DETAILED PROJECT REPORT FOR 46.4MW WIND ENERGY POWER PROJECT IN KONDAPALLE RF AND KUDERU RF OF ANANTAPUR DISTRICT, ANDHRA PRADESH

By

GREENKO WIND ENERGIES PVT LTD

CONTENTS

PROJECT AT GLANCE

1.	Name of the Project	Greenko Wind Energies Pvt Ltd
2.	Location: a) Vicinity b) District c) State	 Kondapalle RF and Kuderu RF near Balavenkatapuram Anantapur Andhra Pradesh
3.	Installed Capacity	1600kW x 29WTGs = 46.4MW
4.	Annual Energy Generation at P75 dependable year	50 GWh
5.	Plant Load Factor	26 %
6.	Net Saleable Energy to Third Party after deducting for Losses	40 GWh
7.	Power Evacuation	132/33 kV or 220 kV Sub Station
8.	Cost per MW of Installed Capacity	Rs. 7.50 Cr per MW
9.	Total cost of the Project on Completion	Rs. 348 Cr
10.	Means of Finance a) Debt / Equity Ratio b) Equity c) Debt	 30:70 Rs.104.4 Cr Rs.243.6 Cr

SALIENT FEATURES OF THE PROJECT

1	Mandal	Kanaganapalli
2	District	Anantapur
3	State	Andhra Pradesh
4	Country	India
5	Latitude	14°32'37.1"N
6	Longitude	77°21'03.6"E
7	Wind Zone	Class III
8	Nearest railway station	Anantapur
9	Each Turbine capacity	1600kW
10	Number of blades per turbine	03
11	Number of turbines	29
12	Nearest airport	Bengaluru International Airport
13	Nearest Highway	SH-82
14	Distance from Anantapur Town	32km
15	Climate in Anantapur District	Generally Tropical
		Minimum temperature : 26℃
		Maximum temperature : 46℃
		Relative humidity: 68%
		Annual rainfall – average: < 700 mm
16	Power evacuation	132/33kV or 220kV SS
17	Land Area	52.66Hectares
18	Elevation	600m above Mean Sea Level

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1. WIND POWER PROJECT

Greenko Wind Energies Pvt Ltd is started by experienced engineers with more than 10 years experience in executing projects and immense experience in development of Wind Power Projects all over India. GWEPL proposes to set up a 46.4MW Wind Power Project at Kondapalle RF and Kuderu RF, Anantapur district, Andhra Pradesh.

The plant will be designed to use wind energy to produce 46.4MW ecofriendly electricity.

The possibilities of wind power station near Kondapalle RF and Kuderu RF, Anantapur district, have opened an opportunity to utilize the same for the power generation. This has established an economical solution for quick augmentation of power generation efficiently through wind based power plant.

1.2. PROJECT DETAILS

Project Location : Kondapalle RF and Kuderu RF, Anantapur district

Gross Plant Capacity (MW) : 46.4MW

Population displacement : Nil

EXECUTIVE SUMMARY

CHAPTER 2
EXECUTIVE SUMMARY

2.1. PURPOSE

The purpose of this report is to present the techno-economic details for the proposed Wind Power Project 46.4MW at site conditions. The proposed power project would be installed in Kondapalle RF and Kuderu RF, Anantapur district, Andhra Pradesh.

This report highlights the brief technical details of the power plant site, technical features, schedule for project execution and organization setup for satisfactory operation and maintenance of the power plant.

2.2. Aspect of DPR

The report broadly covers the following aspects pertaining to the plant:

- Features of the selected site considering land availability and its topography, soil conditions, accessibility by rail and road, availability of Power evacuation plans and other requirements.
- Based on the available resources & Wind data, selection of the configuration of the power plant in respect of number and capacity of Wind turbine generators.
- Preparation of Plot Plan, General Arrangement and Alignment of the Wind Turbines.
- Technical details/description of plant mechanical system/ equipment, electrical system/equipment including preparation of electrical single line diagrams, and Instrumentation & Control system philosophy including plant control philosophy for Wind turbines and all auxiliaries.
- Brief technical descriptive features of the civil / structural works with architectural finishes.
- Project implementation schedule preparation with suggestions for speedy execution.
- Preparation of organization set up for satisfactory operation and maintenance of the plant.

2.3. POWER PROJECT CAPACITY

The Wind power plant option is an attractive proposition compared to the conventional power plant for the following reasons.

- Eco Friendly
- Shorter gestation period

- Higher availability, reliability and flexibility in operation
- Shorter project execution period

The 46.4MW wind power project comprises of 29Nos of Wind turbines @ 1600kW capacity of each, with all auxiliaries.

2.4. LOCATION

The proposed power plant will be located in KONDAPALLE RF AND KUDERU RF, Anantapur District, Andhra Pradesh. The site is approximately 32km from Anantapur. The site is easily approachable by SH-82. Availability of land and infrastructure facilities and atmospheric conditions influenced the site location.

2.5. LAND

The proposed site is in Government/Private land and the total area required will be about 52.66Hectares.

2.6 POWER EVACUATION

The power generated at 690V would be stepped up to 33 kV for its evacuation of the power project based on the proposal recommended by APTRANSCO/DISCOM with suitable metering arrangement will be done along with ABT metering on panel.

2.6. PROJECT COST ESTIMATE

Based on the current international prices of major equipment to be imported and indigenous prices for the balance equipment / materials, the total project cost of the 46.4MW Wind power project including interest during construction is estimated at Rs. 348 Cr. This cost includes pre-operative expenses, EPC and preliminary expenses.

POWER SECTOR SCENARIO

CHAPTER 3

POWER SECTOR SCENARIO

3.0. INDIAN POWER SECTOR SCENARIO

Energy has been universally recognized as one of the most important inputs for economic growth and human development. There is a strong two-way relationship between economic development and energy consumption. On one hand, growth of an economy, with its global competitiveness, hinges on the availability of cost-effective and environmentally benign energy sources, and on the other hand, the level of economic development has been observed to be reliant on the energy demand.

3.1. POWER GENERATION

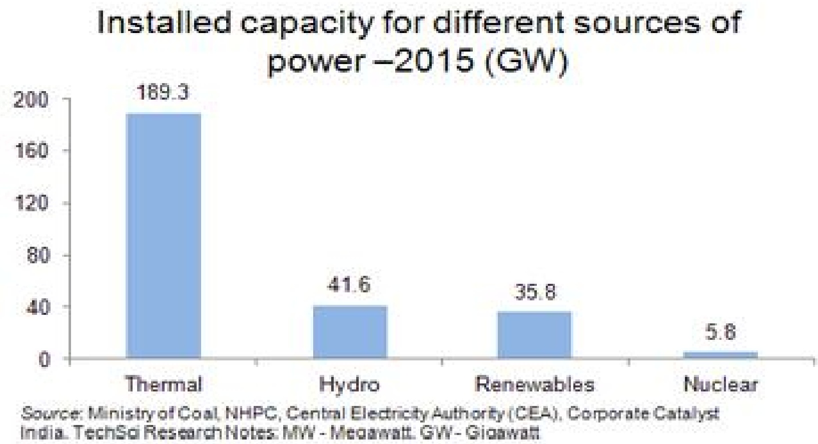
Electricity generation capacity with utilities in India had grown from 1.713 GW in December 1950 to over 272.50 GW by August 2015. India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia. Renewable Power plants constituted 28.43% of total installed capacity and Non-Renewable Power Plants constituted the remaining 71.57%. India generated around 967 TWh (967,150.32 GWh) of electricity (excluding electricity generated from renewable and captive power plants) during the 2013–14 fiscal. The total annual generation of electricity from all types of sources was 1102.9 TeraWatt-hours (TWh) in 2013. India is world's 6th largest energy consumer, accounting for 3.4% of global energy consumption. Due to India's economic rise, the demand for energy has grown at an average of 3.6% per annum over the past 30 years.

The installed capacity in India till August 2015 is 272.50 GW. Thermal Power generation remains the major contributor to the Indian Power Sector with installed capacity of 189.30 GW as on 31st August 2015.

Sources of Power with shares in total installed capacity

•As of 2015, total thermal installed capacity stood at 189.3 GW, while hydro and renewable energy installed capacity totaled 41.6 GW and 35.8 GW, respectively. At 5.8 GW, nuclear energy capacity had increased considerably which otherwise remained the same from 2010 - 14

•For the 12th Five-Year Plan, a total of 88.5 GW of power capacity addition is targeted; of which, 72.3 GW constitutes thermal power, 10.8GW hydro power and 5.3 GW nuclear power



Power Sector at a Glance ALL INDIA

Sector	MW	%age
State Sector	96,825	34.4
Central Sector	74,171	26.4
Private Sector	110,427	39.2
Total	**281,423**	

1.Total Installed Capacity:(As on 30.11.2015):

Fuel	MW	%age
Total Thermal	**195,604**	**69.5**
Coal	170,138	60.5
Gas	24,473	8.7
Oil	994	0.4
Hydro (Renewable)	42,623	15.2
Nuclear	5,780	2.1
RES** (MNRE)	36,41	13.3

Total	**281,423**	

Renewable Energy Sources(RES) include SHP, BG, BP, U&I and Wind Energy

SHP= Small Hydro Project ,BG= Biomass Gasifier ,BP= Biomass Power,

U & I=Urban & Industrial Waste Power, RES=Renewable Energy Sources

Generation Performance

1.0 ELECTRICITY GENERATION PERFORMANCE

1.1 The electricity generation target for the year 2015-2016 was fixed as 1137.5 Billion Unit (BU). i.e. growth of around 8.47% over actual generation of 1048.673 for the previous year (2014-2015). The generation during (2014-15) was 1048.673 BU as compared to 967.150 BU generated during April-March 2014, representing a growth of about 8.43%.

1.2 Programme, actual achievement and growth in electricity generation in the country during 2009-10 to 2015-16 :-

Year	Target	Achievement	% of target	% of growth
2009-10	789.511	771.551	97.73	6.6
2010-11	830.757	811.143	97.64	5.56
2011-12	855.000	876.887	102.56	8.11
2012-13	930.000	912.056	98.07	4.01
2013-14	975.000	967.150	99.19	6.04
2014-15	1023.000	1048.673	102.51	8.43
2015-16* (Upto November 2015)	754.600	739.915	98.05	4.55

1.3 The electricity generation target for the year 2014-15 has been fixed at 1137.5 BU comprising of 966.700 BU thermal; 128.000 BU hydro; 38.000 nuclear; and 4.800 BU import from Bhutan.

2.0 Plant Load Factor (PLF):

2.1 Notwithstanding the fact that many of the Thermal Power Station (TPSs) in the country are very old, the plant load factor has shown improvement over the years 2009-10 to 2012-13.

2.2 The PLF in the country during 2009-10 to 2015-16 is as under:

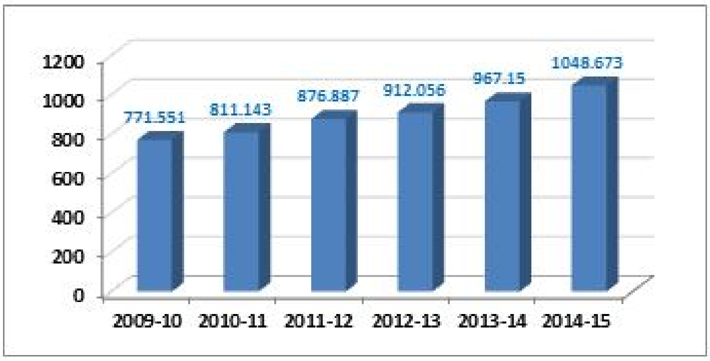
Year	Target	Actual	Sector-wise Actual		
	%	%	Central	State	Private
2009-10	77.2	77.5	85.5	70.9	83.9
2010-11	72.1	75.1	85.1	66.7	80.7
2011-12	68.7	73.3	82.1	68.0	69.5
2012-13	70.0	69.9	79.2	65.6	64.1
2013-14	69.60	65.60	76.10	59.10	62.10
2014-15	65.52	64.46	73.96	59.83	60.58
2015-16 (Upto November 2015)	66.31	61.62	71.79	55.17	59.43

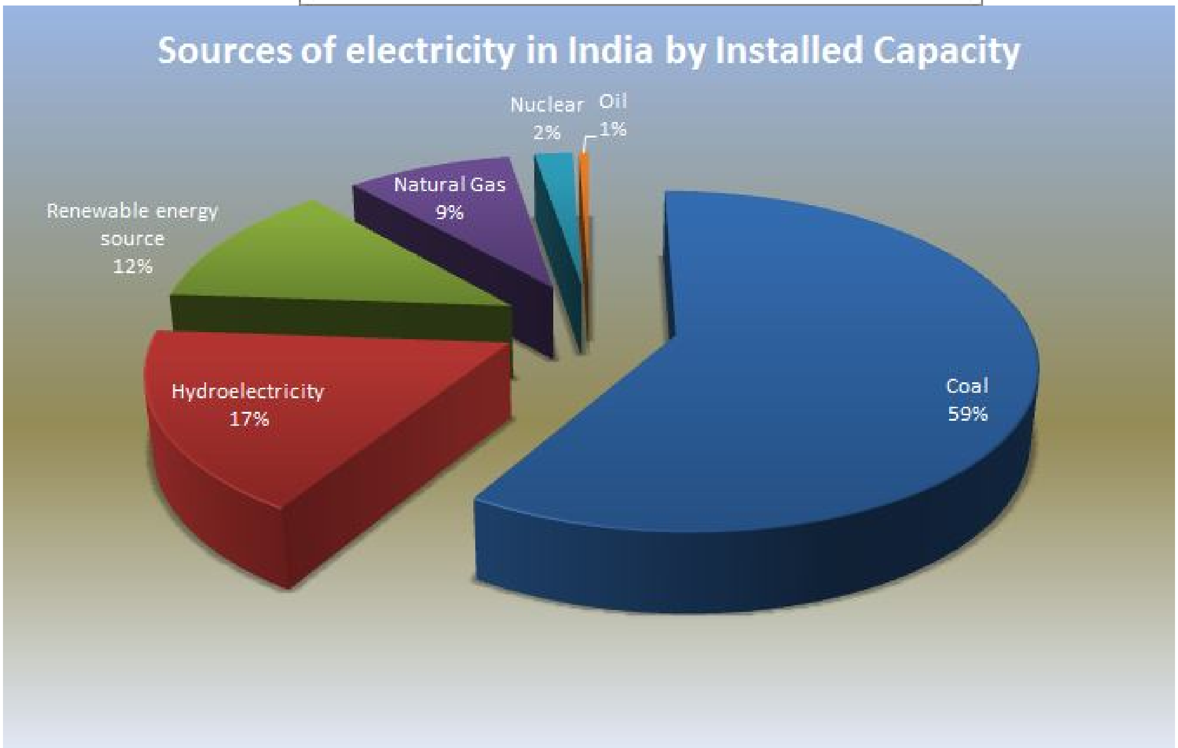
3.0 Power Supply Position
The power supply position in the country during 2009-10 to 2015-16 :

	Energy				Peak			
Year	Requirement	Availability	Surplus(+)/Deficts(-)		Peak Demand	Peak Met	Surplus(+) / Deficts(-)	
	(MU)	(MU)	(MU)	(%)	(MW)	(MW)	(MW)	(%)
2009-10	8,30,594	7,46,644	-83,950	-10.1	1,19,166	1,04,009	-15,157	-12.7
2010-11	8,61,591	7,88,355	-73,236	-8.5	1,22,287	1,10,256	-12,031	-9.8

2011-12	9,37,199	8,57,886	-79,313	-8.5	1,30,006	1,16,191	-13,815	-10.6
2012-13	9,95,557	9,08,652	-86,905	-8.7	1,35,453	1,23,294	-12,159	-9.0
2013-14	10,02,257	9,59,829	-42,428	-4.2	1,35,918	1,29,815	-6,103	-4.5
2014-15	10,68,923	10,30,785	-38,138	-3.6	1,48,166	1,41,160	-7,006	-4.7
2015-16*	7,48,676	7,31,445	-17,231	-2.3	1,53,366	1,48,463	-4,903	-3.2

***Provisional Upto November, 2015**





3.2. ENERGY CONSUMPTION

The per capita consumption remains stagnant since the development of installed capacity was not commutate with the population growth besides slow economic development among the masses of Indian Public. The per capita electricity consumption remains much lower than the world average and even lower than some of the developing Asian economies.

3.3. ENERGY DEFICIT:

India is likely to face an energy shortage of 2.1 per cent, or 24,077 million units (MUs) and a peak shortage of 2.6 per cent, of 4,208 Mw in 2015-16. In the last financial year, the energy shortage was 3.6 per cent (28,138 MUs) and peak shortage was 4.7 per cent (7,006 Mw). The peaking shortages are likely to prevail, mainly in the South and the Northeast, to the tune of 19.8 per cent and four per cent, respectively. On the other hand, surplus energy is anticipated in the order of two per cent and 3.3 per cent in the East and the West, respectively. These are the findings of the load generation balance report for the current financial year, recently released by the Central Electricity Authority (CEA).

State-wise all India allocated power capacity as of July 2015
(including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Maharashtra	24,669.27	3,475.93	-	28,145.20	690.14	3,331.84	6,205.65	9,537.49	38,372.83	13.91%
Gujarat	16,010.27	6,806.09	-	22,816.36	559.32	772.00	4,802.40	5,574.4	28,950.08	10.49%
Madhya Pradesh	11,126.39	257.18	-	11,383.57	273.24	3,223.66	1,670.34	4,894.00	16,550.81	6.00%
Chhattisgarh	13,193.49	-	-	13,193.49	47.52	120.00	327.18	447.18	13,688.19	4.96%

State-wise all India allocated power capacity as of July 2015 (including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Goa	326.17	48.00	-	374.17	25.80	-	0.05	0.05	400.02	0.14%
Dadra & Nagar Haveli	44.37	27.10	-	71.47	8.46	-	-	-	79.93	0.03%
Daman & Diu	36.71	4.20	-	40.91	7.38	-	-	-	48.29	0.02%
Central - Unallocated	1,622.35	196.91	-	1,819.26	228.14	-	-	-	2,047.40	0.74%
Western Region	**67,029.01**	**10,815.41**	**-**	**77,844.42**	**1,840.00**	**7,447.50**	**13,005.62**	**20,453.12**	**100,137.54**	**36.29%**
Rajasthan	9,400.72	825.03	-	10,225.75	573.00	1,719.30	4,710.50	6,429.8	17,228.55	6.24%
Uttar Pradesh	11,677.95	549.97	-	12,227.92	335.72	2,168.30	989.86	3,158.16	15,721.80	5.70%
Punjab	6,444.88	288.92	-	6,733.80	208.04	3,145.13	503.42	3,648.55	10,590.38	3.84%

State-wise all India allocated power capacity as of July 2015
(including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Haryana	6,527.53	560.29	-	7,087.82	109.16	1,456.83	138.60	1,595.43	8,792.41	3.19%
Delhi	5,001.87	2,366.01	-	7,367.88	122.08	822.05	34.71	856.76	8,346.72	3.03%
Himachal Pradesh	152.02	61.88	-	213.90	34.08	3,421.51	728.91	4,150.42	4,398.40	1.59%
Uttarakhand	399.50	69.35	-	468.85	22.28	2,441.82	244.32	2,686.14	3,177.27	1.15%
Jammu & Kashmir	329.32	304.14	-	633.46	77.00	1,805.21	156.53	1,961.74	2,672.20	0.97%
Chandigarh	32.54	15.32	-	47.86	8.84	62.32	5.04	67.36	124.06	0.04%
Central - Unallocated	977.19	290.35	-	1,267.54	129.80	754.30	-	754.30	2,151.64	0.78%
Northern Region	**40.943.50**	**5,331.26**	**12.99**	**46,274.76**	**1,620.00**	**17,796.77**	**7,511.89**	**25,308.66**	**73,203.42**	**26.53%**

State-wise all India allocated power capacity as of July 2015
(including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Tamil Nadu	10,075.10	1026.30	411.66	11,513.06	986.50	2,182.20	8,423.15	10,605.35	23,104.91	8.37%
Karnataka	6,408.46	-	234.42	6,642.88	475.86	3,599.80	4552.48	8,152.28	15,271.02	5.53%
Andhra Pradesh	5,849.21	1,672.65	16.97	7,538.83	127.16	1,721.99	2,002.65	3,724.64	11,390.64	4.13%
Andhra Pradesh	5,598.47	1,697.75	19.83	7,316.05	148.62	2012.54	62.75	2,075.29	9,539.96	3.46%
Kerala	1,038.69	533.58	234.60	1,806.87	228.60	1881.50	204.05	2,085.55	4,121.02	1.49%
Puducherry	249.32	32.50	-	281.82	52.78	-	0.03	0.03	334.63	0.12%
Central - NLC	100.17	-	-	100.17	-	-	-	-	100.17	0.04%
Central - Unallocated	1,523.08	-	-	1,523.08	300.48	-	-	-	1,823.56	0.66%

State-wise all India allocated power capacity as of July 2015
(including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Southern Region	**30,842.50**	**4,962.78**	**917.48**	**36,722.76**	**2,320.00**	**11,398.03**	**15,245.11**	**26,643.14**	**65,685.90**	**23.81%**
West Bengal	8,083.83	100.00	-	8,183.83	-	1,248.30	131.45	1,379.75	9,563.84	3.47%
Odisha	6,753.04	-	-	6,753.04	-	2,166.93	116.55	2,283.48	9,036.52	3.28%
DVC	7,160.66	90.00	-	7,250.66	-	193.26	-	193.26	7,443.92	2.70%
Bihar	2,516.24	-	-	2,516.24	-	129.43	114.12	243.55	2,759.79	1.00%
Jharkhand	2,404.93	-	-	2,404.93	-	200.93	20.05	220.98	2,625.91	0.95%
Sikkim	92.10	-	-	92.10	-	174.27	52.11	226.38	318.48	0.12%
Central - Unallocated	1,572.07	-	-	1,572.07	-	-	-	-	1,572.07	0.57%

State-wise all India allocated power capacity as of July 2015 (including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Eastern Region	**28,582.87**	**190.00**	**-**	**28,772.87**	**-**	**4,113.12**	**434.54**	**4,547.66**	**33,320.53**	**12.08%**
Assam	187.00	718.62	-	905.62	-	429.72	34.11	463.83	1,369.45	0.50%
Tripura	18.70	538.82	-	557.52	-	62.37	21.01	83.38	640.90	0.23%
Meghalaya	17.70	105.14	-	122.84	-	356.58	31.03	387.61	510.45	0.19%
Arunachal Pradesh	12.35	43.06	-	55.41	-	97.57	104.64	202.21	257.62	0.09%
Manipur	15.70	67.98	36.00	119.68	-	80.98	5.45	86.43	206.11	0.07%
Nagaland	10.70	46.35	-	57.05	-	53.32	29.67	82.99	140.04	0.05%
Mizoram	10.35	38.29	-	48.64	-	34.31	36.47	70.78	119.42	0.04%

State-wise all India allocated power capacity as of July 2015
(including allocated shares in joint and central sector utilities)

State/Union Territory	Thermal (in MW)				Nuclear (in MW)	Renewable (in MW)			Total (in MW)	% of Total
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
Central - Unallocated	37.50	104.44	-	141.94	-	127.15	-	127.15	269.09	0.10%
North-Eastern Region	**310.00**	**1,662.70**	**36.00**	**2,008.70**	**-**	**1,242.00**	**262.38**	**1,504.38**	**3,513.08**	**1.27%**
Andaman & Nicobar	-	-	40.05	40.05	-	-	10.35	10.35	50.40	0.02%
Lakshadweep	-	-	-	-	-	-	0.75	0.75	0.75	0.00%
Islands	**-**	**-**	**40.05**	**40.05**	**-**	**-**	**11.10**	**11.10**	**51.15**	**0.02%**
Total	**167,707.88**	**22,962.15**	**993.53**	**191,663.56**	**5,780**	**41,997.42**	**36,470.64**	**78,468.06**	**275,911.62**	**100.00%**

Other Renewable Energy Sources includes small hydro projects, wind, solar, tidal, biomass and urban & industrial waste power.

3.4 POWER SECTOR SCENARIO IN DIFFERENT REGIONS:

In terms of peak power requirement and availability during the month of September 2015, India had power supply deficit of -4903 Megawatt (MW) i.e. -3.2% with peak demand of 153366 MW of power supply and peak availability of 148463 MW of power supply.

The 10 States/UTs with highest percentage of deficit in peak power supply in September 2015 were: Uttar Pradesh, Andaman and Nicobar Islands, Karnataka, Jammu and Kashmir, Goa, Puducherry, Assam, Chhattisgarh, Bihar and Kerala.

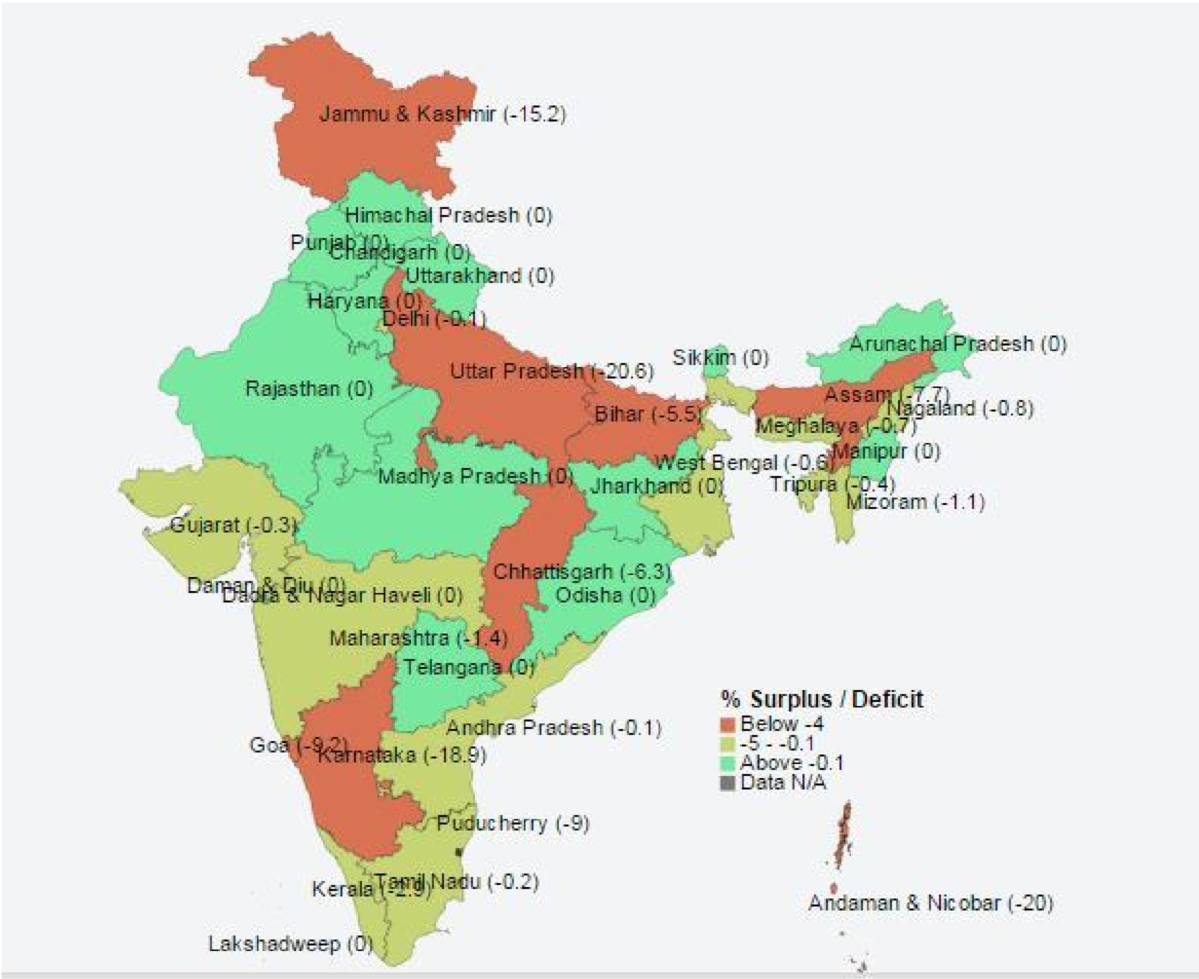
Uttar Pradesh had power supply deficit of -3495 MW (-20.6%) with peak demand of 16988 MW of power supply and peak availability of 13493 MW of power supply in September 2015. Andaman and Nicobar Islands had power supply deficit of -8 MW (-20%) with peak demand of 40 MW of power supply and peak availability of 32 MW of power supply in September 2015. Karnataka had power supply deficit of -1682.5mW (-18.9%) with peak demand of 9000 MW of power supply and peak availability of 7303 MW of power supply in September 2015.

Jammu and Kashmir had power supply deficit of -362 MW (-15.2%) with peak demand of 2388 MW of power supply and peak availability of 2046.4MW of power supply in September 2015. Goa had power supply deficit of -42 MW (-9.2%) with peak demand of 455 MW of power supply and peak availability of 413 MW of power supply in September 2015.

16 states/UTs had no deficit in terms of peak power requirement and availability during the month of September 2015.

Note: Lakshadweep and Andaman & Nicobar Islands are stand- alone systems. Power supply position of these does not form part of regional requirement and availability.

Peak Demand and Peak Power Supply in September 2015

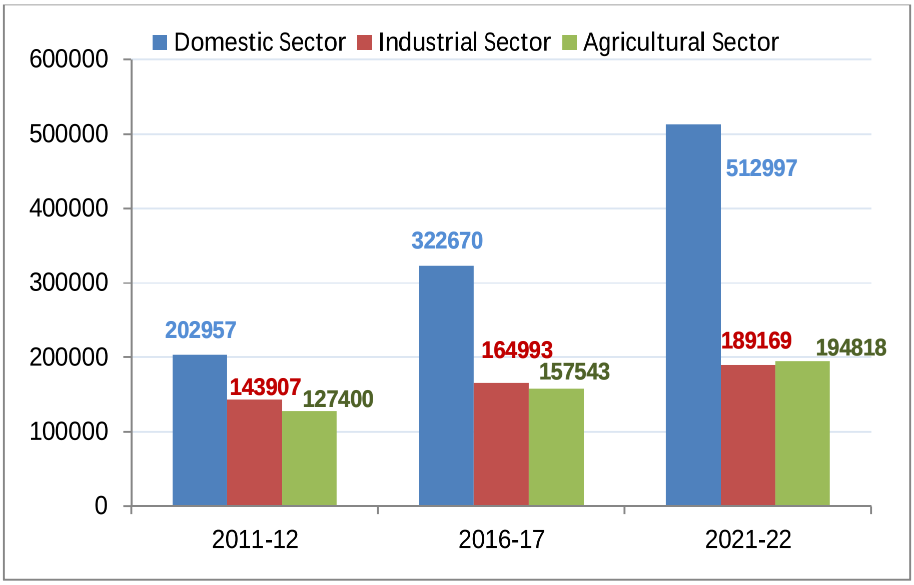


3.5 FUTURE TRENDS IN POWER SECTOR

In estimation with per capita GDP growth at 7.5% and electricity price grows at the rate of 2% per year the electricity consumption in 2011-12, 2016-17 and 2021-22 would be 457639 GWh, 514802 GWh and 595134 GWh respectively.

A capacity addition of 78,700 MW is planned for 11th plan i.e. till 2011-12. This is however not anticipated to be achieved (likely achievement will be around 50 %) and the 12th Plan will commence with a deficit addition. The long term forecast of electrical energy consumption at the end of 11th Plan, 12th Plan and 13th Plan may be 7582.547 GWh, 7133809 GWh and 3093266 GWh respectively.

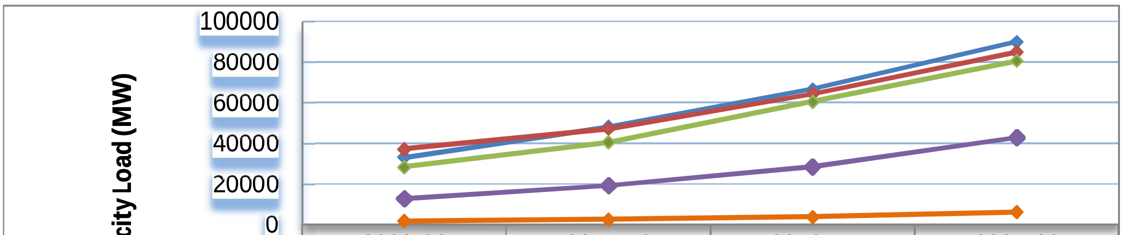
The predicted electricity consumption (in GWh) of different sector is shown in the figure below.



In the above figure the consumption in domestic sector is estimated with conditions of GDP growth at 8% and while agriculture sector is estimated to grow at 4% and industrial sector which has recovered from the recession with a positive growth rate is estimated with a growth rate of 10%. In all these cases, the electricity price is rising at 2% per year.

The peak electricity load in the country estimated to rise up to 298253 MW in 2021-22. In the near future, in 2011-12 the peak load may go up to 302806 MW from the current level of 14672 MW.

Below figure illustrates the estimation of peak electricity load (MW) of different regions.



	2008-09	2011-12	2016-17	2021-22
Northern Region	33034	48137	66583	89913
Western Region	37240	47108	64349	84778
Southern Region	28340	40367	60433	80485
Eastern Region	12901	19088	28401	42712
N-E astern Region	1820	2537	3760	6180

The above estimations show a stiff rise in peak demand of electricity in the country. Even if a state is self-sufficient in power, the issue in managing peak demand will remain critical with the rising population, industrialization and hence rise in energy consumption. The adverse effect of unmet Peak Electricity Load on the economic growth of the country as discussed earlier in Table 1.1 will continue unless until the issue is addressed in urgent.

WIND POWER DEVELOPMENT IN INDIA

CHAPTER 4
WIND POWER DEVELOPMENT IN INDIA

4.1. SIGNIFICANCE OF RENEWABLE ENERGY

Indian economy is highly dependent on “Coal” as fuel to generate electrical energy and for production processes. Thermal power plants are the major consumers of coal in India and yet the basic electricity needs of a large section of population are not being met.

This results in excessive demands for electricity and places immense stress on the environment. Changing coal consumption patterns will require a multi-pronged strategy focusing on demand, reducing wastage of energy and the optimum use of Renewable Energy (RE) sources.

Most of today’s electrical energy is generated by plant with a low cost of production and high reliability. However, concerns about the longer term sustainability of fossil fuel-based generation, particularly related to climate change and largely unaccounted future environmental costs, are driving the energy industry toward sustainable, low carbon emitting, renewable energy sources. Community expectation for this change is high and government policies are also driving the energy industry in this direction.

India is fortunately endowed with large potential of all forms of renewable energy sources, which has carbon avoidance potential.

The fossil fuels oil, coal and gas have two major disadvantages: their availability is not infinite and their combustion generates climate-damaging emissions - causing considerable subsequent damage and costs. The increased use of renewable energies is therefore not only reasonable but also has macroeconomic benefits. And it can also prevent million tons of climate-damaging CO_2 gas.

It is in the above background, the renewable source of energy has attracted global attention and evoked interest among planners, policy makers, economists and environmental activists as a viable option to achieve the goal of sustainable development. If the current interest in renewable source of energy gets concretized into projects to tap their enormous potential, the 21st century can be expected to move away from depleting fossil fuels.

Renewable Energy Sources will offer long term Energy Security to our Projects as well as contribute to Environment thro Clean Energy. In turn this will save for our Nation equivalent Grid power for which Country has to import Fossil fuel be it Coal or Petroleum.

Total Installed capacity from Renewable Energy sources is tabulated below:

Ministry of New & Renewable Energy			
Programme/ Scheme wise Physical Progress in 2015-16 (Up to the month of November, 2015)			
Sector	**FY- 2015-16**		**Cumulative Achievements**
	Target	**Achievement**	**(as on 30.11.2015)**
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)			
Wind Power	2400.00	1315.71	24759.32
Solar Power	1400.00	922,61	4684.74
Small Hydro Power	250.00	106.55	4161.90
Bio-Power (Biomass & Gasification and Bagasse Cogeneration)	400.00	132.00	4550.55
Waste to Power	10.00	12.00	127.08
Total	**4460.00**	**2311.88**	**38283.59**
II. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MW_{EQ})			
Waste to Energy	10.00	0.50	146.51
Biomass(non-bagasse) Cogeneration	60.00	10.50	602.37
Biomass Gasifiers -Rural	2.00	0.20	18.15
-Industrial	6.00	8.67	160.72
Aero-Genrators/Hybrid systems	0.50	0.13	2.67
SPV Systems	50.00	46.50	280.85
Water mills/micro hydel	2.00	0.00	17.21
Total	**130.50**	**66.50**	**1228.48**

III. OTHER RENEWABLE ENERGY SYSTEMS			
Family Biogas Plants (numbers in lakh)	1.10	0.22	48.34
Solar Water Heating – Coll. Areas(million m2)	-	0.00	8.90

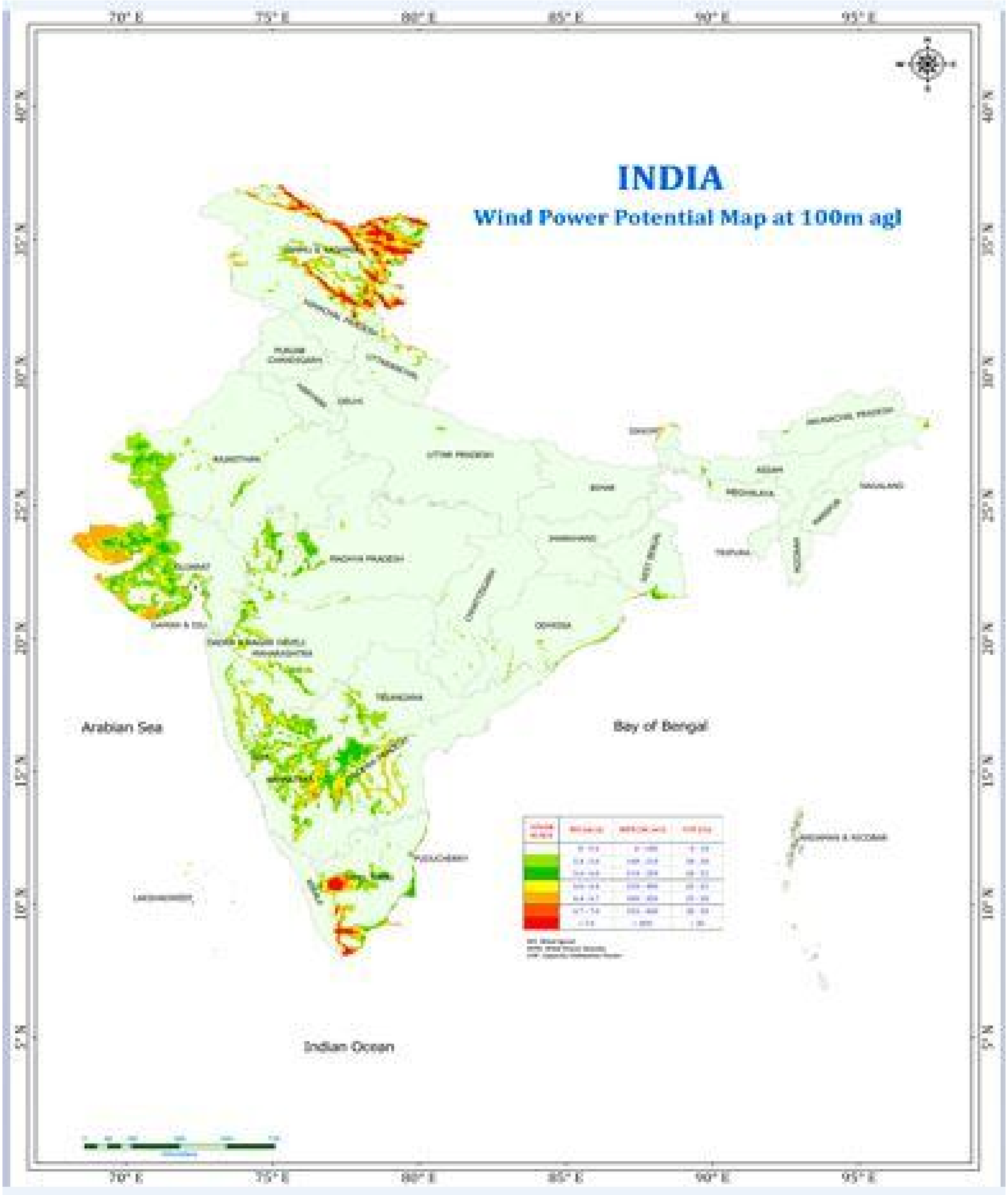
4.2. WHY WIND ENERGY

- Tax holiday for 10 consecutive years. (80 I (A))
- Operation and maintenance costs are low.
- Zero input fuel cost.
- Pay back in 8 to 10 years duration.
- Cost of generation is insignificant after payback period.
- Wheeling to SEB is easy, so no marketing problems.
- Future Benefits of carbon trading
- Expected flexibility under Electricity Act 2003

4.3. WIND POWER INSTALLED IN INDIA

The Indian wind energy sector has an installed capacity of 21264 MW (as on March 31, 2014). In terms of wind power installed capacity, India is ranked 5th in the World. Today India is a major player in the global wind energy market.

Wind power potential in different parts of India is given below



Source: NIWE

The potential is far from exhausted. It has been estimated that with the current level of technology, the 'on-shore' potential for utilization of wind energy for electricity generation is of the order of 45,000 MW. The unexploited resource availability has the potential to sustain the growth of wind energy sector in India in the years to come.

The positive development of wind energy in India has been driven by progressive state level legislation, including policy measures such as renewable portfolio standards and feed-in-tariffs.

MNRE has placed a vital role in framing the Policies and they have had a considerable and positive impact.

Some States with Renewable Portfolio Standards (RPS) or other policies to promote wind generation, have introduced feed-in-tariffs for wind generation which are higher than that for conventional electricity.

The state wise Wind Power installed in the country is tabulated below.

Sl. No.	State	**Installed Capacity (MW), as of 31 March 2015**
1	Tamil Nadu	7455.2
2	Maharashtra	4450.8
3	Gujarat	3645.4
4	Karnataka	2638.4
5	Rajasthan	3307.2
6	Madhya Pradesh	879.7
7	Andhra Pradesh	1031.4
8	Kerala	35.1
9	Others	4.30
Total		**23447.5**

COMPANY PROFILE

CHAPTER 5

COMPANY PROFILE

M/s. Greenko Wind Energies Pvt Ltd, company involved in the field of Renewable Energy Power Generation. The company is having its office at Plot no: 1071, Road No. 44, Jubilee Hills, Hyderabad-500033.

The group in operating by engineering professionals with vast experience in commissioning of wind power projects in the states of Andhra Pradesh, Maharashtra, Karnataka and Rajasthan. The Group is in the process of developing projects across India.

SITE INTRODUCTION

CHAPTER 6

SITE INDRODUCTION

The proposed site for the project is located on the terrain in Kondapalle RF and Kuderu RF, Kanaganapalli Mandal, Anantapur district in Andhra Pradesh. The site is of plain terrain and is wind monitored under NIWEs guidance. With the advent of machines with higher hub height the data was collected at 80 m. This is a site with very moderate wind regime. The project land will be around 52.66 Hectares along with approach road, internal roads and right of way for transmission lines. The site is accessible by road from Anantapur and the distance is 32km and the nearest airport is at Hyderabad and a distance of 181km. The site proposed is a plain site, with a number of small hills with elevation between 500 to 610 m above Mean Sea Level. The weather in Anantapur district remains moderate during the most part of the year. The maximum temperature is around 46°C with a minimum of 26°C. The average annual rainfall is around 700 mm. The atmosphere is not corrosive and hence it is not necessary to provide any special anti corrosive treatment for the wind turbine components and tower other than normal hot dip galvanizing.

POWER CURVE

CHAPTER 7

POWER CURVE

7.1 The power curve provided by different wind turbine manufacturers with the rotor diameter of 82.5m and Hub Height of 80m Tubular Tower will be considered for the micro-sitting.

Calculated Power curve considered for power generation is given below

Wind speed m/sec	Power kW
3	0
3.5	14
4	52
4.5	99
5	153
5.5	215
6	288
6.5	374
7	473
7.5	586
8	715
8.5	858
9	1012
9.5	1163
10	1310
10.5	1439
11	1529
11.5	1578
12	1606
12.5	1612
13	1619
13.5	1620
14	1620
14.5	1620
15	1620
15.5	1620
16	1620
16.5	1620
17	1620
17.5	1620
18	1620
18.5	1620

19	1620
19.5	1620
20	1620
20.5	1620
21	1620
21.5	1620
22	1620
22.5	1620
23	1620
23.5	1620
24	1620
24.5	1620
25	1620

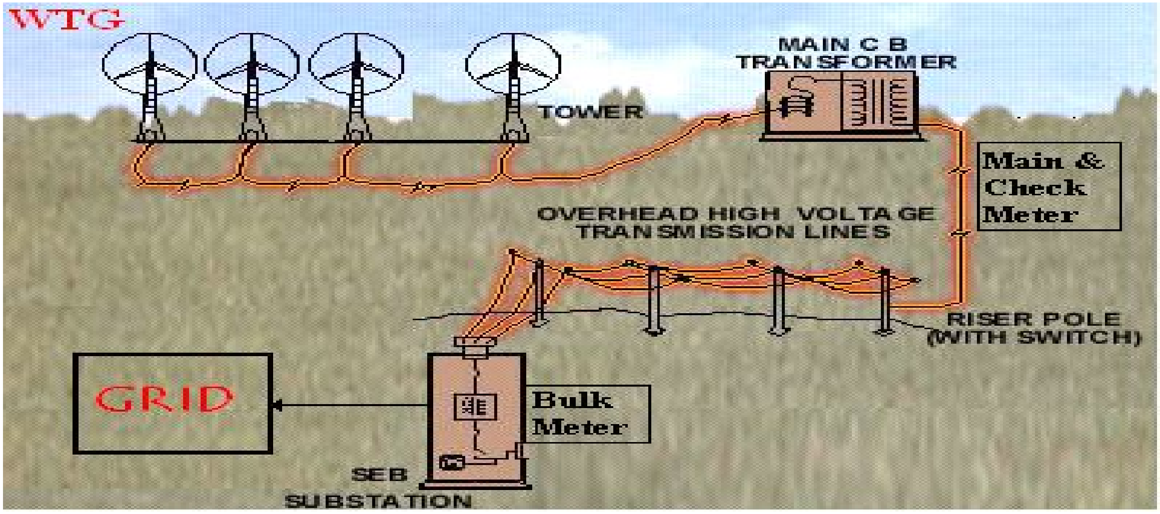
TECHNICAL DETAILS OF THE WIND MACHINE

CHAPTER 8

TECHNICAL DETAILS OF THE WIND MACHINES

8.1 PRINCIPLE OF WIND ENERGY CONVERSION:

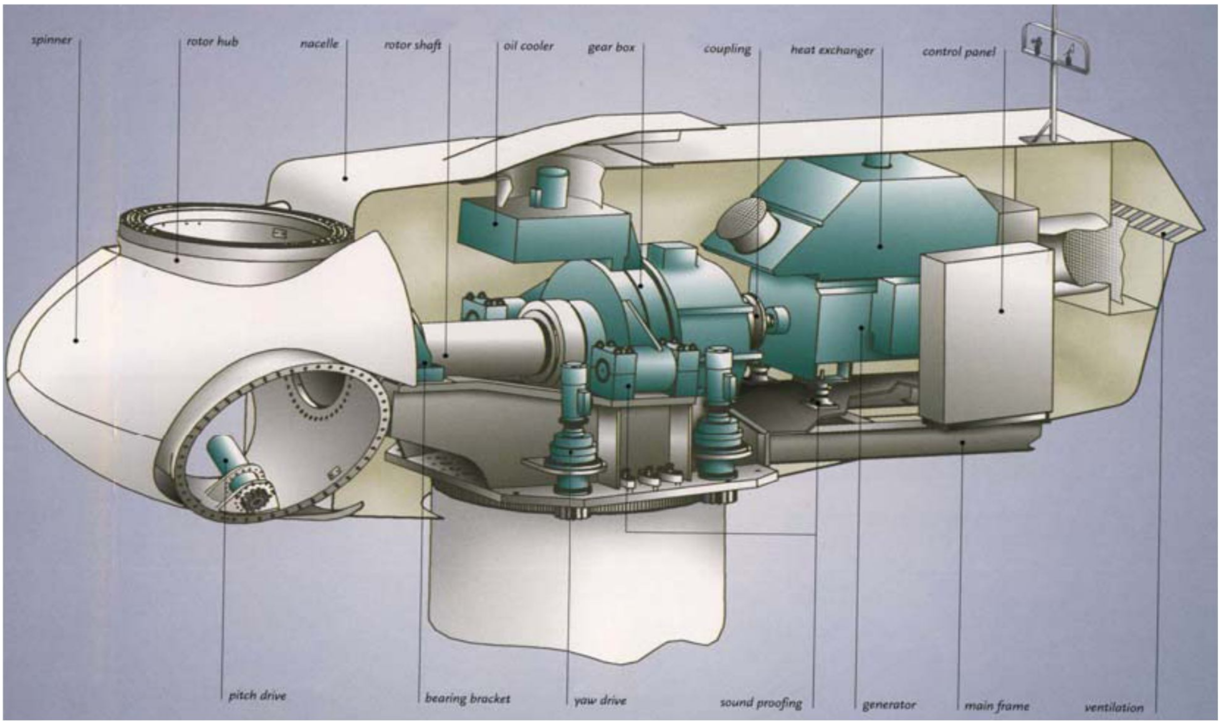
In wind energy generation, kinetic energy of wind is converted into mechanical energy and subsequently into electrical energy. Wind has considerable amount of kinetic energy when blowing at high speeds. This kinetic energy when passes through the blades of the wind turbines, it is converted into mechanical energy and rotates the wind blades. When the wind blades rotate, the connected rotor also rotate, thereby producing electricity with the help of a generator connected to the rotor. Typical construction of Wind farm is given below



8.2 TECHNICAL DESCRIPTION OF THE WIND TURBINE AND MAJOR COMPONENTS

The wind turbine is a three bladed, upwind, horizontal-axis wind turbine with a rotor diameter of 82.5m. The turbine rotor and nacelle are mounted on top of a tubular tower giving a rotor hub height of 80m. The machine employs active yaw control (designed to steer the machine with respect to the wind direction), active blade pitch control (designed to regulate turbine rotor speed), and a generator/power electronic converter system.

The wind turbine features a distributed drive train design wherein the major drive train components including main shaft bearings, gearbox, generator, yaw drives, and control panel are attached to a bedplate. Wind turbine parts are shown in the below figure.



a. ROTOR

The rotor diameter is 82.5m, resulting in a swept area of 7389 m^2, and is designed to operate between 9.8 and 18.7 rotations per minute (rpm). Rotor speed is regulated by a combination of blade pitch angle adjustment and generator/converter torque control. The rotor spins in a clock-wise direction under normal operating conditions when viewed from an upwind location.

Full blade pitch angle range is approximately 90°, with the 0°-position being with the airfoil chord line flat to the prevailing wind. The blades being pitched to a full feather pitch angle of approximately 90° accomplishes aerodynamic braking of the rotor; whereby the blades “spill” the wind thus limiting rotor speed.

b. BLADES

There are three rotor blades used on each wind turbine. The airfoils transition along the blade span with the thicker airfoils being located in-board towards the blade root (hub) and gradually tapering to thinner cross sections out towards the blade tip.

c. BLADE PITCH CONTROL SYSTEM

The rotor utilizes three (one for each blade) independent electric pitch motors and controllers to provide adjustment of the blade pitch angle during operation. Blade pitch angle is adjusted by an electric drive that is mounted inside the rotor hub and is coupled to a ring gear mounted to the inner race of the blade pitch bearing

Active-pitch controller enables the wind turbine rotor to regulate speed, when above rated wind speed, by allowing the blade to “spill” excess aerodynamic lift. Energy from wind gusts below rated wind speed is captured by allowing the rotor to speed up, transforming this gust energy into kinetic which may then be extracted from the rotor.

Three independent back-up units are provided to power each individual blade pitch system to feather the blades and shut down the machine in the event of a grid line outage or other fault. By having all three blades outfitted with independent pitch systems, redundancy of individual blade aerodynamic braking capability is provided.

d. HUB

The hub is used to connect the three rotor blades to the turbine main shaft. The hub also houses the three electric blade pitch systems and is mounted directly to the main shaft. Access to the inside of the hub is provided through a hatch.

e. GEARBOX

The gearbox in the wind turbine is designed to transmit power between the low-rpm turbine rotor and high-rpm electric generator. The gearbox is a multi-stage planetary/helical gear design. The gearbox is mounted to the machine bedplate. The gearing is designed to transfer torsional power from the wind turbine rotor to the electric generator. A parking brake is mounted on the high-speed shaft of the gearbox.

f. BEARINGS

The blade pitch bearing is designed to allow the blade to pitch about a span-wise pitch axis. The inner race of the blade pitch bearing is outfitted with a blade drive gear that enables the blade to be driven in pitch by an electric gear-driven motor/controller.

The main shaft bearing is a roller bearing mounted in a pillow-block housing arrangement.

The bearings used inside the gearbox are of the cylindrical, spherical and tapered roller type. These bearings are designed to provide bearing and alignment of the internal gearing shafts and accommodate radial and axial loads.

g. BRAKE SYSTEM

The electrically actuated individual blade pitch systems act as the main braking system for the wind turbine. Braking under normal operating conditions is accomplished by feathering the blades out of the wind. Any single feathered rotor blade is designed to slow the rotor, and each rotor blade has its own back-up to provide power to the electric drive in the event of a grid line loss.

The turbine is also equipped with a mechanical brake located at the output (high-speed) shaft of the gearbox. This brake is only applied as an auxiliary brake to the main aerodynamic brake and to prevent rotation of the machinery as required by certain service activities.

h. GENERATOR

The generator is a doubly-fed induction type. The generator meets protection class requirements of the International Standard IP 54 (totally enclosed). The generator is mounted to the bedplate and the mounting is designed so as to reduce vibration and noise transfer to the bedplate.

i. FLEXIBLE COUPLING

Designed to protect the drive train from excessive torque loads, a flexible coupling is provided between the generator and gearbox output shaft this is equipped with a torque-limiting device sized to keep the maximum allowable torque below the maximum design limit of the drive train.

j. YAW SYSTEM

A roller bearing attached between the nacelle and tower facilitates yaw motion. Planetary yaw drives (with brakes that engage when the drive is disabled) mesh with the outside gear of the yaw bearing and steer the machine to track the wind in yaw. The automatic yaw brakes engage in order to prevent the yaw drives from seeing peak loads from any turbulent wind.

The controller activates the yaw drives to align the nacelle to the average wind direction based on the wind vane sensor mounted on top of the nacelle.

A cable twist sensor provides a record of nacelle yaw position and cable twisting. After the sensor detects excessive rotation in one direction, the controller automatically brings the rotor to a complete stop, untwists the cable by counter yawing of the nacelle, and restarts the wind turbine.

k. Tower

The wind turbine is mounted on top of a tubular tower. The tubular tower is manufactured in sections from steel plate. Access to the turbine is through a lockable steel door at the base of the tower. Service platforms are provided. Access to the nacelle is provided by a ladder and a fall arresting safety system is included. Interior lights are installed at critical points from the base of the tower to the tower top.

l. Nacelle

The nacelle houses the main components of the wind turbine generator. Access from the tower into the nacelle is through the bottom of the nacelle. The nacelle is ventilated. It is illuminated with electric light. A hatch at the front end of the nacelle provides access to the blades and hub. The rotor can be secured in place with a rotor lock.

m. ANEMOMETER, WIND VANE AND LIGHTNING ROD

An anemometer, wind vane and lightning rod are mounted on top of the nacelle housing. Access to these sensors is accomplished through a hatch in the nacelle roof.

n. LIGHTNING PROTECTION

The rotor blades are equipped with a lightning receptors mounted in the blade. The turbine is grounded and shielded to protect against lightning, however, lightning is an unpredictable force of nature, and it is possible that a lightning strike could damage various components notwithstanding the lightning protection deployed in the machine.

o. WIND TURBINE CONTROL SYSTEM

The wind turbine machine can be controlled automatically or manually from either an interface located inside the nacelle or from a control box at the bottom of the tower. Control signals can also be sent from a remote computer via a Supervisory Control and Data Acquisition System (SCADA), with local lockout capability provided at the turbine controller.

Service switches at the tower top prevent service personnel at the bottom of the tower from operating certain systems of the turbine while service personnel are in the nacelle. To override any machine operation, Emergency-stop buttons located in the tower base and in the nacelle can be activated to stop the turbine in the event of an emergency.

p. POWER CONVERTER

The wind turbine uses a power converter system that consists of a converter on the rotor side, a DC intermediate circuit, and a power inverter on the grid side.

The converter system consists of a power module and the associated electrical equipment. Variable output frequency of the converter allows operation of the generator.

TECHNICAL SPECIFICATIONS OF THE WEG ARE GIVEN BELOW:

Parameter	Description
Rotor Diameter	82.5m
Tower Height	80m
Nacelle	Glass fiber Reinforced Plastic cover with sky light hatch, lighting and venting.
Noise abatement	The gear box and generator mountings are designed such that they minimize vibration and noise transfer to the blade plate, additionally nacelle housing interior is lined with thick sound insulation material
Lighting	Inside Nacelle and tower interiors
Tower	Tubular, Steel tower of hub height 80m designed to IEC specifications. Connection to foundation via to foundation rings. Anti corrosion protection provided by multiple coatings.

Door	Steel door including locking cylinder and air louvers.
Rotor Blades	Three rotor blades with lighting protection system. Rotor diameter 82.5m. Pitch regulation with electric single blade positioning and supply back up in hub
Gear Box	Planetary spur combination
Generator	Doubly fed asynchronous generator with slip rings.
Down tower assembly	Integrate the main control, IGBT convertor and low voltage distribution in to single cabinet. Data is designed free of water invasion or tide attack
Power factor of system	The adjustable power factor 0.95 ind. To 0.95 cap adjustable can be maintained at a constant level across the entire power range with in the frame work of control tolerances
Electrical system	As per seller's technical specification
Control Cabinet	Design of system controls to protection level IP 54
Wind Direction Gauge and anemometer	Positioned on nacelle roof
Color	Light gray, RAL 7035 or similar, for tower, nacelle and blades
Remote Monitoring	Remote data monitoring via modem and computer. The connection is through broadband line .In the event of fault in the operating sequence of the unit, a message is automatically sent to the computer at service center or operating center
Wind SCADA	Wind SCADA Standard over view
Codes and standards	As per applicable IEC Standard and GL guide lines
Alternator output	690 VA
Power factor	0.8
Voltage	33000 V ± 5%

Gross output of the wind power plant is 46.4MW at site conditions and gross output of each WEG is 1600kW.

The electrical system consists of LT & HT switchgear, transformer, switchyard equipments, 430 V MCC, DC system, and lighting, UPS, emergency power supply, and earthling and associated protection devices.

The plant control and instrumentation will consist of interlocks and protection, auto control, local instruments and PLC's.

POWER EVACUATION

CHAPTER 9

POWER EVACUATION

The power generated from the proposed wind power project shall be evacuated to APTRANSCO/DISCOM SS. Power would be evacuated on a convenient voltage that is most feasible technically as well as economically. The major criteria for selection of voltage are quantum of power to be transmitted, the distance up to available of grid facility etc

The power evacuation shall be on 132 kV or 220 kV Voltage level.

The evacuation approval will be obtained from APTRANSCO/DISCOM for the evacuation of power generated from this project.

INFRASTRUCTURE

CHAPTER 10

INFRASTRUCTURE

10.1. INFRASTRUCTURE

CONSTRUCTION

Site activities of project group will be carried out as per Prescribing systems and procedures, their scope of responsibilities, inter-relationships as outlined in the various chapters.

This management system is a part of Integrated Project Management and Control System developed by the consultant for implementation of Power projects with the object of achieving the goal within the defined schedule of time, cost and quality.

Organization tasks and framework for construction management has been organized in four distinct headings namely:

- Construction Management Tasks.
- Construction Management Organization
- Functional Boundaries & Scope of Work
- Construction Management Interface.

The Construction Management Tasks cover the following:

- Infrastructure development
- Construction execution supervision
- Safety and security
- Planning, Scheduling, Reviewing and Control
- Field quality surveillance
- Site contracting
- Material Management
- Cost control
- Liaison with external agencies
- Personnel administration and welfare
- Finance and Account.

10.2. SITE PREPARATION

a. ROAD AND SURFACE PREPARATION

Black top road is available up to the proposed site location. These roads are required to be widened and strengthened for heavy movement of trailers and cranes. Approach road has to be constructed to carry the WTGs to site.

The strength of the road has been designed to carry the cranes and heavy trailers. At each tower location the surface shall be levelled and compacted for crane handling and tower assembly.

In order to assess the exact depth of cutting required for the proposed slope, the profile survey shall be done and it is proposed that the length of the road be increased if required to reduce the depth of cutting. For constructing the road and to prepare the top surface 3 numbers of series excavators will be deployed with the rocker buckets, two numbers of compressors, two numbers tippers, one number water tanker and one number of road roller will also be deployed for speedy execution of works.

b. DRAINAGE

Drains along the raising side of the hill are proposed and at suitable points required size of culverts are proposed to be provided. The size of the drainage shall be maintained at 0.75x0.75 M. for ensuring the proper drainage of rainwater.

c. SOIL CONDITIONS

In order to determine the actual safe bearing capacity of the soil and to understand the details of stratification, soil investigation fieldwork will to be carried out and the same shall be entrusted to experienced and reputed agency.

The foundation for the Wind Turbine Generators shall be designed taking into consideration the local soil conditions.

d. CIVIL WORKS

The foundation for the Wind Turbine Generator will be casted as per the design supplied by the manufacturer.

In general the entire wind generator manufacturing companies having different type of foundation for the same machine depends on the strata of the soil.

The design supplied by the company for the same will be done according to the relevant IS standards.

The steel shall be of FE430 / FE 500 grade.

Before take up the construction activities the following factors will be considered.

- Soil bearing capacity of the particular location.
- Soil resistively.

e. ELECTRICAL INFRASTRUCTURE WORKS

All the electrical infrastructure works will be carried out as per the IE rules and as per the specification of APTRANSCO for the designing and construction of electrical works.

10.3. OPERATION AND MAINTENANCE

The proposed organization structure for the operation and maintenance (O&M) of the power plant is presented in the exhibits. In order to ensure a high level of performance of the power plant, it is proposed to induct experienced O&M engineers from the very beginning of the project.

The basic structure and the broad functional area within the O&M organization would be as follows.

The power plant manager would have the primary responsibility for the O&M of the power plant. The organization will comprise of three broad functional areas viz. operation, maintenance and administration. The basic duties covered under each of these functional areas would be as follows:

Operation Scope:

The manager, mechanical, electrical and instrumentation I/C will work in general shift. All other operation personnel would work on three shift basis.

Manpower for shift personnel managing key areas has been generally done on 3+1 concept, to take into account leave taken by shift personnel.

Maintenance Scope:

Maintenance of mechanical and electrical plant, control systems, buildings, roads and drainages etc. Operation of the plant work shop, planning and scheduling maintenance works and deciding the requirement of spare parts.

Trained technicians will be employed to assist the maintenance group in day to day maintenance of the plant.

10.4. MAN POWER TRAINING & PLACEMENT

Organization Structure

The project will be headed by a Power Plant manager, a senior level executive from the customer side, who will have overall administrative as well as technical control of the power plant. For effective operation, maintenance and administration of the project, adequate number of suitable technical and administrative personnel will be posted under him.

Training and Development

Performance of the employees always depends upon the training and developmental programs organized by the consultants / customers from time to time. This is one of the important tools to derive improved performance from the operators of the power plant.

A string of modern and well-equipped audio – visual program is set up at the project site as well as head quarters.

Type of Training – Pre-Employment Training

Pre-employment training aims at providing requisite skills and confidence to the personnel, who enter the organization as fresh trainees at different induction levels. Long duration training schemes and on the job training schemes is in vogue to take care of further training.

Post – Employment Training

Post – Employment Training provides opportunities to personnel at various levels of the organization hierarchy to take-up higher responsibility and skills and also to re-orient them to keep pace with the advancement in power plant operations / technology. This package basically has three components Viz. Management development for senior level executives for developing functional knowledge and managerial skills, specialized training activities to acquaint the employees with the latest technology around the world in power industries and employee development programs to develop and upgrade skills and also to attain higher educational levels for the benefit of personnel at different levels.

LAND DETAILS

CHAPTER 11

Land Details

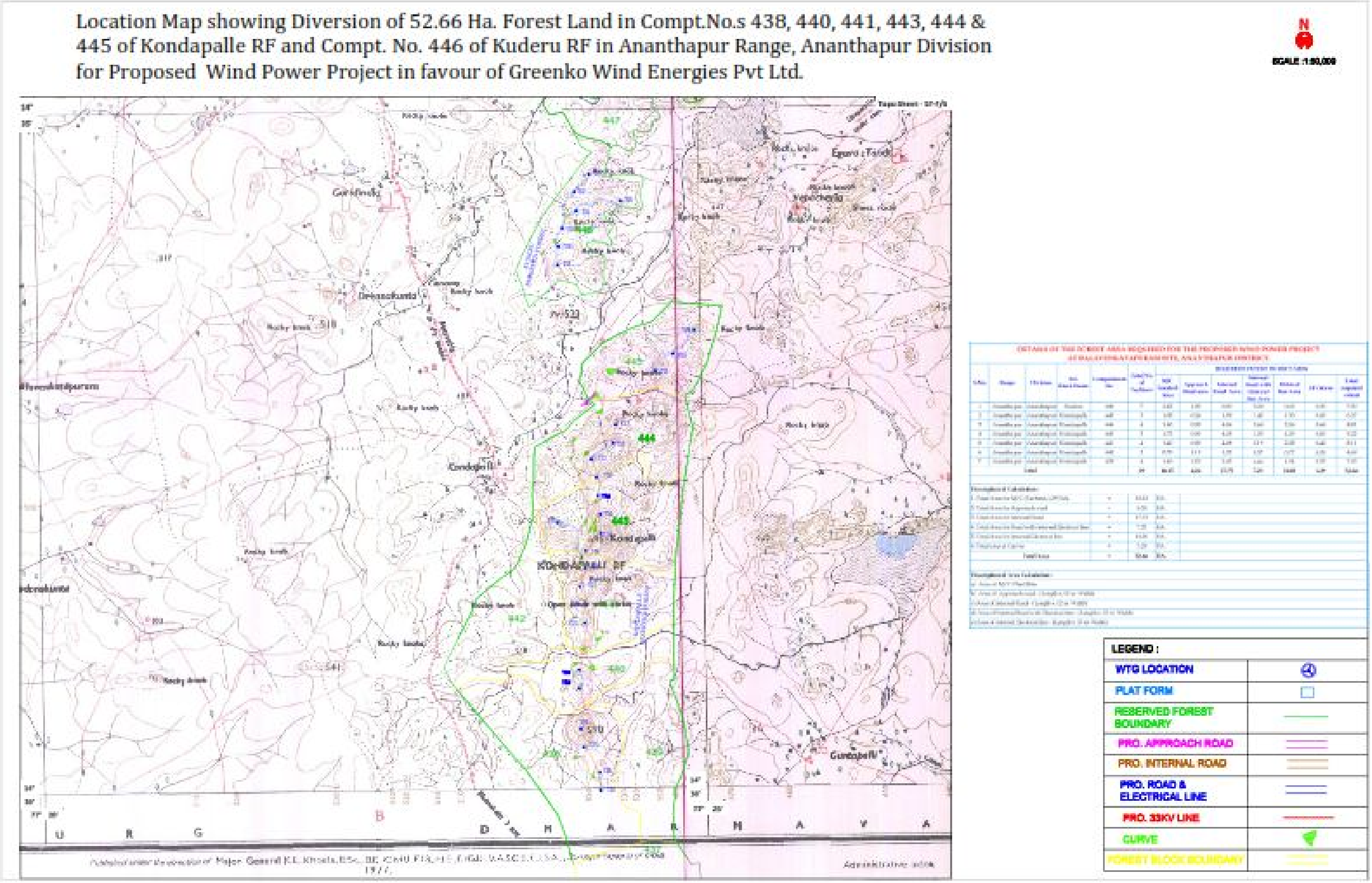
The total 52.66 Ha of land is required for the proposed project, which is forest land for Erection of Wind Turbine Generators, Electrical Lines and Approach roads etc. Detailed break-up of the land required is as below.

DETAILS OF THE FOREST AREA REQUIRED FOR THE PROPOSED WIND POWER PROJECT AT KUDERU &KONDAPALLI RFs, ANANTHAPUR DISTRICT.

S.No	Range	Division	R.F. Block Name	Compartment No	Total No of Turbines	REQUIRED EXTENT IN HECTARES						
						M/C Located Area	Approach Road area	Internal Road Area	Internal Road with Elertrical line Area	Eletrical line Area	At Curves	Total required extent
1	Ananthapuram		Kuderu	446	7	2.45	1.30	0.00	3.24	0.62	0.30	7.90
2			Kondapalle	445	3	1.05	0.24	1.59	1.45	1.30	0.65	6.27
3				444	4	1.40	0.00	4.06	0.64	2.06	0.64	8.81
4				443	5	1.75	0.00	4.28	1.33	1.29	0.60	9.25
5				441	4	1.40	0.00	4.08	0.19	2.05	0.40	8.11
6				440	2	0.70	1.19	1.32	0.37	0.77	0.35	4.69
7				438	4	1.40	1.52	2.43	0.00	1.94	0.35	7.63
Total					**29**	**10.15**	**4.24**	**17.75**	**7.21**	**10.01**	**3.29**	**52.66**

Description of Calculation :	Area (Ha)	
1. Total Area for M/C (Turbines.) 29 No's.	10.15	4.24
2. Total Area for Approach road	4.24	39.22
3. Total Area for Internal Road	17.75	
4. Total Area for Road with Internal Electrical line	7.21	
5. Total Area for Internal Electrical line	10.01	
6. Total area at Curves	3.29	52.66
Total Area	**52.66**	

Map showing the break-up of the land required for the project as below.



PROJECT COST ESTIMATE

CHAPTER 12

PROJECT COST ESTIMATE

Detailed project cost and its breakup is given below:

Project Cost Breakdown	Total Cost Crores	Cost/ MW
Equipment Cost	248.24	5.35
Land & Licenses	19.488	0.42
Civil Works	17.632	0.38
Electrical Works	32.944	0.71
Other Expenses	6.496	0.14
IDC & Finance Charges	19.024	0.41
Contingency	4.176	0.09
Total	**348**	**7.50**

MEANS OF FINANCE

The cost of establishing a 46.4MW Wind based power project is estimated at Rs. 348Crores and the same is envisaged to be financed in the following manner.

Share Capital : Rs.104.4 Cr

Term loan : Rs.243.6 Cr

In the above financing pattern, the debt equity ratio works out 30:70 and promoters would be bringing 30% of the project cost as share capital.

PROJECT FINANCIAL ANALYSIS

CHAPTER 13

PROJECT FINANCIAL ANALYSIS

13.1 General

The financial analysis gives the details of the operation and profitability, the cost of generation of power and cash flow after commissioning of the project. The analysis also gives the internal rate of return for the project, debt service coverage ratio and the rate of return of the quality.

Key assumptions considered in the model

Finance Related Assumptions

Debt	%	70%
Long term interest rate	%	11.5%
Tenure	Yrs	13
Moratorium	Yrs	0.5

CUF Probability		P75
Operation and Maintenance		
% of CAPEX	%	1.40%
Insurance Expenditure		
Charge in % of CAPEX	%	0.20%
Overhead Expenses		
% of CAPEX	%	0.10%

Saleable Electricity

The Gross generation of power at alternator terminals in the plant will be about 40 GWh.