 days from the date of capacity allocation towards completion of the project in the prescribed time frame.

Audit observed that in one[52] case a 16 MW capacity was not commissioned by the developer but the bank guarantee for ₹ 80 lakh was not encashed by RRECL.

7. Conclusion

Wind power was the fastest growing renewable energy resource in India, constituting 67 *per cent* of the total RE capacity. MNRE had assessed the potential for wind energy at 50 m mast height. Assessment of capacity at 80 m height was in progress and that at 100 m height was yet to be explored.

Against an estimated potential of 1,02,788 MW at 80 m mast height, the installed capacity was 21,137 MW[53] which was 21 *per cent* of potential at 80 m height.

At the beginning of the 11th Five Year Plan period, total installed capacity of wind power was 7,091 MW. During the 11th Five Year Plan period, against target of 10,400 MW, capacity of 10,259 MW was achieved. In the first two years of the 12th Five Year Plan period, against a target of 5,000 MW, 3,779 MW was achieved. Thus, there was overall shortfall of nine *per cent* in achievement of targets as of 2014. This was despite the fact that the targets set were modest in comparison to the assessed wind energy potential as well as technological competence available in the country. It appeared that the targets had been routinely set by MNRE without proper planning, analysis, involvement of and communication with the States.

The installed capacity in the high potential States varied from zero to 68 *per* cent of the potential. Maharashtra had the highest exploitation of the wind energy potential at 68 *per cent*. The remaining States had exploited only five to 51 *per cent* of their potential. Three States did not have any installed wind power capacity.

MNRE could not ensure seamless transition of GBI and AD schemes in the 12th Five Year Plan. The growth in wind energy sector was hampered by the resultant uncertainties in the policy framework. The safeguards proposed for ensuring that developers did not avail benefit, simultaneously under GBI and AD schemes, were not introduced.

There was no competition in the wind energy sector either with respect to tariff fixation or with respect to allocation of sites to the developers. Thirty two stations identified as potential sites allotted to private developers for setting up wind farms had not been developed within the extended time frame of five years. These stations were not included in National Institute of Wind Energy's normal list of potential stations as stipulated in MNRE's guidelines. This deprived potential developers who could be looking for such sites for establishing wind farms of the opportunity to develop projects.

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[52] M/s Vish Wind Infrastructure Limited.

[53] However, as per the records furnished by individual SNAs, the installed capacity totaled upto 20,564 MW. The difference was largely in the installed capacity in Madhya Pradesh as recorded in MNRE i.e. 424 MW whereas as per the SNA records, it was only 52 MW.

There were problems in evacuation of wind power generated by the States due to non-availability of sufficient transmission infrastructure, non-synchronization of generation and grid management in the event of unexpected fluctuations. Lack of adequate infrastructure and scientific techniques to predict wind power also created problems in maintaining grid discipline.

Though MNRE acknowledged the importance of re-powering of old wind turbines, no action had been taken in this regard.

8. Recommendations

- *MNRE should focus on development of wind energy in the States endowed with high wind energy potential.*
- *MNRE may work towards development of adequate transmission and distribution infrastructure, both intra-State and inter-State, to meet the needs of large scale evacuation of wind power and grid stabilization through scientific forecasting techniques.*
- *MNRE may look into the issue of repowering the old wind turbines and formulate a policy for optimal utilization of existing capacities and their enhancement.*