INDIAN WIND ENERGY OUTLOOK 2011

GWEC
GLOBAL WIND ENERGY COUNCIL

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CONTENTS

Vani Vilas Sagar wind farm, Karnataka *© Enercon India*

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सत्यमेव जयते

MINISTER
NEW AND RENEWABLE ENERGY
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MESSAGE

I am delighted to know that the World Institute of Sustainable Energy, the Indian Wind Turbine Manufacturers' Association and Global Wind Energy Council are bringing out "Indian Wind Energy Outlook 2011" during the "Wind Power India 2011", an international wind energy conference and exhibition being held at Chennai.

Wind energy is the fastest growing renewable energy sector in the country. With a cumulative deployment of over 13,000 MW capacity, it accounts for nearly 70% of the installed capacity in the renewable energy sector in the country. The sector is growing rapidly and we are likely to achieve, for the first time in the country, a capacity addition of 2000 MW in a year, this year.

My Ministry has been at the forefront of providing all out support for the accelerated development of wind energy through proactive policy and regulatory interventions. Our policies provide for a host of fiscal incentives, feed-in-tariffs as a recently activated Renewable Energy Certificate regime. We have also recently introduced a Generation Based Incentive (GBI) Scheme to help more Independent Power Producers (IPPs) enter the arena. We are confident that our strongly facilitative measures will help India rapidly achieve its wind power potential.

Despite our remarkable progress leading to India attaining the fifth position globally in wind power generation, we are conscious that a lot more would need to be done. While we harness our vast on-shore potential; we have to also parallely explore our long coastal line to tap the possible off-shore wind potential. We have to start planning for repowering of old turbines and developing the technology to harness low wind regimes. I hope that the manufacturing industry as well as the developers are engaging themselves seriously in these issues.

I compliment the publishers of the outlook – it is a chronicle of our success so far; it is also, I hope, a reminder of the unfinished agenda and an inspiration for all of us to collectively strive towards greater and greater heights.

(Farooq Abdullah)

India is a key market for the wind industry, presenting substantial opportunities for both the international and domestic players. In 2010, the Indian wind sector experienced its strongest annual growth ever, with 2.1 GW of new installations. With strong political will and the right incentives in place, wind energy can play a major role in securing a sustainable and clean energy future for India.

We are very pleased to release the 'India Wind Energy Outlook 2011' produced jointly by GWEC, WISE and IWTMA in time for the Wind Power India 2011 event in Chennai. This report is a valuable tool for members of the wind industry and policy makers alike to learn about the market opportunities and the legal and regulatory framework in India. In addition, it gives us insights into the challenges going forward and offers suggestions for overcoming remaining hurdles for wind power development.

The Indian government has been committed to exploring the country's vast renewable energy resources for the last three decades, and the time has now come to elevate this political will to concrete action, both to reap the domestic benefits from renewable energy development, and to build on India's growing leadership internationally in resolving both the energy and climate challenges.

In this, the work done by the Ministry of New and Renewable Energy under the guidance of the Hon'ble Minister Dr. Farooq Abdullah is laudable. We look forward to working closely with all stakeholders to strengthen the role that India can play in driving wind power development globally; while also supporting the efforts towards developing a comprehensive renewable energy law which would reinforce the National Action Plan on Climate Change target of 15% renewable energy for India by 2020.

The 'India Wind Energy Outlook 2011' is the wind industry's contribution to these discussions, and the wind energy sector looks forward to continuing the dialogue with decision makers in order to allow India to reap the full benefit of this indigenous and clean energy source.

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Wind farm in Bhuj, Gujarat © Wind Power Works

STATUS OF WIND POWER IN INDIA

1.1 RENEWABLE ENERGY IN INDIA

Nearly two decades ago the Indian economy was snatched back from the brink of a composite economic crisis[1]. The Indian government undertook some hard-hitting liberalization measures that would have been unthinkable in a business as usual political landscape. Largely as a result of those actions, today India is in a position to be counted as one of the 'emerging economies'.

Successive governments have looked towards locking in an average economic growth rate of at least 6-8%, up from 3.5% from the 1950s through the 1980s. The original objective of the 11th Five Year Plan (2007-2012[2]) was to achieve a GDP growth rate of 9% over this period. This was revised to 8.1% last year[3] by the Planning Commission. Given the plans for rapid economic growth, the requirement for energy services and supporting infrastructure is simultaneously escalating.

Electricity demand has continuously outstripped production, and a peak energy shortage of around 12.7% prevailed in 2009-10[4]. To meet this shortfall as well as the National Electricity Policy target of 'Electricity for All by 2012'[5], the cleanest options available to India are Renewable Energy Technologies (RETs). For the government to seriously consider meeting its promise of electricity for all by 2012[6], renewable energy options including wind power will have to play a crucial role in India's emerging energy mix. Not only are they environmentally sound but also their project gestation periods are significantly shorter than those for thermal or nuclear power plants.

According to the Ministry of New and Renewable Energy (MNRE), today the share of renewable based capacity is 10.9% (excluding large hydro) of the total installed capacity of 170 GW in the country, up from 2% at the start of the 10th Plan Period (2002-2007). This includes 13,065.78 MW of wind, 2,939 MW of small hydro power, 1,562 MW of (bagasse based) cogeneration, 997 MW of biomass, 73.46 MW of 'waste to power' and 17.80 MW of solar PV for grid connected renewables at the end of 2010[7].

The originally stated cumulative target for the current plan period was to add 92 GW[8] of new capacity of which about 14 GW was to come from renewable sources. Given the right mix of regulatory and institutional support, renewable sources could meet the proposed capacity addition of 14 GW from renewable energy before the end of the 11th five year plan-period (2007-2012). This would bring the total share of renewable energy sources upto 15% of the new installed capacity in the 11th plan-period.

Over the next decade, India will have to invest in options that not only provide energy security but also provide cost-effective tools for eradicating energy poverty across the board. India is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and has as part of its obligations released a National Action Plan on Climate Change[9] (released in June 2008) by Prime Minister Manmohan Singh which has laid out his government's vision for a sustainable and green future for India's economy.

India's developmental needs will be challenged by climate change impacts. This requires a timely pre-emptive shift towards achieving an energy efficient and green economy. Over the next couple of decades renewable energy will play a major role in delivering that shift.

1.2 WIND POWER SCENARIOS

There are several published scenarios that examine the future role of wind power globally as a part of the necessary energy system overhaul towards a clean energy future. The Global Wind Energy Council (GWEC) developed its scenarios in collaboration with Greenpeace International and the German Aerospace Centre (DLR). These scenarios are updated biennially. The resultant publication - the Global Wind Energy Outlook (GWEO)[10] - first looks toward 2020, and then onwards to 2030 and 2050. Some of the other prominent scenarios are the World Energy Outlook[11] (2010) from the International Energy Agency (IEA) and the Energy [R]evolution: A Sustainable World Energy Outlook[12] by Greenpeace (2010).

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1 The gross fiscal deficit of the government (center and states) rose to 12.7% by 1990-91. This deficit had to be met by borrowings, the internal debt of the government rose from 35% of GDP at the end of 1980-81 to 53% of GDP by 1990-91. The foreign exchange reserves had dried up to the point that India could barely finance three weeks worth of imports and had to air-lift its gold reserves to raise 600 million dollars from the Bank of England. http://www.cid.harvard.edu/archive/india/pdfs/530.pdf
2 The Indian Fiscal year runs from April to March. Hence 11th Plan period will run from April 2007 – March 2012, The 12th Plan period will run from April 2012 to March 2017.
3 http://economictimes.indiatimes.com/Policy/Commission-scales-down-11th-Plan-growth-target-to-81/articleshow/5714921.cms
4 http://www.mnre.gov.in/pdf/mnre-paper-direc2010-25102010.pdf
5 http://economictimes.indiatimes.com/news/news-by-industry/energy/power/electricity-for-all-by-2012-power-minister/articleshow/3836381.cms
6 Currently about 400 million people do not have access to electricity in India.
7 http://www.mnre.gov.in/ Click on link to 'Achievements' section. There could be some rounding-off errors.
8 http://planningcommission.gov.in/plans/planrel/fiveyr/11th/11_v3/11v3_ch10.pdf
9 http://pmindia.nic.in/climate_change.htm
10 http://www.gwec.net/index.php?id=168
11 http://www.worldenergyoutlook.org/docs/weo2010/WEO2010_es_english.pdf
12 http://www.springerlink.com/content/nu354g4p6576l238/fulltext.pdf

BOX 1: **GLOBAL WIND ENERGY OUTLOOK: SCENARIO AND ASSUMPTIONS**

Reference Scenario (IEA Based)	Moderate Scenario	Advanced Scenario
The most conservative of all, the 'Reference' scenario is based on the projections in the 2009 World Energy Outlook from the IEA. This takes into account only existing policies and measures, but includes assumptions such as continuing electricity and gas market reform, the liberalization of cross-border energy trade and recent policies aimed at combating pollution. The IEA's figures only go out to the year 2030, but based on these assumptions, DLR has extrapolated both the overall Reference scenario and the growth of wind power up to 2050.	The 'Moderate' scenario takes into account all policy and measures to support renewable energy either already enacted or in planning stages around the world. It also assumes that the targets set by many countries for either renewable, emission reductions and/or wind energy are successfully implemented, as well as the modest implementation of new policies aimed at reducing pollution and carbon emissions. It also takes into account environmental and energy policy measures that were part of many governments economic stimulus packages implemented since late 2008. Up to 2014 the figures for installed capacity are closer to being forecasts than scenarios.	The most ambitious scenario, the 'Advanced' version examines the extent to which this industry could grow in a best case 'wind energy vision'. The assumption here is a clear and unambiguous commitment to renewable energy as per the industry's recommendations along with the political will necessary to carry it forward.

There are many variables that will determine the path of development and growth of wind energy. The box above lists the assumptions underlying the GWEO scenarios and associated assumptions for wind power development.

GWEO SCENARIO RESULTS

The GWEO scenarios show that even with the continuation of current policy measures to encourage wind power development and serious government efforts to meet existing targets, the resulting 'Moderate' scenario growth will put the development of wind power on a dramatically different trajectory from the IEA-based 'Reference' scenario.

The global wind markets have grown by an average 28% per year in terms of total installed capacity during the last decade. The IEA's Reference scenario suggests that growth rates for wind power would decrease substantially in the coming years, and that 2010 would see an addition of only 26.8 GW. However, in reality the global wind industry added 35.8 GW during the year[13].

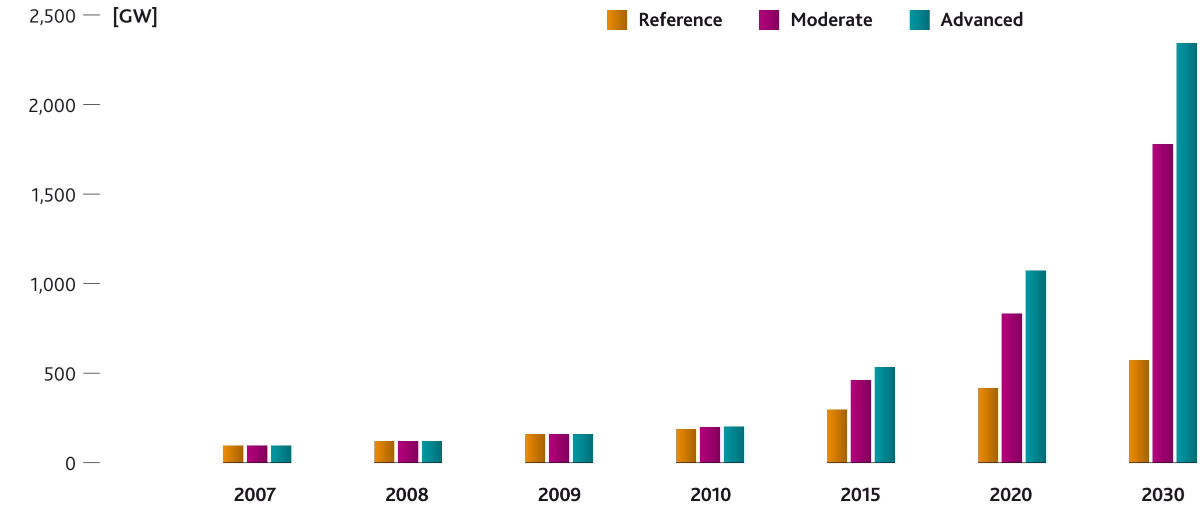
13 http://www.gwec.net/index.php?id=30&no_cache=1&tx_ttnews[tt_news]=279&tx_ttnews[backPid]=97&cHash=01e9c85e9f

The Indian market grew by almost 68% on a year-on-year basis with 2,139 MW of new capacity installed between January and December 2010. This made India the third largest annual market after China and the USA for 2010. With more than 13 GW of total installed capacity at the end of 2010, India ranks fifth in the world in terms of cumulative installed capacity.

The IEA projects that 327 GW of power generation capacity will be needed in India by 2020, which would imply a yearly addition of about 16 GW. This is reflected in the stated target for new capacity addition by the Indian government under its 11th Five Year Plan. The plan envisages an addition of 78.7 GW by 2012 from traditional sources (coal, nuclear and large hydro) and an additional 9 GW by 2012 (revised from 10.5 GW) from new wind generation capacity.

During the first three years of the 11th Plan period ending March 2010, India added 4.6 GW of wind power capacity. With over a year to go before the current plan period is over it is very likely that Indian wind power installations will meet and exceed the 11th plan-period target, which will be a record of sorts as historically the targets have never been met through conventional thermal and hydro projects within a plan period.

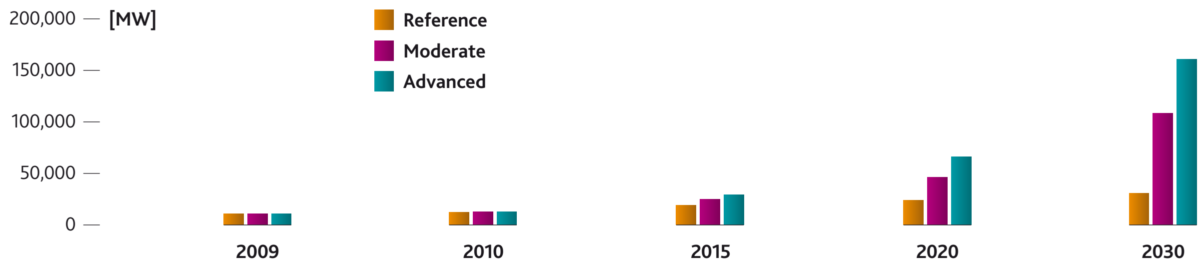
GLOBAL CUMULATIVE WIND POWER CAPACITY



		2007	2008	2009	2010	2015	2020	2030
Reference	[MW]	93,864	120,297	158,505	185,258	295,783	415,433	572,733
	[TWh]	206	263	347	406	725	1,019	1,405
Moderate	[MW]	93,864	120,297	158,505	198,717	460,364	832,251	1,777,550
	[TWh]	206	263	347	435	1,129	2,041	4,360
Advanced	[MW]	93,864	120,297	158,505	201,657	533,233	1,071,415	2,341,984
	[TWh]	206	263	347	442	1,308	2,628	5,429

Source: GWEO 2010,pp 6

INDIA: CUMULATIVE WIND POWER CAPACITY 2009-2030



Year	Reference [MW]	Moderate [MW]	Advanced [MW]
2009	10,926	10,926	10,926
2010	12,276	12,629	12,833
2015	19,026	24,747	29,151
2020	24,026	46,104	65,181
2030	30,526	108,079	160,741

Source: GWEO 2010[14]; pp 31

Under the IEA's Reference scenario, India's wind power market is shown to shrink considerably to only about 600 MW per year by 2030. This translates into a total installed capacity of merely 24 GW by 2020 and 30.5 GW by 2030. Wind power would then produce close to 60 TWh every year by 2020 and 75 TWh by 2030, and save 35 million tons of CO_2 in 2020 and 45 million tons in 2030. Investment in wind power in India would drop to about $910 million by 2030[15] [at 2010 $ value].

However under the GWEO scenarios, we expect that by the end of 2015, between 24.7 GW and 29 GW will be installed in India. Under the moderate scenario this would reach almost 46 GW by 2020 and 108 GW by 2030. In this scenario, about $9 billion would be invested in Indian wind power development every year by 2020, representing a quadrupling of the 2009 investment figures. Employment in the sector would grow from the currently estimated 28,000 jobs to over 84,000 by 2020 and 113,000 by 2030.

14 The actual installed capacity at the end of 2010 was 13,065 MW, which was in fact ahead of even the Advanced Scenario projection.

15 http://www.gwec.net/index.php?id=158

TABLE 1: **GRID CONNECTED RENEWABLE ENERGY POTENTIAL IN INDIA**

Energy Source	Capacity (MW)	Assumed Plant Load Factor (PLF)	Annual energy generation in billion kWh
Wind (onshore)	100,000	25	219
Small Hydro	15,000	45	46
Bagasse	5,000	60	26.3
Biomass	16,881	60	88.72
Large Hydro (existing & future)	100,000	60	525.6
Large Hydro in Bhutan	16,000	60	84.1
Waste to Energy	5,000	60	26.28
*Solar CSP based power generation	200,000	35	613.2
*Solar PV/CPV based power generation	200,000	20	350.4
Geothermal	10,000	80	70.1
Total	**662,881**		**2,049.70**

Note: Resource Potential of other RE Sources including offshore wind, tidal, biogas-based power not considered.
** In India a total suitable desert area of 208,110 square kilometers is available for solar power generation. At 10% utilization of this area the stated CSP/PV potential can be achieved (assuming 20 MW/sq.km)*
CSP: Concentrated Solar Power
PV: Photovoltaic

Source: WISE, January 2011

The GWEO advanced scenarios show that wind power development in India could go much further depending upon adequate regulatory support and political will. By 2020 India could have 65 GW of wind power in operation, employing 170,000 people and saving 173 million tons of CO_2 emissions each year. Investment by then would be to the tune of $10.4 billion per year. The World Institute for Sustainable Energy (WISE) estimates deploying just the current generation of wind turbines could yield a potential onshore wind power capacity of 65 GW–100 GW.

The Ministry of New and Renewable Energy (MNRE) has so far underplayed the potential of renewable energy (RE) sources in India. WISE did a revised estimate of the true potential of grid-connected RE in India as given in Table 1. WISE sees its own numbers as a conservative estimation.

With the present level of momentum established in India's wind sector, the ten years between 2020 and 2030 could see spectacular growth if some of the systemic barriers are addressed in a timely manner. With the political will geared towards fully exploiting the country's wind resource and reaping the accompanying economic, environmental and energy security benefits, the 'Advanced scenario' could be reached, which would see substantial wind power growth in many regions of the country. Wind power would then be instrumental in achieving a genuine energy revolution, putting India on the path to a sustainable energy future. India is now at a crossroads for making these decisions, which will determine the future of her energy system. As well as, to a great extent, the future of the planet.

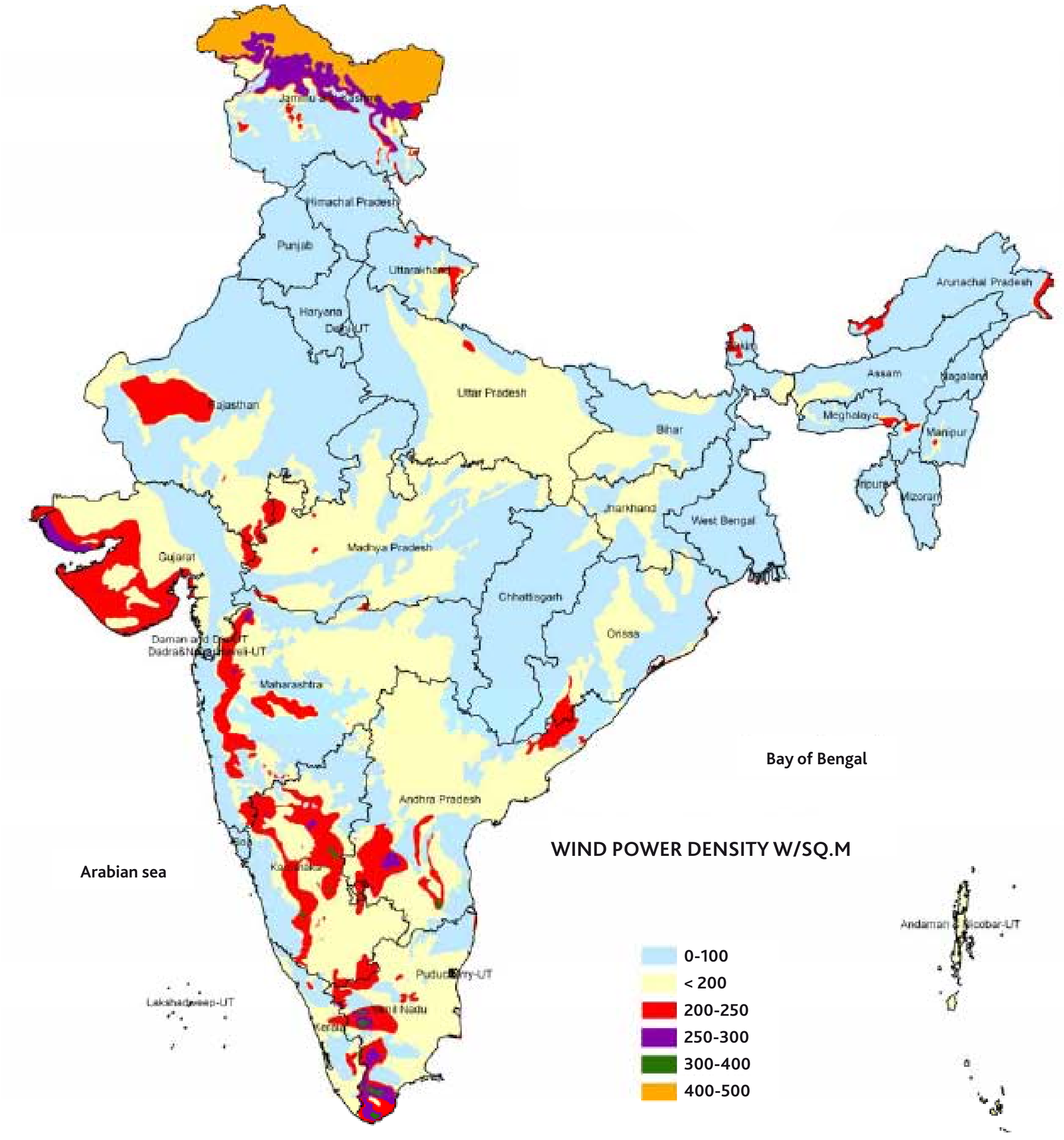
1.3 ESTIMATED WIND POWER RESOURCE

The Centre for Wind Energy Technology[16] (C-WET) published the Indian Wind Atlas in 2010, showing large areas with annual average wind power densities of more than 200 Watts/m² at 50 meter above ground level (MAGL). This is considered to be a benchmark criterion for establishing wind farms in India as per CWET and the MNRE[17].

The potential sites have been classified according to annual mean wind power density ranging from 200 W/m² to 500 W/m². Most of the potential assessed sites have an annual mean wind power density between 200-250 W/m² at 50 MAGL. The Wind Atlas has projected Indian wind power installable potential (name plate rating) as 49,130 MW at 2% land availability[18]. This is seen as a conservative estimate of wind power potential in India. Comparative wind power development across some of the Indian states is shown in Annex 1 on page 52.

16 *In April 2010 C-WET published an Indian Wind Atlas which was prepared in collaboration with Riso, Denmark. Fresh sites are selected for resource assessment by C–WET every year and the rest are closed down, having served their purpose.*
17 *Centre for Wind Energy Technology: Indian Wind Atlas (2010). In India a site having an annual mean wind power density of 200 W/m² at 50 [MAGL] is considered a wind power potential site*
18 *The assessment in the India Wind Atlas is assumed at 2% land availability for all states except the Himalayan States, North-Eastern States and the Andaman & Nicobar Islands. In NE States and in the Andamans & Nicobar it is assumed as 0.5%, however the potential would change as per the real land availability in each state. Further the installable wind power potential is calculated for each wind power density range by assuming 9 MW (average of 7D*5D, 8D*4D and 7D*4D spacing is the rotor diameter of the turbine) could be installed per square km.*

WIND POWER DENSITY MAP FROM INDIAN WIND ATLAS (2010)



Source: Centre for Wind Energy Technology (2010)

With the improvement in technology and increase in the hub height of the wind turbine it has become possible to generate more electricity than assumed in earlier estimates. Based on the resource assessment carried out by C-WET, wind speeds in India are in the low to moderate range except in some pockets like coastal southern Tamil Nadu and the Rann of Katch (Gujarat). Further India's as yet un-assessed offshore wind potential was not included in the C-WET study.

1.4 OFFSHORE WIND POWER DEVELOPMENT

A long coastline and relatively low construction costs could make India a favoured destination for offshore wind power.

Offshore wind development is a relatively new phenomenon, and Europe is the only sizeable market at present, with a total offshore capacity of 3 GW. The global offshore wind turbine segment has been dominated by two established players, Vestas and Siemens. However, there are other manufacturers active in the market such as REPower, Sinovel, Areva and Bard, with strong interest from GE Wind, Gamesa, XEMC and WinWinD.

Special construction requirements make offshore wind power 1.5-2.5 times more expensive than onshore, making large-scale offshore deployment difficult in developing regions. The current average rated capacity of offshore wind turbines is 2.5 MW as compared to average onshore wind turbine capacity of 1.06 MW (BTM ApS, 2010). It should be noted that most of the 4-6 MW turbines currently in the testing or early deployment stage are designed for offshore operation. If the government supported small capacity offshore demonstration projects, it could build confidence and bring in public and private investment in this sector in the years to come.

To examine the feasibility of offshore wind farms, C-WET conducted the first phase of its study at Dhanushkodi in the State of Tamil Nadu. So far, the area around Dhanushkodi has shown good potential, where wind power density of 350–500 Watt per square metre (w/m²) has been recorded. For the next stage, C-WET is currently awaiting approval from various government agencies.

Based on a study carried out by WISE on the clearances required for offshore projects, it is understood that more than 20 central and state ministries and departments would need to be involved in the process. As this technology is in its nascent stage in India there is a need for specific policy framework for offshore wind power generation.

On the corporate side, there have been a few early moves on offshore wind in India. Oil and Natural Gas Corporation (ONGC) announced its plans to tap offshore wind power. Further, in June 2010, global majors like Areva, Siemens and GE announced their plans to explore offshore wind power opportunities in the country. Tata Power is the first private sector player to submit a formal request to the Government of Gujarat and Gujarat Maritime Board for approval of an off-shore project in India.

1.5 WIND TURBINE INSTALLATIONS

Wind turbine generator (WTG) capacity addition in India has taken place at a CAGR[19] of 24.67% for the period of 1992-2010. The installed capacity increased from a modest base of 41.3 MW in 1992 to reach 13,065.78 MW by December 2010.

The official installation figures show that amongst the states, Tamil Nadu ranks the highest both in terms of installed capacity and in terms of energy generation from wind, with shares of 41.8% and 53.4% respectively. Other states like Gujarat, Maharashtra and Rajasthan have seen significant growth in wind capacity over the last four to five years, also due to a stable policy and regulatory regime. Table 2 provides an overview of the share of different states in installed capacity (MW) and cumulative energy generation (in Million Units[20]).

TABLE 2: **STATE WISE GENERATION AND INSTALLED CAPACITY**

State	Cumulative Generation (MU)	Cumulative installed capacity (MW)
Andhra Pradesh	1,451	138.4
Gujarat	8,016	1,934.6
Karnataka	9,991	1,517.2
Madhya Pradesh	554	230.8
Maharashtra	11,790	2,108.1
Rajasthan	3,938	1,095.6
Tamil Nadu	41,100	5,073.1
Kerala	110	28
Total	**7,6950**	**12,125.8**

up to 31st March 2010

Source: WISE, January 2011

1.6 REPOWERING POTENTIAL

Repowering is the process of replacing older, smaller wind turbines with modern and more powerful machines, which would reap considerably more power from the same site. In India, about 46% of the WTGs were rated below 500 kW in 2010, adding up to 2,331.3 MW (about 18% of cumulative installed capacity).

19 CAGR : Compound Annual Growth Rate
20 One Unit is = 1 kWh

BOX 2: **WHY REPOWERING?**

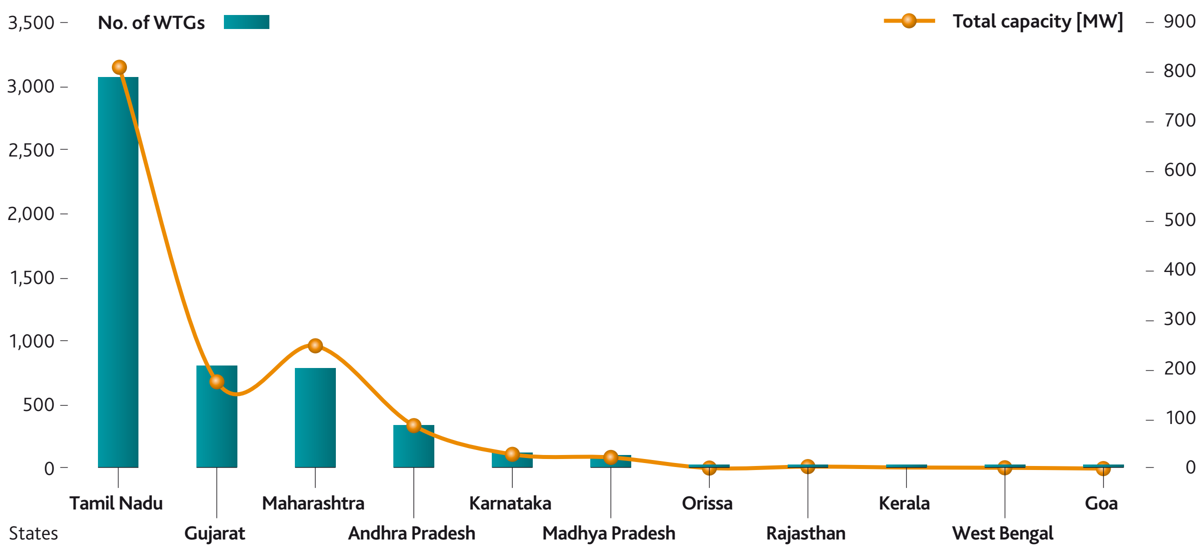
- Many of the states facing power shortages are also host to sites with good wind power potential which is not being used efficiently and is currently saddled with old and inefficient wind turbines. Repowering with more powerful turbines would bring considerable benefits to these states.

- Large areas are occupied by more than 8,500 small rating turbines (<500 kW capacity), manufactured by suppliers that have long since disappeared from the Indian market (as of March 2009). This leads to lapses in operations & maintenance (O&M), which in turn increases a machine's down time and reduces revenue. In addition, maintenance costs tend to be higher for aging WTGs.

- Breakdown of critical components badly affects machine availability and O&M cost for smaller capacity machines. The effective capacity utilization factor of small (<500 kW) machines in Tamil Nadu is estimated at less than 15%.

- Old wind turbines were often installed at maximum hub-heights of 30 to 40 meters and occupy land on good resource sites. However, these sites could benefit from modern turbines extracting energy from the much higher wind power density at high hub heights.

FIGURE 1: **STATE LEVEL REPOWERING POTENTIAL IN INDIA**



Source: WISE

Figure 1 shows state-wise repowering potential as of March 2009. Amongst the states with good wind potential Tamil Nadu leads with a repowering potential of more than 800 MW followed by Gujarat, Maharashtra, Andhra Pradesh and Karnataka.

A special drive for repowering of old wind farms undertaken by the central government would encourage the industry to take this up on a larger scale. This could be done by way of creating suitable mechanisms and offering support along with financial incentives, to make new repowering projects viable.

Currently, neither the states nor the central government provides dedicated policy support or incentives to encourage Indian wind power developers or investors to repower their old projects. However, there are some challenges to be addressed before a comprehensive repowering attempt in India. Some of the key challenges are listed in Box 3.

BOX 3: **CHALLENGES FOR REPOWERING**

- **Turbine ownership:** Repowering will reduce the number of turbines and there may not be one-to-one replacement. Thus, the issue of ownership needs to be handled carefully.
- **Land ownership:** Multiple owners of wind farm land may create complications for repowering projects.
- **Power Purchase Agreement:** PPAs were signed with the state utility for 10, 13 or 20 years and the respective electricity board may not be interested in discontinuing or revising the PPA before its stipulated time.
- **Electricity evacuation facilities:** The current grid facilities are designed to support present generation capacities and may require augmentation and upgrading.
- **Additional costs:** The additional decommissioning costs for old turbines (such as transport charges) need to be assessed.
- **Disposal of old turbines:** There are various options such as scrapping, buy–back by the government or manufacturer, or export. Local capacity may need to be developed.
- **Incentives:** One of the primary barriers to repowering is the general lack of economic incentive to replace the older WTGs. In order to compensate for the additional cost of repowering, appropriate incentives are necessary.
- **Policy package:** A new policy package should be developed which would cover additional project cost and add-on tariff by the State Electricity Regulatory Commissions (SERCs) and include a repowering incentive (on the lines of the recently introduced generation-based incentive scheme by MNRE).

All these issues related to repowering can no doubt be resolved by learning from the experiences in other markets such as Denmark and Germany, although they are still at the early stages of their own repowering. These markets have introduced various incentive mechanisms and policies to encourage repowering, and done away with provisions that initially hampered repowering. If a sensible policy package is developed, many old sites can provide two to three times their current electricity generation after repowering.

1.7 TECHNOLOGY DEVELOPMENT TRENDS

Modern wind power technology has come a long way in the last two decades, and both globally and in India, improved technology has slowly and steadily improved capacity utilization. The existing and emerging trends in the development of wind power technology are discussed in this section.

A key trend in the Indian industry is the development of multi-megawatt turbines installed at greater hub heights. Larger diameter rotors mean that a single wind power generator can capture more energy, or more 'power per tower'. This allows WTGs to take advantage of higher altitudes with stronger winds and less turbulence (wind speed generally increases with height above the ground). Subsequently larger machines have resulted in a steady increase in the capacity factor on average from 10-12% in 1998 to 20-22% in 2010.

For two decades now, global average WTG power ratings have grown almost linearly, with current commercial machines rated on average in the range of 1.5 MW to 2.1 MW. Details of existing capacity factors across the five key states of Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu are presented in Annex 2 on page 52.

The average size of WTGs installed in India has gradually increased from 767 kW in 2004 to 1,117 kW in 2009. Currently, megawatt-scale turbines account for over half the new wind power capacity installed in India. The average size of WTGs installed in all the major markets between the years 2004-2009 is shown in Annex 3 on page 53.

Wind farm in Gadag, Karnataka © *Suzlon*

The shift in India to larger WTGs is a result of improved infrastructure available to handle bigger turbines and improved economics of the sector. As generator size increases, fixed overall project costs fall on a 'per unit of output' basis. Given that finding sites and establishing transmission corridors is a significant investment, developers need to maximize the use of available sites for wind power generation. Installing fewer high capacity turbines, versus installing a greater number of smaller turbines, reduces overall capital investment by lowering installation, maintenance and potentially real estate costs. For example, instead of siting ten 600 kW turbines on acres of land, developers can instead site only three 2.0 MW WTGs. A detailed comparison of WTG technology options and development trends in India is provided in Annex 4 on page 53.

1.8 INVESTMENT IN WIND POWER SECTOR

The Government of India has outlined ambitious capacity expansion and investment plans for the current plan period (2007- 2012) and wind power projects form the majority of the proposed capacity addition. The total investments on development of RE during the plan period is expected to be in excess of $15 billion (~Rs. 60,000 crores). The majority of this investment is being raised through domestic private investors, concessional financing from specialised government agencies and multilateral financial institutions.

Due to growing awareness of the benefits of wind power and evolving government priorities more banks and lending institutions are showing interest in funding these projects. On top of the financing spectrum is IREDA, the Indian Renewable Energy Development Agency, the apex nodal agency for renewable energy development in India and a funding arm of MNRE. The other government agencies that actively fund renewable energy projects are the Power Finance Corporation (PFC) and Rural Electrification Corporation (REC).

The multilateral agencies such as the World Bank, the International Finance Corporation (IFC), and the Asian Development Bank (ADB), as well as bi-lateral agencies such as KFW (German Development Bank) have also stepped up their assistance to the sector in the last few years. Prominent domestic banks that fund renewable projects are IDBI, ICICI, IFCI, SBI and PNB among others. Foreign banks such as Standard Chartered, RBS India (formerly known as ABN Amro) and Rabobank are also providing renewable energy project financing.

Currently the market in India for the RE business is growing at an annual rate of 15%. The scope for private investment in RE is estimated at about $3 billion per annum. Given the evolving regulatory and policy regime, the business outlook is generally positive at this time. Proposed policy guidance and regulations are also coming into place to further strengthen this rate of growth.

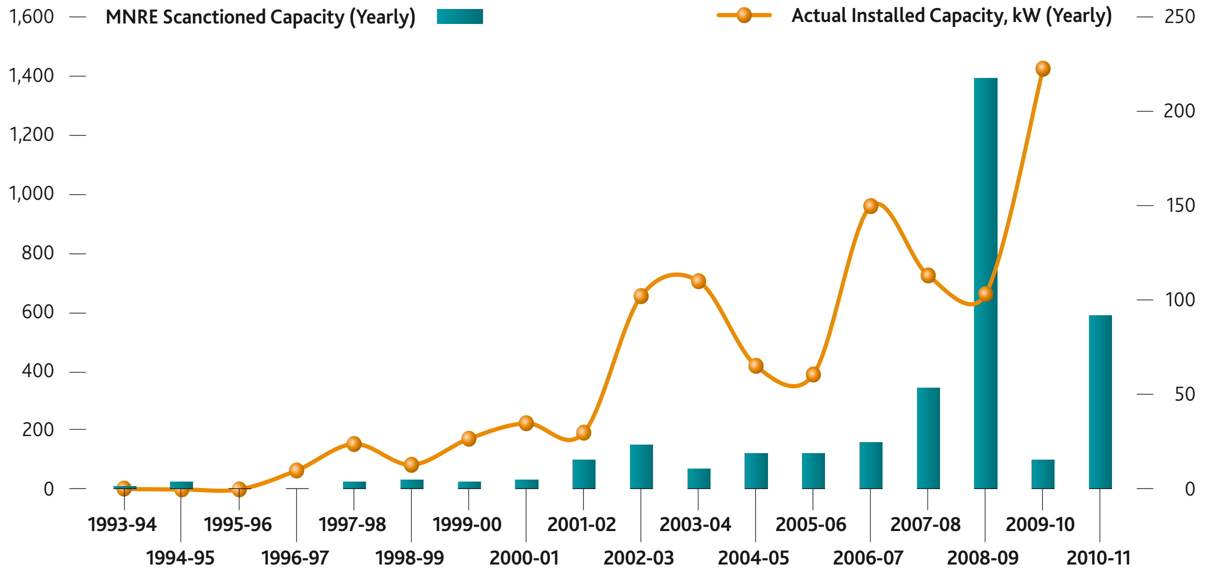
1.9 SMALL WIND AND HYBRID SYSTEMS

The global market for small wind turbines (SWTs) has been on the upswing over the last two to three years. This is driven by rapidly growing energy demand, higher fossil fuel prices and improved SWT technology, which can be deployed for a diverse pool of applications, both in 'grid-tied' and 'stand-alone' modes.

With the increasing shortfall in power supply and energy across the country, India could benefit significantly from exploiting the potential of micro-generation technologies that can meet energy needs under the distributed generation mode, so as to provide long-term solutions. WISE estimates India's micro-generation potential at about 83 GW. However, costs are a major hurdle and policy support needs to be oriented towards promoting mass manufacturing and early adoption of these micro-generation options.

Although a small annual market for such systems (~150–200 kW) currently exists in India, it is largely driven by the capital subsidy programme of the MNRE. Most of the current installations are of the stand-alone type.

FIGURE 2: **ANNUAL SANCTIONED & ACTUAL INSTALLED CAPACITY OF SWTs & WIND–SOLAR HYBRID SYSTEMS**



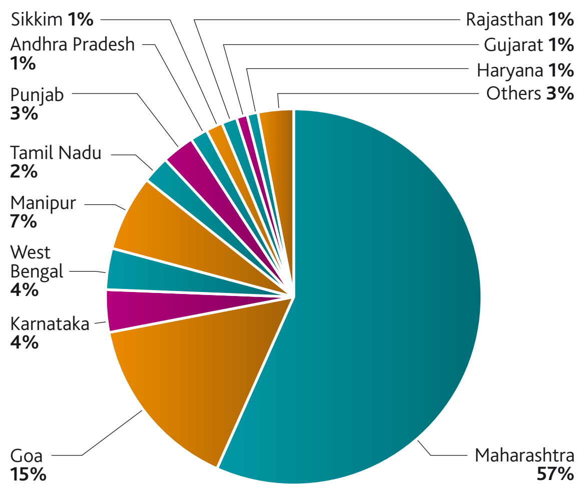
Source: WISE

The "Small Wind Energy and Hybrid Systems"[21] programme initiated in 1994 by the MNRE focussed solely on small wind energy and hybrid systems. The objective of the programme is to develop technology and promote applications of water pumping windmills and aero-generators/wind-solar hybrid systems. Although the programme helped to promote awareness of small wind systems in India, it created interest only among select users and has yet to make a real impact. The implementation of the programme was extended in April 2010 to the fiscal year 2011-2012. The physical annual target was set to installed 500 kW aero-generator/wind-solar hybrid systems and 25 water pumping windmills with estimated financial budget of Rs. 50 million over 2010-2012.

The programme is implemented through State Nodal Agencies (SNA) mainly in Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Rajasthan, Sikkim, Tamil Nadu, Goa, and West Bengal and the Andaman and Nicobar Islands. Manufacturers of water-pumping windmills, aero-generators, and wind–solar hybrid systems are also eligible to market the systems directly to users. The programme is being extended to other potential states. The development path of wind-solar hybrid systems in India since 1994 is summarized in Figure 2.

An aggregate capacity of 1.07 MW[22] of aero-generators or hybrid systems was installed under the programme up to December 2010. Interestingly, almost 57% of the total cumulative installations in the country are in Maharashtra followed by Goa, Karnataka, West Bengal, Manipur and Tamil Nadu. Almost all the projects sanctioned by the MNRE and those actually commissioned availed themselves of capital subsidy benefits from the Ministry. The share of key states with SWTs and wind–solar hybrid systems is shown in Figure 3.

FIGURE 3: **STATE-WISE DISTRIBUTION OF WIND–SOLAR HYBRID SYSTEMS**



Source: WISE

21 http://mnre.gov.in/adm-approvals/wind-hybrid-system.pdf
22 http://www.mnre.gov.in/ click on link to Achievements on main page.

1.10 BARRIERS TO HIGHER GROWTH

The low utilization of the country's wind power potential so far is attributable to several factors, including lack of an appropriate regulatory framework to facilitate purchase of renewable energy from outside the host state, inadequate grid connectivity; high wheeling[23] and open access[24] charges in some states, delays in acquiring land and obtaining statutory clearances.

In 2010, India installed a record 2.1 GW of new wind power capacity. For this growth to be maintained it is essential that the industry is supported by a predictable policy and regulatory environment. Proposed amendments to India's tax laws (such as the Direct Tax Code – DTC; Goods and Services Tax - GST) will have an impact on the investment portfolio of wind power. Besides these there are other potential barriers to achieving higher growth rates in the short to medium term.

The main reason for the growth of wind power has been the availability of Accelerated Depreciation (AD), providing the facility to offset taxes on income from other sources. With the possible introduction of the DTC from the next fiscal year (2012-13), the quantum of this benefit could be affected, which could have an impact on the investments in the Indian wind sector. The Generation Based Incentive (GBI) scheme has not attracted as many Independent Power Producers as envisaged, since the investors are of the opinion that the current rate of Rs. 0.5/kWh is not adequate or in line with the fiscal benefits offered under the AD scheme, and the two are mutually exclusive.

Further, the multitude of regulatory agencies adds to the confusion – there is the Central Electricity Regulatory Commission (CERC) and each state also has a State Electricity Regulatory Commission (SERC). The CERC issues guidelines for determining the feed-in-tariff from RE sources and these are applicable to central government power generating stations and those who transmit power in the inter-state corridor. However, this is applicable to a very small number of power producers and the vast majority is still covered by the tariff determined by the SERCs. This duality is not useful. For example an SERC could determine the tariff which may or may not be equivalent to the tariff determined by the CERC. This has a major impact on the project developers.

23 *Wheeling charges: An amount charged by one electrical system to transmit the energy of, and for, another system or systems.*

24 *Open access: In the Electricity Act, 2003 it is defined as the "non-discriminatory provision for the use of transmission lines or distribution system or a associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission"*

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Inadequate grid infrastructure is another key issue that needs to be addressed urgently. Across most of those states with significant wind potential, the grid does not have sufficient spare capacity to be able to evacuate ever increasing amount of wind power. As a result, the state distribution utilities are reluctant to accept more power and on a merit order basis prefer thermal power. Thus, there is an urgent need to augment the grid capacity and the regional Southern Grid needs to be connected with the rest of the country on a real-time basis. This requires better forecasting of power demand across the nation, and a modernization of the grid.

In most of the states availability of land for wind farms is a contentious issue. Even if private lands are available, conversion of land use status from agricultural to non-agricultural is a time consuming process. Further if the land is close to a protected area or forest lands then obtaining clearance from forest authorities for using the forest land for wind power generation is also time consuming.

Current and projected growth rates for wind power development in India are putting increasing strain on the WTG manufacturing sector, and the component supply chain needs to be improved. It would be beneficial for the small and medium enterprises [SMEs] to have acces to concessional financing to bear the risks related to production capacity augmentation.

As the industry grows, there will be demand for trained manpower and accordingly, the academic curriculum may need to be modified. The IWTMA has started an initiative towards this end by joining hands with a local engineering college to develop a cadre of trained manpower with the help of the industry. Depending on the success of the pilot programme, this industry driven initiative is planned to be replicated across other technical colleges and polytechnics.

Wind farm in Tamil Nadu © NEG Micon

POLICY ENVIRONMENT FOR WIND

2.1 NATIONAL POLICY & REGULATORY FRAMEWORK

Enactments prior to the Electricity Act, 2003 (EA 2003) had no specific provisions that would promote renewable or non-conventional sources of energy. Despite this shortcoming, the Ministry for New and Renewable Energy[25] (MNRE) attempted to give impetus to the sector by way of policy guidelines in 1994-1995, with mixed results. However the EA 2003 changed the legal and regulatory framework for the renewable energy sector. The Act provides for policy formulation by the Government of India and mandates the State Electricity Regulatory Commissions (SERCs) to take steps to promote renewable and non conventional sources of energy within their jurisdiction.

A) Electricity Act, 2003

The Electricity Act 2003, introduced some enabling provisions conducive to accelerated development of grid connected renewables.

Under Section 61(h), promotion of cogeneration and generation of electricity from renewable sources of energy has been made the explicit responsibility of SERCs, which are bound by law to take these considerations into account while drafting their terms and conditions for tariff regulations. Nearly all SERCs have issued their tariff regulations incorporating suitable clauses, which will enable them to provide a preferential treatment to renewable energy (RE) during the tariff determination process.

Under Section 86 (1) (e), the SERCs are also made responsible for the following:

i. Ensuring suitable measures for connectivity of renewable power to the grid
ii. Sale of renewables based electricity to any person
iii. Mandating purchase of a certain percentage of total energy consumption from renewables.

BOX 4: **SUMMARY OF CURRENT FISCAL AND TAX INCENTIVES**

- 80% accelerated depreciation for investors if the project is commissioned before 30 September of the same financial year; or 40% if the project is commissioned before 31 March of the same financial year.
- Generation Based Incentive (GBI) scheme for grid interactive wind power projects -a GBI of Rs 0.50 per kWh as introduced in 2009 [details below]
- Concession on import duty on specified wind turbine components
- 10 year income tax holiday for wind power generation projects
- 100% exemption from excise duty on certain wind turbine components
- Wheeling, banking and third party sales, buy–back facility by states
- Guaranteed market through a specified renewable portfolio standard in some states, as decided by the state electricity regulator
- Reduced wheeling charges as compared to conventional energy
- 100% FDI investment allowed in renewable energy generation projects
- Special incentives provided for promotion of exports from India for various renewable energy technologies under renewable sector specific Special Economic Zones (SEZ).
- Wind potential states have announced preferential tariffs, ranging from Rs 3.39–5.32 per kWh

25 *MNRE was then known as the Ministry of Non-conventional Energy Sources (MNES)*

Wind farm in Tamil Nadu *© NEGMicon*

As mandated under section 86 1(e) of the Electricity Act (2003), 22 SERCs have fixed quotas (in terms of % of electricity being handled by the power utility) to procure power from renewable energy sources. The mandate, which is called a Renewable Purchase Specification[26] (RPS), varies from 0.5% to 14% in various states over varying time-scales. Few states have come out with technology specific RPSs. Besides, the state regulators determine the tariff for all RE projects in the states and ensure connectivity to the grid through extension of power evacuation from the RE project sites, which are generally at remote locations and away from major load centres.

Further the EA 2003 initiated the adoption of the following key policies and related regulation:

I. National Electricity Policy (2005)
II. National Tariff Policy (2006)
III. Rural Electrification Policy (2006)

26 *Renewable Purchase Specification (RPS) and Renewable Purchase Obligation (RPO) are interchangeably used terms.*

I. NATIONAL ELECTRICITY POLICY ,2005

In compliance with section 3 of the Electricity Act 2003 the central government notified the National Electricity Policy in February 2005. Clause 5.12 of the NEP stipulates several conditions to promote and harness renewable energy sources. The following are an excerpt from the relevant portions.

"5.12.1 Non-conventional sources of energy being the most environment friendly there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, **efforts need to be made to reduce the capital cost of projects** based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, **adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.**

5.12.2 The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by **providing suitable measures for connectivity with grid** and **sale of electricity to any person** and also by **specifying,** for purchase of electricity from such sources, a **percentage of the total consumption** of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made **applicable for the tariffs to be determined by the SERCs at the earliest.** Progressively the **share of electricity from non-conventional sources would need to be increased** as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the **Commission may determine an appropriate differential in prices to promote these technologies.**

5.12.3 Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. **SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power** from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability."

II. NATIONAL TARIFF POLICY ,2005

National Tariff Policy (2006) framed under the Section 3 of the EA 2003:

- Elaborates the role of regulatory commissions
- Mechanism for promoting use of renewable energy
- Time for implementation

The following is an excerpt of the relevant portions.

"(1) Pursuant to provisions of section 86(1)(e) of the Act, the Appropriate Commission shall **fix a minimum percentage for purchase of energy** from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 1, 2006. It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.

(2) Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.

(3) The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non–conventional sources, to be followed in cases where such procurement is not through competitive bidding."

III. RURAL ELECTRIFICATION POLICY, 2006

Also, in compliance with Sections 4 and 5 of the Electricity Act, 2003, the central Government prepared the rural electrification policy (REP) published in August 2006. The policy under its Section 3 (3.3) for the first time provided policy framework for decentralized distributed generation of electricity based on either conventional or non-conventional resources or methods of generation. Thereby providing the relevant regulatory direction for off-grid/ stand-alone small-scale wind farms. The following is an excerpt of the relevant portions of EA 2003 and REP, as applicable to decentralized generation.

Section 2 (63) "Stand alone system" means the electricity system set up to generate power and distribute electricity in a specified area without connection to the grid;

Section 3.3 Decentralized distributed generation facilities together with local distribution network may be based either on conventional or non-conventional methods of electricity generation, whichever is more suitable and economical. Non-conventional sources of energy could be utilized even where grid connectivity exists provided it is found to be cost effective.

Section 4 "The central government shall, after consultation with state governments, prepare and notify a national policy, permitting stand-alone system (including those based on renewable sources of energy and non-conventional sources of energy) for rural areas."

Section 5 The central government shall also formulate a national policy, in consultation with the state governments and the state commissions, for rural electrification and for bulk purchase of power and management of local distribution in rural areas through panchayat institutions, users' associations, co-operative societies, non-governmental organizations or franchisees.

B) Integrated Energy Policy

In India the first attempt at pulling together an umbrella energy policy came forth after almost 60 years of the country's existence. The Planning Commission brought out the 'Integrated Energy Policy: Report of the expert committee (IEP)'[27] in October 2006, which provided a broad overarching framework for the multitude of policies governing the production, distribution, usage etc. of different forms of energy from various sources (conventional and non-conventional).

Although the report of the expert committee has been available since 2006, political commitment to it has been limited. A lone Public Information Bureau[28](PIB) press release in December 2008 indicated that the cabinet had assented to the policy and enumerated some key features of the IEP. The follow up on its recommendations are not as easily determinable as those for the National Action Plan on Climate Change.

27 *http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf*

28 *http://www.pib.nic.in/newsite/erelease.aspx?relid=46172*

Upon examining the IEP purely from the perspective of the support it provides to RETs, the most ground-breaking segment is to be found in Chapter 7 (*Policy for promoting renewable and non-conventional energy sources*), which emphasizes the need to move away from capital subsidies towards performance incentives for promoting renewable sources.

2.2 NEW INITIATIVES FROM THE GOVERNMENT

2.2.1 GENERATION BASED INCENTIVES

In 2009, the Government of India implemented a Generation Based Incentive (GBI) scheme for grid connected wind power projects. A GBI of Rs. 0.50 per kWh, with a cap of approximately $33,000 per MW per year, totalling $138,000 per MW over 10 years of a project's life is being offered under this scheme. The GBI is over and above the tariff approved by respective SERC and will be disbursed on a half yearly basis through the Indian Renewable Energy Development Agency (IREDA). This scheme is applicable to wind power projects not using accelerated depreciation benefits and which are commissioned before 31st March 2012. However wind power projects selling power to third party/merchant power plant are excluded from the GBI incentives.

The GBI incentive scheme is being implemented through IREDA for which separate guidelines were published. As per these guidelines each investor, whether using GBI incentives or Accelerated Depreciation incentives, is required to register with IREDA. IREDA issued a Unique Identification Number for each WTG commissioned under this scheme after 17th December 2009 [more details in next segment].

However, fourteen months into the implementation of the incentives, the progress on the ground has been much slower than expected. Only 394.21 MW of new capacity was registered for GBI till January 2011[29]. While it is true that any new policy initiative takes time to gain acceptance, it is also true that the current GBI scheme needs to be made lucrative enough in order to encourage wind power developers to opt for the GBI over the existing accelerated depreciation (AD) benefits.

29 *http://www.ireda.gov.in/pdf/GBI%20Projects.pdf*

RATIONALE FOR GBI

The main objectives of the GBI scheme are:

a. To broaden investor base by
   - Facilitating the entry of large Independent Power Producers (IPPs)
   - Attracting Foreign Direct Investment (FDI) to the wind power sector
b. To provide a level playing field for various classes of investors.
c. To incentivize higher efficiencies
d. To provide a framework for transition from a purely investment based incentive to an outcome based incentive

GBI was introduced to **promote actual generation of wind power** rather than the mere installation of WTGs. The GBI scheme attempts to build a business case for IPPs. The advent of IPPs in the segment is also expected to lead to more utility-scale installations which, in turn, would help build investor confidence in the sector. To date the majority of India's wind power growth has been financed domestically. The bulk of the financing has been asset financing where captive power generators have been investing to expand their own power supply. Credit from private investors has traditionally been extended to wind power projects based on the balance sheet strength of the developer rather than on the creditworthiness of the project itself (WISE, 2010).

With the entry of IPPs, the WTG manufacturing segment is also likely to attract a greater number of players, resulting in more competitive pricing. Since the GBI is based on actual electricity generation rather than capacity addition, developers will strive towards maximizing the efficiency of their projects in order to reap the full benefits. This would encourage efficiencies in the entire value chain of the wind power sector, including project installation practices, turbine operations and design as well as operation and maintenance. Such practices would further add to the financial viability of projects.

IMPACT OF THE GBI SCHEME

The GBI scheme was initially implemented in June 2008 on a pilot basis. The pilot scheme received an overwhelming response with over 300 MW of projects applying for the 49 MW scheme. Taking this as a positive sign, the government re-launched the scheme in December 2009, enlarging its size to 4,000 MW. Under the expanded scheme, the government earmarked $84.4 million/Rs. 3.8 billion for wind power projects.

Despite the initial euphoria surrounding the GBI scheme, the actual progress has been slower than expected. Since its announcement, 53 projects aggregating 394.21 MW and 408 WTGs have been registered for GBI benefits (as of 31.01.2011). About 80% of the capacity registered under the GBI scheme is accounted for by six installations: 202.2 MW of China Light and Power India Limited; two installations for 50.4 MW of IL&FS[30]; and three installations for 40.8 MW of the Vaayu (India) Power Corporation. The remaining 20% is made up of 16.5 MW projects each of Grace Infrastructure Private Ltd and iEnergy Wind Farms Private Ltd and one project of Cepco Industries Pvt Ltd of 12 MW. The remaining 39 projects are small–scale projects. Missing from the list of applicants are major IPPs and incumbent developers.

During the same period through January 31, 2011 a total of 269 projects with installed capacity of 494.62 MW were submitted to IREDA for using the accelerated depreciation route[31]. The balance of the installed capacity in India this year is in the process of registration with IREDA.

This continued interest shown in the accelerated depreciation scheme and comparatively poor response to the GBI scheme clearly highlights the **need for a review of the GBI scheme. It is essential to revise the tariff (incentive) upwards along with other modifications** if required for achieving the expected outcome of the scheme.

In its present form, the GBI scheme is not attractive enough to pull developers away from AD. According to estimates by IREDA, at the prevailing tariffs, the internal rate of return (post-tax) for wind assets would be higher by 1.2-1.5% in case of AD benefits in all key states other than Maharashtra. Also, the low capacity factors (20-25%) in most of the states mean that the present GBI will not make a project more feasible in comparison to accelerated depreciation.

The scheme has also failed to attract IPPs focused on renewable energy. Only those IPPs that are engaged in thermal power generation and have a mandate to cut down their carbon footprint have opted for the GBI. A pure RE based IPP would not be sufficiently attracted towards using the GBI because at Rs 0.50 per kWh as it does not provide adequate returns. This number needs to be reassessed in the coming months with proper consultations with both government and industry experts.

BOX 5: **BARRIERS TO WIDER ACCEPTANCE FOR GBI**

- The GBI scheme was based on the premise that there is a huge market outside the power distribution companies, which buys power at regulated rates, and there would be freedom to supply to direct, open access customers. None of these premises has proven true in the field and hence, very few developers have opted for it.
- The bureaucratic processes involved in obtaining approvals and clearances for qualifying for GBIs are acting as a dampener. It takes a substantial amount of time for the benefit to come into the beneficiary's hands.
- For the evolution of wind projects from a tax planning measure to an energy planning instrument, the GBI scheme would have to be further enhanced. Industry experts in India suggest that **enlarging the scheme** to include captive and third–party sales, as well as **doubling the incentive** to Rs. 1.0 per kWh and/or **removing the cap** of Rs. 62 Lakhs [approximately $138,000] per MW could help boost the appeal of the scheme [WISE, 2010].
- There is also a need for clarity with respect to the inclusion of benefits in the determination of tariffs. While the scheme states that the incentives would be provided to developers over and above the SERC determined tariff, the new CERC regulations state that all available incentives, including AD and GBI, are to be included while determining tariffs. Tariffs based on the proposed regulations would mean that the projected returns could be lower than in the current scenario. Meanwhile, as the government is yet to clarify its stand, companies are finding it difficult to plan their investments.

30 IL&FS: Infrastructure Leasing & Financial Services Limited (IL&FS) is one of India's leading infrastructure development and finance companies.

31 http://www.ireda.gov.in/pdf/AD%20Projects.pdf

Wind farm in Karnataka © NEGMicon

2.2.2 STATE FEED-IN TARIFF

At present thirteen SERCs have declared preferential feed–in tariffs for purchase of electricity generated from wind power projects established in respective states. All the SERCs have adopted a 'cost plus' methodology to fix the feed–in tariff, which varies across the states depending upon the state resources, project cost and other tariff computing parameters as considered by the respective SERCs. A brief comparison of wind power related polices in key states is given in Table 3 below.

TABLE 3: **COMPARISON OF POLICIES FOR WIND POWER IN KEY STATES**

States	Tariff rates per kWh	Annual tariff escalation	Percentage Renewable Portfolio Standard for wind
Andhra Pradesh	Rs. 3.50	Constant for 10 years for the PPAs to be signed during 01-05-09 to 31-03-2014	5% for all RE (2011/12)
Gujarat**	Rs. 3.56	No escalation for 25 years of project life	5% (2011/12) 5.5% (2012/13)
Harayana	Rs. 4.08	With 1.5% per year till 5th year	10% (2010/11) for all RE
Karnataka*	Rs. 3.70	No escalation for 10 years	7-10% (2010/11) for all RE
Kerala	Rs. 3.64	No escalation for 20 years of project life	3% (2011/12 & 2012/13) for all RE
Madhya Pradesh**	Rs. 4.35	No escalation for 25 years of project life	6% (2011/12)
Maharashtra	Wind Zone I–Rs. 5.07 Wind Zone II–Rs. 4.41 Wind Zone III–Rs. 3.75 Wind Zone IV–Rs. 3.38	No escalation for 13 years	7% (2011/12) 8% (2012/13) for all RE
Orissa	Rs. 5.31	No escalation for 13 years	5% for all RE (2011/12)
Punjab	Rs. 3.49	With base year 2006/07 & with 5 annual escalations @5% up to 2011/12	4% for all RE (2011/12)
Rajasthan**	Rs. 3.87 & Rs. 4.08	No escalation for 25 years of project life Rs. 3.87/kWh for Jaisalmer, Jodhpur & Barmer districts while Rs. 4.08/kWh for other districts	7.5% (2011/12)
Tamil Nadu	Rs. 3.39	No escalation for 20 years of project life	14% for all RE (2010/11)
Uttarakhand	Wind Zone I–Rs. 5.15* Wind Zone II–Rs. 4.35* Wind Zone III–Rs. 3.65* Wind Zone IV–Rs. 3.20*	Rs. 5.65 for 1st 10 year & Rs. 3.45 for 11^{th} year onward Rs. 4.75 for 1st 10 year & Rs. 3.00 for 11^{th} year onward Rs. 3.95 for 1st 10 year & Rs. 2.55 for 11^{th} year onward Rs. 3.45 for 1st 10 year & Rs.2.30 for 11^{th} year onward	4.53% for all RE (2011/12)
West Bengal*	Rs. 4.87	No escalation for 10 years	3% for all RE (2011/12)

* *RPS for Bangalore Electricity Supply Company Ltd. (BESCOM), Mangalore Electricity Supply Company Ltd.(MESCOM), and Calcutta Electricity Supply Company Ltd. (CESC) is 10% while for Gulabarga Electricity Supply Company Ltd. (GESCOM), Hubli Electricity Supply Company Ltd. (HESCOM) and Hukeri it is 7%.*
** *RPS percentage specified only for wind*

Conversion Rate : $1.00~Rs. 45.00

32 Alternative term for a Tax (also a tax on tax): The term is still frequently used in a few countries including Britain, Ireland, to indicate a local tax, Scotland, to indicate a land tax, and India, applied as a suffix to a indicate a category of tax such as 'property-cess'; 'education-cess'

2.2.3 NATIONAL CLEAN ENERGY FUND

The Government of India proposed the creation of the National Clean Energy Fund (NCEF) in the Union Budget 2010-2011 by imposing a clean energy cess[32] of Rs. 50 ($1.10) per tonne on all coal produced in India as well as on coal imports. From initial estimates, the cess could generate an annual revenue of approximately $550 million (2500 Crore) in the year 2010-2011. The fund is expected to be used for research, development and deployment of cleaner and renewable energy technologies. The Finance Ministry has, through the Clean Energy Cess Rules 2010, spelled out the manner in which the cess would be collected and assessed by the Revenue Department. An inter-ministerial group has been set up in the finance ministry to approve projects and eligibility requirements for accessing funds from the NCEF.

2.2.4 RENEWABLE PURCHASE SPECIFICATION

The Electricity Act 2003 proposed mandatory Renewable Purchase Specification (RPS) for all the states. To date, 26 states have specified targets for the uptake of renewable electricity. With the introduction of the new Renewable Energy Certificate scheme, states are looking at fulfilling the RPSs set by the Electricity Act through this provision. The state-wise status of Renewable Purchase Specifications as on 01.01.2011 is provided in Annex 5 on page 54.

2.2.5 RENEWABLE ENERGY CERTIFICATES

In order for distribution utilities or licensees to meet the RPS, renewable energy needs to be available. To ensure this, a mechanism to create tradable Renewable Energy Certificates (REC) was put in place by the CERC in 2010. All the RE projects commissioned after 01.04.2010 are eligible to register under the REC framework.

A Renewable Energy Certificate (REC) is a tradable certificate of proof that one MWh of electricity has been generated by a RE plant in the state. Under this framework, RE generators can trade RECs through a power exchange platform that will allow market based price discovery, within a price range determined by the CERC. The respective price limits are called forbearance price and floor price and their values are calculated separately for solar and all non-solar energy sources (wind, biomass, small hydro). While the CERC has stipulated[33] floor and forbearance price for non-solar RECs and for solar RECs, respectively, the real price of an REC would be determined at the power exchanges. RECs will be traded in the power exchange within the boundary set by the forbearance price and floor price, determined by the CERC from time to time. For wind power generation, this range is Rs 1,500 to Rs 3,900 per REC.

Wind farm in Karnataka *© NEGMicon*

	Non Solar REC (Rs. / MWh)	Solar REC (Rs. / MWh)
Forbearance Price	3,900 (~$87)	17,000 (~$378)
Floor Price	1,500 (~$33)	12,000 (~$267)

The only requirement for a RE generator to be eligible for trading RECs is that the power generator must sell its power to the host distribution utility or licensee at Average Power Procurement Cost[34] (APPC). APPC is the weighted average cost of power purchase for the utility and is usually lower than the preferential tariff for the RE sources available in the state.

Under the REC framework, a RE generator will have the option to sell two products through the power Exchange:

- Generated electricity (not at preferential tariff but at APPC)
- Renewable Energy Certificate (one REC equivalent to one MWh of electricity generation)

On the demand side, the REC framework allows the utilities with purchase obligations to buy RECs through the national exchange irrespective of state potential and installed capacity. On the supply side, the REC mechanism allows the RE generators to get a base revenue income by selling power at the APPC and an additional market determined revenue stream through the REC trading platform.

32 *Alternative term for a Tax (also a tax on tax): The term is still frequently used in a few countries including Britain, Ireland, to indicate a local tax, Scotland, to indicate a land tax, and India, applied as a suffix to a indicate a category of tax such as 'property-cess'; 'education-cess'*

33 *CERC: vide Order dated 1st of June 2010 :Petition No. 99/2010*

34 *The APPC for a state represents the weighted average pooled power purchase by distribution licensees (without transmission charges) in the state during the last financial year (2009-10).*

BOX 6: **HIGHLIGHTS OF THE FRAMEWORK REC MECHANISM**

1 RE Certificate	Is equal to 1 MWh generated
Validity of REC	For 365 days after issuance
When should a generator receive the REC	Within 3 months of generation from the RE sources
Types of RECs	• Solar energy REC • Non-Solar energy REC
Purpose of REC	• To encourage renewables based power generation • To help meet Renewable Purchase Specifications
Penalty for non-compliance	'Forbearance price' (maximum price) • Non-solar (Rs. 3,900/REC) • Solar (Rs. 17,000/REC)
Price guarantee	Through 'Floor price' (minimum price) • Non-solar (Rs. 1,500/REC) • Solar (Rs. 12,000/REC)

Status of implementation of REC mechanism

In order to ensure compliance with the requirement under the REC mechanism by participants, the CERC has appointed compliance auditors at the national level. Power exchanges have also finalised rules and bylaws required to exchange RECs. Along with adopting the CERC regulations, the SERCs are expected to notify their respective regulations to enable fulfilment of RPS obligations through purchase of RECs. It must be noted here that the rate for state wide RPS at this stage is driven by the National Action Plan on Climate Change target of 15% renewable energy by 2020 as part of the energy mix for India. However the NAPCC does not stipulate state-wise breakdown of its top line target.

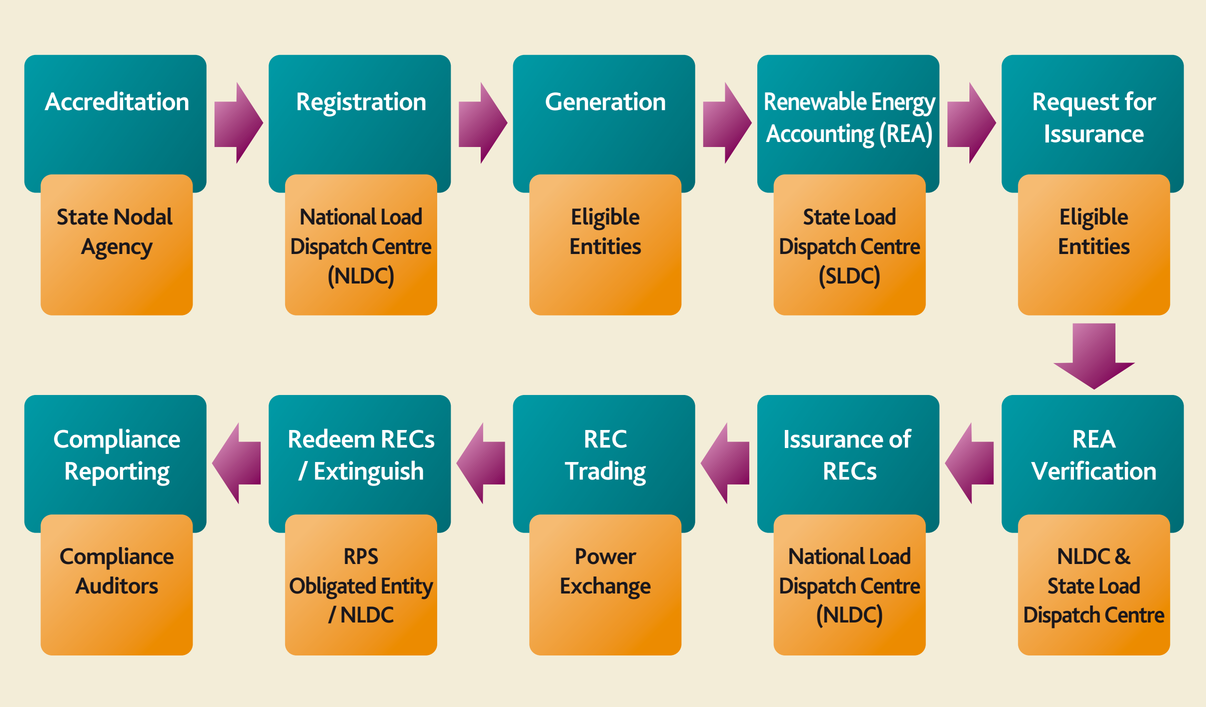
As of January 2011, 14 SERCs have amended their RPSs, recognising RECs as valid instruments to fulfil the RPS by obligated entities. The status of REC regulations of the SERCs across the states (as on 11.01.2011) is shown in Annex 5 on page 54.

REC mechanism: implementation challenges & concerns

- Many SERCs have adopted a normative tariff approach for determining a generic tariff for projects commissioned during a pre–specified control period[35] without considering the location, technology, and size of the WTGs. These norms vary significantly across the states. Uniformity in the respective tariff determination methodology would help to bring clarity and predictability in the system.
- In many states, preferential tariffs once determined have remained unchanged over the control period of over two to three years, despite significant changes in the market conditions and the underlying parameters. In the case of floor awnd forebearance price (determined by the CERC) there is a need for a regularization of the process of determining these prices. Otherwise, inadequate price levels may act as a barrier to investment in wind based projects for generating RECs.
- Obligated entities, mostly distribution utilities, which have to purchase a portion of their power requirements from RE sources, may not comply with the RPS levels set by the regulatory commissions in the absence of an adequate enforcement mechanism. The confidence of investors/ developers in the **compliance market** diminishes in case of lack of adequate enforcement mechanisms and relaxation of compliance targets. Penalties for non-compliance need to be enforced. With the notification of the REC

35 Control Period : "Control Period" means the period during which the norms for determination of tariff specified in these specific regulations shall remain valid (Electricity Act 2003)

FIGURE 4: **ORGANIZATIONAL FRAMEWORK FOR REC MECHANISM**



Source: WISE

regulations by many SERCs, the **details of a uniform scale of penalties** need to be specified and enforced across all states so as to strengthen and generate the necessary demand-pull for RE sources.

2.2.6 **DIRECT TAX CODE**

The Government of India, with a view to making Indian industry globally competitive and simplifying the current tax regime, tabled the Direct Tax Code (DTC) Bill, 2010 on 30.08.2010 in the Parliament. The proposed DTC Bill, 2010 shall replace the Income Tax Act of 1961 and is envisaged to come into effect from 01.04.2012. The DTC Bill, 2010 needs to be carefully examined from the perspective of energy generation sector and the wind power sector, in particular. The likely impact on wind power investment of some of the DTC provisions are listed below:

- A domestic wind power investor would be required to pay a Dividend Distribution Tax (DDT) of 15% on dividends declared, distributed or paid. Further, in case of a foreign investor, the branch profits will be taxed at the rate of 15%, in addition to the normal payable taxes.
- The DTC Bill (2010) proposes a reduction in corporate tax from an existing level of 33.99% (including surcharge and cess) to 30%. This shall marginally benefit small domestic wind power generators for whom DDT is not applicable. However, for large publicly listed domestic wind power generation companies and foreign wind power companies, applicability of other levies such as DDT at 15% and branch profit tax at 15% would make the effective tax rate quite high and may discourage large investment in the wind power sector. *Also the proposed investment linked incentive regime may be interpreted as a continuation of the accelerated depreciation benefit* to the wind power sector. Besides, various analyses by industry specialists reveal that proposed revisions in tax regime under the DTC Bill may not have significant impacts on post tax equity returns from the perspective of wind power development.
- Compared to the current tax regime under the existing Income Tax Act, a marginal increase in the Minimum Alternative Tax[36] (MAT) rate from 19.33%, inclusive of surcharge and education cess, to 20% is proposed with the additional benefit to carry forward the MAT credit to 15 years beyond the existing time period of 10 years.

36 *http://law.incometaxindia.gov.in/DitTaxmann/incometaxacts/2007itact/sec_115ja.htm*

2.2.7 GOODS AND SERVICES TAX

In another development under the indirect tax regime in India, the Ministry of Finance has proposed to introduce a Goods and Services Tax (GST), applicable from 1st April, 2012. With the implementation of GST all the other taxes like CST, VAT, Service Tax and Excise Duty will be abolished and only the GST will be applicable. This would require a Constitution Amendment Bill to be passed by the Parliament in the current fiscal year (2011-12) as a step towards the roll out of GST for the next fiscal year.

The salient features of the proposed GST are as follows:

- GST to be levied on all transactions of goods and services under a dual GST structure - Centre (C-GST) and State (S-GST) replacing most indirect taxes
- Taxes paid on the input side to be available as credit seamlessly throughout the supply chain leading to less cascading and increase in investments, improved competitive position of Indian producers and improved factor productivity
- Increase in tax base, reduction in tax rates
- Improved administration

Analysis[37] of the impact of the GST on the wind power sector shows that the impact of tax cascading on to the final price per unit of electricity generated and distributed could be as significant as 30% (during the entire life cycle of the WTG which is around 20-25 years). Besides that, the Report of the Task Force on GST under the 13th Finance Commission issued on 15 December 2009 also assessed the impact of the embedded taxes in power generation and distribution to be as high as 30% of the cost of power production and distribution.

Renewable energy products were exempted from the levy of excise under the previous regime, however this is not likely to be the case under a GST regime. This could result in the cost of a RE project shooting up by 15-20%.

Any higher tax implications of the above nature could hamper the growth of the wind energy sector. Hence there is a need to discuss and analyse these provisions in depth by the Industry, MNRE and with the other relevant Ministries[38].

37 Ajit Panit. Analysis of Direct Tax Bill, 2010 and Implications for Wind Energy development Vol. 6 No.4, Aug – Sept 2010, InWind Chronical
38 DRAFT Programme Dossier Advance Copy to Speakers and Session Chairman cum Moderators, 2nd International Wind Energy Conference and Exhibition, WE20 by 2020, Feb 2011, Delhi, India

Apart from the above, incentives by both the central government and the state governments are also available in major wind power developing states. Respective State Nodal Agencies (SNAs), State Electricity Boards (SEBs) and state utilities are providing state specific incentives to wind farm developers at different stages. More information on state based incentives, grid integration and metering practices is provided in Annex 6 on page 56 and Annex 8 on page 57.

2.3 NATIONAL RENEWABLE ENERGY LAW IN INDIA

While the policy environment for wind power in India has improved in recent years, the industry is still heavily dependent on tax incentives that tend to attract a narrow range of investors. In addition, the Indian power sector is plagued with inefficiencies and severe reliability problems that create a difficult environment for wind power growth. Probably the most important requirement for India is an integrated framework that has a vision, a plan and an implementing mandate that supports the RE policies and regulations from the conceptual to the implementation stage. Today, most leading countries with strong wind power development have this framework in place in the form of a renewable energy law. Such a framework, if adopted, can help to reduce concerns of investors related to long term regulatory certainty and associated market risks.

Besides that, there are a number of contradictions between existing policy guidelines and frameworks. For example the National Action Plan on Climate Change (NAPCC) and the Integrated Energy Policy (IEP) of the Government of India are in opposition to each other on the issue of renewable energy. The NAPCC stipulates that by 2020, India should be producing 15% of its energy from RE sources (other than large hydro). This provision comes in direct conflict with the IEP which visualizes only 5% renewable penetration by 2032. Since both documents have been approved by the cabinet, it is necessary to overhaul the IEP to bring it in line with the latest policy of the government, as enunciated in the NAPCC.

What is clear from the range of analysis and scenarios presented in this report is that an energy economy based on renewables is possible. To facilitate this much needed transition from an inefficient fossil-fuel dependent economy to a clean energy economy, a whole host of policy, regulatory, legal and institution building measures need to be adopted.

Chhadvel wind farm in Dhule, Maharashtra *© Suzlon*

The most important of them is the **enactment of a comprehensive 'renewable energy law'**. Besides that, dynamic and enforceable RPSs, 'priority sector' lending status for RE, removal of subsidies for fossil fuels, implementation of RECs, a comprehensive smart grid development programme etc are also needed. Any further delay in seriously addressing these concerns will only add to the cost of transitioning towards a clean energy future for India.

2.4 NATIONAL ACTION PLAN ON CLIMATE CHANGE

On 30th June 2008, the Prime Minister's Council on Climate Change approved the National Action Plan on Climate Change (NAPCC). The NAPCC stipulates that a dynamic minimum renewable purchase target of 5% (of total grid purchase) may be prescribed in 2009-2010 and this should increase by 1% each year for a period of 10 years. That would mean that by 2020, India should be producing 15% of its energy from renewable sources.

According to WISE's estimates, the generation share of 15% for renewables equates to a capacity of 107,000 MW by 2020, a net addition of almost 90,000 MW over present (~17,000 MW) installed capacity. Assuming that approximately 60% of this requirement will be met through wind power alone, more than 50,000 MW additional wind power would be required to meet the 15% RE target by 2020. The NAPCC outlined its implementation strategy through the establishment of eight national missions. Of these, two were in the field of energy, namely the National Solar Mission and the National Mission for Enhanced Energy Efficiency. However it does not in its present state have a mission dedicated to wind power.

The future development of this action plan is also closely tied to India's future obligations under the United Nations Framework Convention on Climate Change (UNFCCC).

GRID INTEGRATION

The inherent variability of wind power brings about fluctuations in power output, which can create problems for the traditional grids in maintaining a supply and demand balance. Most of the wind farms in India are located in remote areas and quite far away from load centres. Due to a weak transmission and distribution network, it is difficult to transmit the power from wind farms to the load dispatch centres. This is one of the key constraints for the future development of wind power in the country.

In the past, with vertically integrated utilities, a single organisation was responsible for the planning and operation of networks and giving access to generators, and therefore the technical requirements did not have to be particularly clearly defined or codified.

Now, with increased ownership separation between grid operators and power generators the need for defining the technical requirements governing the relationship between them becomes essential. Renewable energy generation often complicates the process of evacuation and dispatch, as these generators have characteristics which differ from the directly connected synchronous generators used in large conventional power plants.

To increase the penetration of renewables based electricity into the regional grids the Central Electricity Regulatory Commission (CERC) formulated grid standards for RE and incorporated them in its latest grid code. However the challenges facing the Indian grid are multi-faceted, ranging from the need for improved forecasting capabilities to ensuring a proper rollout of the provisions under the Indian Electricity Grid Code (2010). The development of a 'Smart Grid' which would address some the obstacles to integrating renewable electricity could hugely benefit India. Some of these issues are discussed in detail in the following sections.

3.1 INDIAN ELECTRICITY GRID CODE

The Indian Electricity Grid Code[39] (IEGC) was adopted in May 2010 and it supersedes the Indian Electricity Grid Code, 2006. It provides detailed guidelines on the role of various players involved in the operation of a power system. The IEGC brings together a single set of technical and commercial rules, encompassing all the utilities connected to/or using the inter-state transmission system. On the basis of IEGC 2010, all state regulators have to issue their own grid codes for their states.

In IEGC 2010, major provisions related to renewable energy (including wind) are listed below:

- Consideration of capacity addition and the transmission requirement for evacuating power from RE sources in the transmission plan
- Special arrangements for data transfer and communication
- Provision for managing generation from variable sources like wind and solar while ensuring grid security
- Appropriate meters and Data Acquisition System facilities for accounting of Unscheduled Interchange (UI)[40] charges
- Forecasting and scheduling of wind and solar power generation has been made mandatory with effect from 1.1.2012
- Another provision is that the grid operator can instruct the RE developer to curtail generation on consideration of grid security or if the safety of any equipment or personnel is endangered

Some countries with a large quantity of RE have implemented technical standards and regulations for the integration of power from renewable energy sources into the electricity grid system. IEGC is a good first step towards helping to integrate RE power sources into the grid. However it is still a long way before renewable energy sources can be treated at parity with conventional power sources.

3.2 TECHNICAL CHALLENGES IN THE INDIAN GRID

3.2.1 GRID TRANSMISSION PLANNING

The best wind sites in various states with high wind potential, and thus the large scale wind power generation are located in remote locations. However, since grid infrastructure is often insufficient to transport the wind power to the load centres, the power output needs to be consumed within the regional or national power grid.

39 http://www.nldc.in/docs/gridcode.pdf

40 Unscheduled interchange is the difference between actual generation and scheduled generation.

Wind farm in Thoseghar, Maharashtra *© Enercon India*

Construction of new long distance transmission lines to meet the needs of large scale wind power development are thus extremely necessary, and the lack of adequate evacuation capacity is one of the major issues that needs to be addressed in grid transmission planning (GTP). It is essential for the transmission capacity planning process to incorporate a long term vision of wind power additions. GTP must involve wind sector players at the planning stage, in order to minimise bottlenecks arising from the lack of evacuation capacity. It would be advisable to form a separate transmission planning authority for renewable energy sources within the Central Electricity Au thority (CEA) in order to address these issues.

3.2.2 INTERCONNECTION STANDARDS

Grid stability is a key consideration for interconnection of any new system to the existing grid. For a conventional electricity network based on a radial power distribution model, high levels of wind power would pose some challenges related to the stability and efficiency of the interconnected systems. The variable nature of wind power necessitates the development of interconnection standards to enable the grid to sustain the variability without affecting the power quality adversely. The IEGC 2010, incorporates special provisions that require system operators to make efforts to evacuate all available wind and solar power.

3.2.3 DEVELOPING LOCAL DISTRIBUTION NETWORKS

In India, the local distribution network system is weak and often requires substantial augmentation and layout of parallel evacuation infrastructure. This adds to the project costs and also causes delays. The issue is further complicated by stipulations related to cost sharing of this additional infrastructure, which represent an issue especially for state owned utilities that are cash strapped. More often than not, the host utility has a significant say in deciding the cost sharing mechanism.

Recognizing the criticality of the issue, the National Clean Energy Fund could be used for providing infrastructure support for green initiatives such as wind power projects. It could also be used to help improve the capacity of the local distribution network to be able to evacuate wind power and thus help make wind a preferred power generating source for local and regional grid operators.

3.2.4 BENEFITS OF FORECASTING AND SCHEDULING

Currently in India, due to the predominance of thermal and hydro power, the grid balances the fluctuations with minimal interventions. However with more and more variable sources likely to come online, this scenario will change. One of the concepts being floated to address these issues is that of a 'Smart Grid', which is discussed in detail in the next section

IEGC 2010, made forecasting and scheduling mandatory for wind and solar power generators with effect from January 2012. Accurate forecasting is critical to managing wind power's variability. To implement the IEGC guidelines, each new wind power developer has to make arrangements for a data acquisition system facility for transfer of information to grid operators. This will help both the wind farm and grid operators to share data and pass on information in a short time span. Daily generation schedules and revised schedules can also be communicated to the grid operator through this arrangement. For grid operators it will be convenient to accommodate these generation schedules within their dispatch schedules.

Although forecasting requires some initial investment, it will be beneficial in the long run. Scheduling requirements can help generators to trade power and compete with schedulable conventional power on the trading platform, allowing generators to earn significantly higher revenues. This is important for India where revenue collection is a major problem for the power sector.

In wind power forecasting the main participants are wind farm operators and grid operators and its success depends upon close cooperation between them. Wind forecasting uses sophisticated numerical weather forecasts, wind power plant generation models and statistical methods. With accurate prediction of wind power generation, grid operators can plan effectively for the available power. This will result not only in improving the economic efficiency of grid operation but also help in planning for any maintenance and outages to be taken up by the operators. It will further help in compensating for planned outages of thermal plants, and provide additional reserve margin in case of unplanned outages. Thus, forecasting wind power is important to its cost-effective integration within the regional and national power grids.

Another benefit from reliable forecasting and scheduling of wind power is the change in the mindset of grid operators. The biggest advantage of scheduling wind power will be that it will make wind farms appear more like conventional power stations, bridging the gap between demand and supply with the grid operators. Once wind power is understood to be reliable and predictable, it is more likely to get higher returns to the operators.

Under the IEGC 2010, the wind farm operators will have to predict wind generation with reasonable accuracy for proper scheduling and dispatching of power from wind in the interconnected grid system. If actual generation is beyond +/- 30% of the schedule, the wind generator would have to bear the UI charges. However in mature markets like Europe the requirements are a lot more stringent i.e. requiring an accuracy of 85-90% for the next 24 hour period.

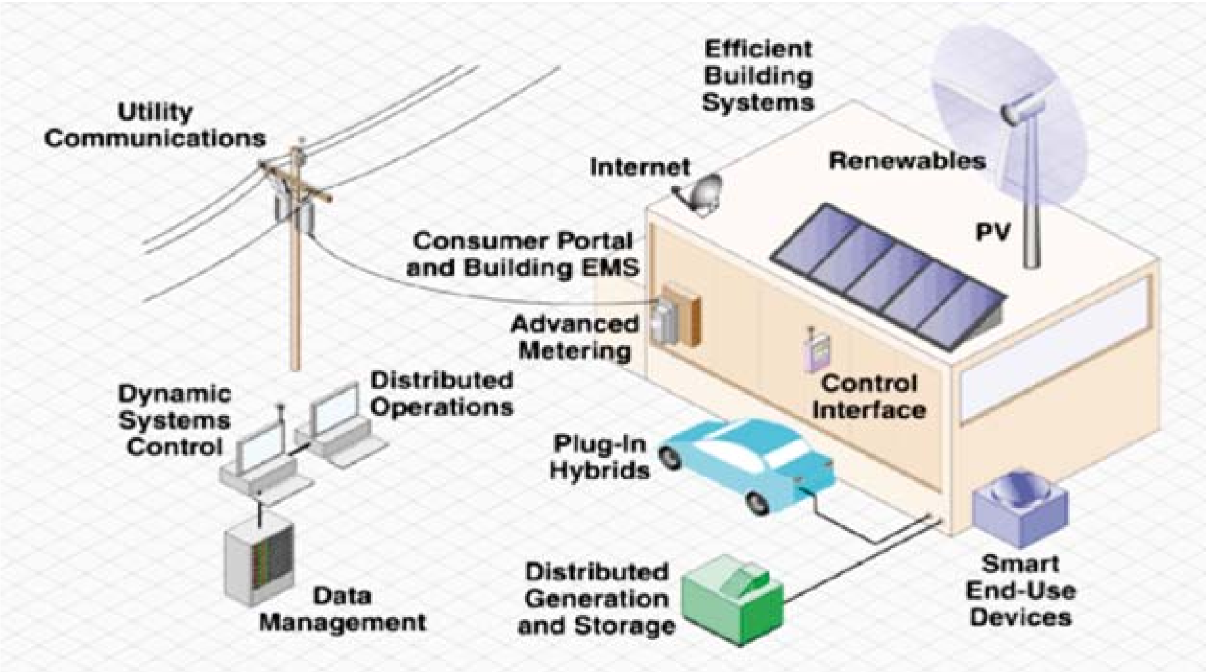
3.3 SMART GRID IN INDIA

The latest buzz word in power industry corridors is 'Smart Grid', which in simple terms means intelligent power generation, transmission, distribution and management, as well as increasingly sophisticated levels of load management. The grid must be designed to be able to manage power flows from variable and geographically distributed generators to dispersed load centres. Particularly in the case of RE sources (such as hydro, solar and wind) the generating resource could be distant from the load centre and power has to be transmitted across a national grid to dispersed load centres.

The Ministry of Power took the first step towards grid reforms when it set up the 'India Smart Grid Taskforce' in June 2010. Their vision of a smart grid brings together the fields of communications, IT and the power sector to establish a comprehensive power infrastructure. Further, on the demand side it envisages giving a choice to the customer to decide the timing and amount of power consumption based upon the price of the power at a particular moment of time.

With the power grids across the country being required to take on electricity produced from non-traditional sources under various schemes (Renewable Purchase Specifications and the Renewable Energy Certificate mechanism), the need to revamp and modernize the national/regional and local grids must be one of the primary areas of investment and development.

FIGURE 5: **DIAGRAMMATIC REPRESENTATION OF A SMART GRID**



© Electric Power Research Institute, 2007 [41]

A smart grid would have to be in place, so as to maximize the potential of RE, especially by providing a uniform platform for distributed generation assets to 'plug and play'. This is a critical service for a country that is plagued with the double challenge of providing energy access to all and an almost perennial supply shortfall.

Some key features of a smart grid are:

- Self-healing: sophisticated grid monitors and controls anticipate and instantly respond to system problems in order to mitigate outages or power quality problems.
- Secure from natural and man-made threats: smart-grid technologies will facilitate identification of and response to deliberate or natural disruptions.
- Enhanced control by customers: a smart grid allows consumers greater control of the appliances and equipment in their homes and workplace by interconnecting the energy management systems in smart buildings and thus enables consumers to lower their energy consumption.
- Asset optimization: Smart grid optimizes assets while minimizing the cost of operation and maintenance.

CHALLENGES FOR A SMART GRID IN INDIA

The two leading challenges associated with the advancement of renewable, distributed energy generation assets are (a) variability and (b) integrating the two-way power flow to and from millions of distributed points.

Variability arises because RE based power is available only at certain times. There are two ways to solve the challenge. The first is to use a variety of renewable sources in combination. The second and most discussed possibility is to rely on energy storage. In fact a cost-effective and technically viable solution to this conundrum will deliver the bridge towards a real energy revolution for a green energy future. Additionally forecasting can help address the variability issue of renewables (wind and solar) when used for large-scale projects.

The other challenge is to successfully add RE based two-way power flow[42] in a distribution network that was primarily designed for electricity flow in just one direction. Hooking up generation sources at the distribution level brings with it a whole new complexity of concerns, making true end-to-end intelligence absolutely essential because grid operators

41 http://smartgrid.epri.com/

42 Two-way power flow: Consumers (both individual and commercial) who decide to produce enough power for their own needs could sell excess electricity back to the grid - a scenario that requires safe and reliable two-way power flow.

Wind farm in Tamil Nadu *© NEGMicon*

will need to measure and aggregate in real time the capacity being added by millions of energy producers if that power is to be properly routed as efficiently as possible.

One of the great advantages of distributed energy is that it does not need to be transmitted over long distances because it is generated in close proximity to consumption centres, minimizing transmission and distribution losses. However, as Indian utilities begin to have distributed energy readily available, they will need to understand the best way to distribute and make use of it.

To enable grid operators to properly dispatch the electricity produced from distributed generation sources, communication systems that can carry price signals and commands are a must. Apart from information technology (IT) and communication concerns, many engineering challenges confront the upgrading of grid assets or infrastructure. For example, distribution power lines were designed to handle a certain amount of power; if that capacity is exceeded substantially, it may exceed the safety threshold of the lines. This means that older lines need to be 'resized' to cope with the extra load. Transformers and other distribution hardware also require upgrading. Further, protecting the entire system takes on a new complexity once power starts moving in two directions. Consequently, coordinating among the number of protective devices will be a major concern. In some cases, utilities will need to re-engineer the system design to address such issues as the need for larger circuit breakers.

These are pressing challenges as more than 26 Indian states have now agreed to meet RPSs and to put in place other mandates and incentives such as RECs and GBI. Unless and until the grid is equipped for a timely uptake of this power, the real benefits of an efficient, cost-effective and clean electricity mix will not be realized.

For this initiative to be successful, it is essential that the various ministries such as the Ministry of Power, the Ministry of New and Renewable Energy, the Ministry of Communications and Information Technology and the Ministry of Environment and Forests come together to evolve a common plan of action. Further both state and national grid operators and their respective electricity regulatory commissions must begin a nation-wide collaborative dialogue towards defining a common understanding of a truly smart grid infrastructure for India. A top down prescriptive report from the central government through its 'India Smart Grid Task Force' could lead to costly delays which would result in the investors and power producers moving on to other investment opportunities.

Wind farm in Tamil Nadu © NEGMicon

Wind farm in Tamil Nadu © NEGMicon

WIND INDUSTRY: A KEY DRIVER FOR LOW CARBON DEVELOPMENT

Fossil fuel-based electricity generation is the single largest source of greenhouse gases, contributing nearly 40% of global CO_2 emissions. The need to move to a more sustainable form of power generation is imperative for avoiding the worst impacts of climate change, in line with the target now agreed by all of the world's governments to keep global mean temperature rise below 2°C above pre-industrial levels.

To achieve this goal, we must fundamentally transform the way we power our economies and use energy. This demands a shift away from the last century's legacy of unrestrained fossil fuel use and its associated emissions towards cleaner and renewable sources of energy. If we are serious about ensuring a secure future for our planet, the displacement of conventional fossil fuel-based technology with low-carbon technologies must be dealt with as a matter of the highest priority. Wind power fits the bill perfectly as one of the few commercially proven green technologies with potential for rapid scale up.

Wind energy is a viable alternative to fossil fuels – it does not emit greenhouse gases or other pollutants. Within less than one year of operation, a WTG can offset all emissions from its construction to run virtually carbon free for the remainder of its 20 year lifetime. The total wind resource is sufficient to meet global energy requirements several times over, and many more times the current total global electricity consumption.

Wind power is already making a significant contribution to emissions reductions in both industrialized and developing countries. According to GWEC, wind power is predicted to produce 680 TWh of electricity globally in 2012, thereby saving 408 million tons of CO_2 (assuming 600kg/MWh as an average value for the carbon dioxide reduction by wind, as per IEA's estimate). This would translate to around 42% of Kyoto Protocol industrialized (Annex I) countries' commitments by 2012[43]. According to GWEC, even under the most optimistic projections of actual emission reductions based on countries' commitments made in Copenhagen in 2009, wind energy can contribute nearly half of all emission reductions of Annex I countries by 2020.

43 http://www.gwec.net/uploads/media/Wind___climate_fact_sheet_low_res.pdf

There is no doubt that wind energy is going to play a major role in the fight against climate change. The only question is whether or not it plays that role soon enough to help reach the goal of keeping global mean temperature rise below 2°C. This is the time to act. The Indian wind industry has the potential to deliver on many of the measures necessary for a low carbon economy. What is needed is the political, regulatory and administrative will to engineer the transition.

4.1 INITIATIVES FOR A LOW CARBON ECONOMY

For India, climate change and energy security concerns have come together in a way that draws increasing attention to its energy policy. The need to address both climate change and energy security has given rise to a Prime Ministerial directive called the National Action Plan on Climate Change (NAPCC) which identifies eight areas or "missions" for focused energy and climate policy interventions: solar energy, energy efficiency, sustainable habitat, water, Himalayan ecosystems, sustainable agriculture, strategic knowledge for climate change and a 'Green India'. Each of the missions will proceed in what are known as Public, Private and People (PPP) partnerships, which bring together central and state governments, businesses, civil society and community organizations to create an effective and realistic strategy for the implementation of the eight missions.

In January 2010, the Planning Commission appointed a 26 member expert group to prepare a 'low-carbon growth strategy' for India. The mandate for the expert committee included preparation of a cross-sectoral study and recommendations on critical low carbon initiatives to be undertaken, including sector specific initiatives with timelines and targets starting in 2011. In its draft report, submitted to government in September 2010, the committee identified core GHG emission sectors and recommended its action plans for the power sector, transport sector, forestry, Iron and steel industry, cement industry, oil and gas Industry, fertilizer industry, etc. The report analyses moderate, high and aggressive emission intensity reduction scenarios for both 8% and 9% average GDP growth rate up to 2010 and takes its base year as 2005.

The recommendations for the power sector include moving to cleaner coal technology (from sub critical plants to super critical plants), greater contribution from nuclear power and

Anthiyur wind farm in Tamil Nadu *© NEGMicon*

continuing emphasis on renewables. However, the report has grossly underestimated the role that renewables can play in the transition to the low carbon path. As of today, the expert committee is working on the final report and it is expected that these methodological lapses will be rectified in the final submission.

The draft report of the Low Carbon Committee has been criticized by WISE on the following grounds. The report acknowledges that the world is moving towards a 100% renewable energy scenario by 2050. Once this is recognised it is obvious that it must be given high priority if India is to address the impacts of climate change and also ensure energy security. The report fails to address the gravity of the problem and has not come up with any viable solutions.

Indian policy design has in many ways started moving towards a low carbon path by penalizing pollution. The 2010 budget announcement to introduce the National Clean Energy Fund (NCEF) was a move in that direction. This cess is expected to generate annual revenues of around $550 million (2,500 Crores) in the current financial year (2010-2011).

The NCEF is proposed to be utilized for the development of clean energy technologies in India.

Many leading industrialized states have also proposed a green cess on electricity. In Maharashtra, a green cess of Rs. 0.08 per kWh of electricity consumed by commercial and industrial consumers is being collected ,leading to annual revenues of around Rs. 50 Million[44]. This fund is to be used for promotion of RE project implementation in the state. Karnataka is another state that is considering implementing a similar cess.

4.2 INDIA: A GLOBAL MANUFACTURING HUB

Established and proven wind turbine technology in India has led to huge investments in the sector. Increased domestic demand and expansion of the in–house manufacturing capacity of the Indian wind industry has resulted in attracting many new manufacturers into the fray. Indian WTG manufacturers are also increasingly engaging in the global market

44 http://www.deccanherald.com/content/49654/green-cess-kerc-nod-sought.html by taking advantage of lower manufacturing costs in India. With increased wind power penetration into the grid, WTGs will have to address issues related to grid stability and power quality in the immediate future.

Until March 2010, four major manufacturers (Suzlon, Enercon India, Vestas India and RRB Energy) had about 82.5% of annual Indian market share. Some other manufacturers were also present in the market, including ReGen Powertech, Gamesa, Leitner–Shriram, Global Wind Power, Kenersys, and WinWinD; however, their cumulative market share in annual installations was only 12.9%. The share of the annual market for manufacturers, who supplied WTGs with power rating less than 500 kW, was 4.6% during FY 2009-2010. Of late, riding on the wind power boom, more than 17 new manufacturers have ventured into WTG manufacturing in India, and some smaller players like Shriram EPC and Elecon Engineering have re–entered the market with new, higher capacity machines.

The existing annual WTG manufacturing capacity is about 7.5 GW in India and is rapidly expanding. According to WISE it is likely to cross 17 GW per annum by 2012. Many new manufacturers are aiming to export to developed markets, especially the USA and the emerging developing country markets in South Asia, Middle East and Africa and now also in South America. Also, some international companies with subsidiaries in India are now sourcing more than 80% of their components from Indian component manufacturers. Significant job opportunities are available in the wind sector at present. Most of the new manufacturers are expected to enter the market during the next six to 24 months. A few of them have already started providing wind power project solutions during 2010. Today, India can be counted as one of the emerging global hubs for manufacturing WTGs.

© Vestas India

4.3 WIND TURBINES FOR LOWER WIND REGIMES

Low wind regimes require considerable changes not only in the design of turbine components but also in generator configuration in order to reduce the Cost of Energy (COE) as much as possible. This can be optimally done by utilizing two parallel approaches: reducing costs and maximizing power capture.

This approach is already endorsed by the market forces in the low wind regime market. Manufacturers are now offering Class II and Class III machines with newer technologies and higher power capture capabilities. In the case of India, the trend is markedly clear as shown in the table in Annex 7 on page 56. Most of the new manufacturers are offering Class III machines that are more suitable for low wind regimes.

BOX 7: METHODS FOR REDUCING COSTS AND MAXIMIZING POWER CAPTURE IN LOW WIND REGIMES

Cost reducing measures

- ‘Designing down’ from high wind regime turbines specifications related to normal and extreme load requirements (designing for lower fatigue load, horizontal loading, etc)
- Minimizing components or parts by use of gearless machines, passive generator cooling system, using common bearings, etc. These measures help to reduce costs of maintenance and spares.

Maximizing power capture

- Taller towers
- Large rotor diameters
- Higher designed efficiency at partial loads, low cut-in wind speeds
- Efficient generator, modern electronics etc.

Wind farm in Thoseghar, Maharashtra © Enercon India

FINANCING, BUSINESS MODELS AND CDM CHALLENGES

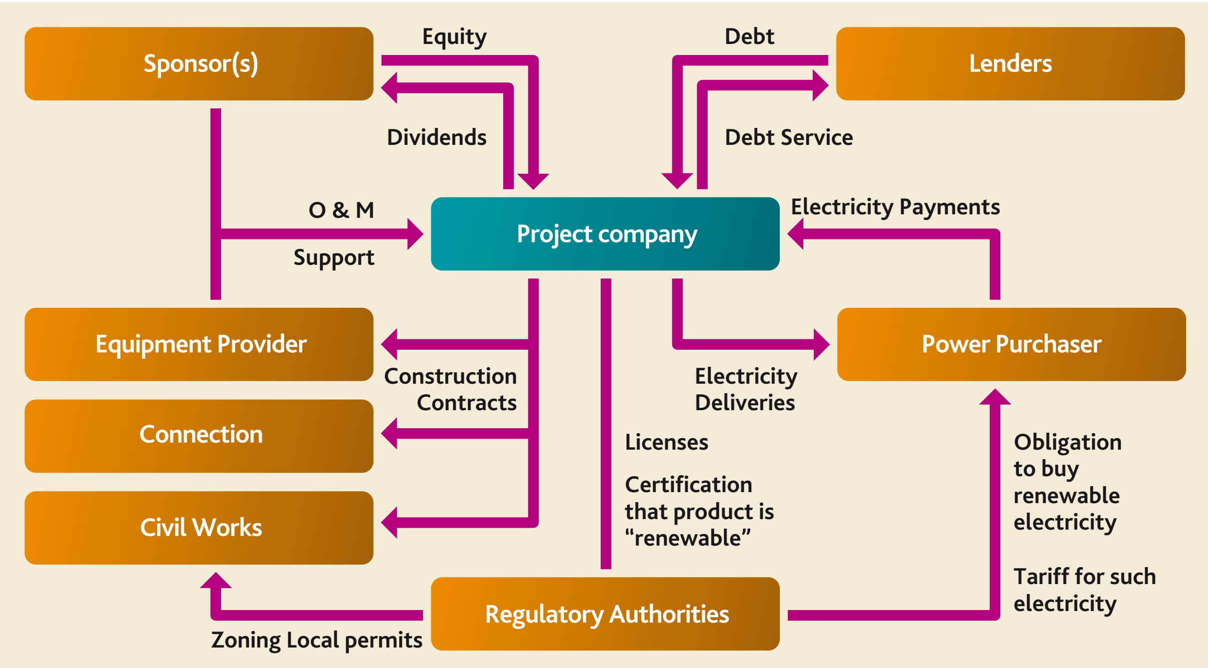
5.1 PROJECT FINANCING

Multilateral and bilateral financing mechanisms are offering new avenues for investors in the developing country markets. The World Bank is increasingly providing funding for renewable and energy efficiency projects globally. The Asian Development Bank (ADB) is involved in augmenting the RE sector through various financial schemes and measures under a broad framework called 'Strategy 2020'. This strategy stipulates that ADB will help Developing Member Countries (DMCs) to move their economies onto low-carbon growth paths by expanding the use of clean energy sources. The International Finance Corporation (IFC) offers various financing mechanisms both through debt and equity participation. This reflects the growing interest and demand for environmental-friendly sources of power.

Bilateral funding agencies are also in a good position to play a major role in wind power financing across Asia, with the United States Agency for International Development (USAID) actively promoting the development of RE through its Market Development for Renewable Energy (MDRE) programme. The European Investment Bank (EIB) through the Global Energy Efficiency and Renewable Energy Fund (GEEREF) and the KFW (German Federal Government) are financing investments in developing countries.

Despite the presence of strong institutional financing mechanisms in India there are considerable barriers to securing local financing for RE projects. The majority of financing to date was asset financing[45], especially in the wind sector. However, the advent of Independent Power Producers (IPP)[46] in the wind sector is helping to establish project financing as an acceptable mode. With more and more banks considering RE projects on a non recourse basis, the scenario is drastically changing and this shift in the attitude of financiers is reflected in elongated maturities and tenors of loans as well as lower borrowing costs. Venture capital and private equity firms are also viewing renewables as an exciting opportunity. The changing perception is also endorsed by the participation of many RE generation companies in the equity market through the IPO route. The establishment of domestic institutional financing channels like IREDA (Indian Renewable Energy Development Agency), PFC (Power Finance Corporation) and REC (Rural Electrification Corporation) is further helping to bridge this gap between equity and debt financing.

FIGURE 6: **PROJECT FINANCING STRUCTURE**



Source: www.vestas.com

45 The most common kind of asset financing is to extend loans against accounts receivable, but other kinds of asset financing, such as lending against inventories, is becoming more common.

46 Independent Power Producer (IPP) : a generating company not owned/ controlled by the Central/State Government

Wind farm in Karnataka *© NEGMicon*

5.2 INDIAN BUSINESS MODEL

Most of the existing Indian WTG manufacturers are providing 'end to end' turnkey[47] solutions to investors. Until recently, the growth of the wind sector in India has been characterized by the dominance of WTGs in every segment of the value chain for wind power development. The role of these manufacturers extends from identification of potential sites to undertaking wind monitoring of identified sites to commercial development and O&M (operation and maintenance) of the completed projects.

Most WTG manufacturers undertake wind monitoring and mapping exercises and studies to identity viable wind sites. Then the WTG manufacturers co-ordinate with the respective State Nodal Agency (SNAs) for allocation of identified wind farm sites, acquisition of land and development of necessary infrastructure such as access roads, evacuation arrangements etc. In other words, they are responsible for the complete development of a wind farm. The WTG manufacturers then sell individual/multiple WTG units, as the case may be.

BOX 8: **BUSINESS MODEL COMPARISON**

	Turnkey solution by WTG manufacturer	Developer based (other than WTG manufacturer)
Strength	• Complete control over project value chain	• Faster decision in case of land procurement, infrastructure creation, resource mobilization, etc. being a local entity
Weakness	• Singular control of WTG manufacturer, from an investor's perspective • May have limitations from the point of competitive costing for large scale IPPs	• Limited control over complete project value chain • Less experience of complete project execution in domestic market
Opportunity	• Small investors mostly rely on turnkey solution models	• Opportunity to invite competitive WTG bids • Great growth potential with large IPPs/utilities/ PSUs entering the market
Threat	• Limited land holding may put constraint on growth	• Delay in project execution due to WTG supply delays • Delay in project execution, O&M due to lack of experienced manpower

47 A turn-key or a turn-key project is a type of project that is constructed by a developer and sold or turned over to a buyer in a ready-to-use condition.

BOX 9: **OPTIONS FOR FINANCING A WIND POWER PROJECT**

There are various routes to financing a wind power project through banks and other financial institutions in India.

1. Full recourse (Corporate guarantees/cash collateral)	2. Limited/non-recourse financing
Financing basis	**Financing basis**
• Creditworthiness • Full recourse • Balance sheet and share price/valuation implications	• Cash flow of the project • Non/limited recourse to sponsor
Highlights	**Highlights**
• Interest rate depends on creditworthiness • Standard documentation • Usual credit assessment	• Interest rate depends on project risk • Low risk profile and stable cash flows • Comprehensive documentation • Structuring effort/cost/time • Project, regulatory and technical risk assessment by independent consultants

Source: Vestas.com

These days the 'developer model' is being explored by some of the Independent Power Producer (IPP) developers. Some of the new global entrants are supportive of this development as a preferred option.

Until now, mostly power-intensive companies such as those in the textile or cement sectors invested in wind power for their captive[48] consumption, so as to reduce the energy costs of their production coupled with the benefits of accelerated depreciation. Also, firms and individuals invested in WTGs to avail themselves of accelerated depreciation benefits to minimise their tax liabilities. Thus a small investor with ownership of just one or two WTGs was in fact the predominant market phenomenon. But now, an increasing number of investors are planning wind farms of 50 MW and above. The IPP model for wind power represents the next-generation growth phase for the sector.

5.3 PARTICIPATION IN CARBON MARKETS

The enthusiastic participation of Indian industry in the Kyoto Protocol's project based offset mechanism has helped raise awareness and built tremendous capacity in the market to be able to undertake projects with an internationally applied due diligence. The astounding success of the Clean Development Mechanism has been a mixed blessing in several ways. It was designed as a climate finance instrument to deliver additional financing for sustainable and clean development in developing countries. However in the past years the need for improving its environmental integrity and operational performance has been recognised as a priority.

India has the second highest number of wind power projects registered under the CDM. However, the continuation of the CDM (in its current form) remains in doubt post 31st December 2012.

Under the Copenhagen Accord of the United Nations Framework Convention on Climate Change, India pledged to take on an emission intensity improvement target of 20% to 25% by 2020 compared to 2005 levels. According to the World Energy Outlook of the IEA (2010), the major contributors to abatement in India will be energy efficiency and renewables. The 15% by 2020 renewables target under the NAPCC will further strengthen this demand. All this bodes well for Indian wind sector's participation in a global carbon market.

48 *Captive Power Plant: "Power plant set up by any person to generate electricity primarily for his own use and includes a power plant set up by any co-operative society or association of persons for generating electricity primarily for use of members of such cooperative society or association…"(Electricity Act, 2003)*


Wind farm in Tamil Nadu © NEG Micon

ADDITIONAL BENEFITS OF WIND POWER FOR INDIA

At the Delhi International Renewable Energy Conference (DIREC) in late 2010, governments issued a Declaration[49] which calls for actions to up-scale and mainstream renewables for energy security, climate change and economic development. Among other elements, the declaration outlines the following salient points:

BOX 10: THE DIREC DECLARATION

- Acknowledges the multiple benefits of renewable energy
- Commends the goal enunciated by the UN Secretary-General's Advisory Group on Energy and Climate Change of universal access to modern energy services by 2030
- Calls on the UN to designate 2012 as the 'International Year of Energy Access'
- Recognizes that consistent and sustained government policies have a favourable impact on technology deployment and will increase the uptake of renewable energy
- Notes that public funds are instrumental in leveraging and incentivizing large-scale private investment in developing countries
- Welcomes the Delhi International Action Programme that encourages governments, international organizations, private companies, civil society and others to take voluntary action for up-scaling renewable energy within their jurisdictions or spheres of responsibility.

It is heartening to see this engagement by the Government of India in promoting international dialogue with public and private players towards mainstreaming RE for energy security, climate change mitigation and economic development. In the following sections these and related issues are discussed further.

49 *http://www.mediaterre.org/docactu,Q0RJLUwtMy9kb2NzL3RoZS1kaXJlYy1kZWNsYXJhdGlvbg==,1.pdf*

6.1 UN CLIMATE TALKS & THE CANCUN AGREEMENTS

At the 16th session of the Conference of Parties (COP16) to the United Nations Framework on Climate Change (UNFCCC) in Cancun in December 2010 the fact that any agreement at all was reached came as a surprise to many observers, as the expectations going into the meeting had been extremely low. This does not mean that there is universal applause for the outcome and many observers and parties have expressed their reservations; and they are of course right in some ways. We are no closer to a global price on carbon than we were before the meeting; there is no agreement as to whether we are seeking a new overarching single climate treaty, or the amendment of the Kyoto Protocol or a new protocol for developing countries and the USA; and the existing emissions reduction targets will not get us anywhere near the objective of keeping average global temperature rise below 2°C. Governments will have to do much better to make any real difference in a world increasingly threatened by unprecedented climatic changes.

During much of 2010, the UNFCCC's multilateral approach to a truly global solution was repeatedly pronounced 'dead' by a wide range of commentators. Although that sentiment has not disappeared, it seems that the UNFCCC process, the only place where a global agreement can be achieved, lives to fight another day. The fact that any agreement at all was achieved must be judged a success, albeit limited.

DOES THE KYOTO PROTOCOL HAVE A FUTURE?

On the Kyoto Protocol side of the negotiations, much has been achieved over the years. Nearly all of the countries of the world have ratified this landmark instrument, except for the United States. Virtually all of the countries of the world would like to see at least some of the elements of the architecture of the Kyoto Protocol continue past the end of its first commitment period in December 2012, including, most importantly for the wind industry, the flexible mechanisms (Clean Development Mechanism and Joint Implementation) based on carbon trading. However, this cannot be achieved without agreeing legally binding emission reduction targets for the period after 2012, and this is where the battle lies.

The discussion on the post-2012 architecture of the Kyoto Protocol has been going on for five years now, and very little

Wind farm in Tamil Nadu *© NEGMicon*

progress has been made. The main substantive agreement was back in 2007, when the Parties (which exclude the United States, and at that point, Australia) agreed that the range of emission reductions required from industrialised countries for the period up to 2020 was in the range of minus 25-40% against a 1990 baseline. This follows the findings of the IPCC's Fourth Assessment Report, in order to have a chance to keep global mean temperature rise below 2°C. Yet the United States has steadfastly held to its position that it will not be bound by internationally agreed, legally binding emission reduction obligations. This political dynamic has made the negotiations even more tedious and complex. The dynamics are further complicated by the fact that both Japan and Russia indicated during COP 16 that they were not willing to go ahead with a second commitment period of the Kyoto Protocol.

Virtually all experts agree that private sector finance, leveraged by a carbon market and driven by deepening emission reduction obligations by an ever increasing number of countries is going to provide the lion's share of the finance, the technology, the innovation and the know-how to address the climate crisis. The carbon market has many detractors, yet no one has as yet come up with a viable alternative. Carbon taxes, although favoured by many economists, are generally considered to be politically untenable (as evidenced by the fact that none have been enacted over the past 20 years) and are unlikely to find support within the business community. Furthermore, the historical track record shows that taxes, while a very good way of raising revenue, are a very imprecise and generally ineffective way to modify consumer behaviour.

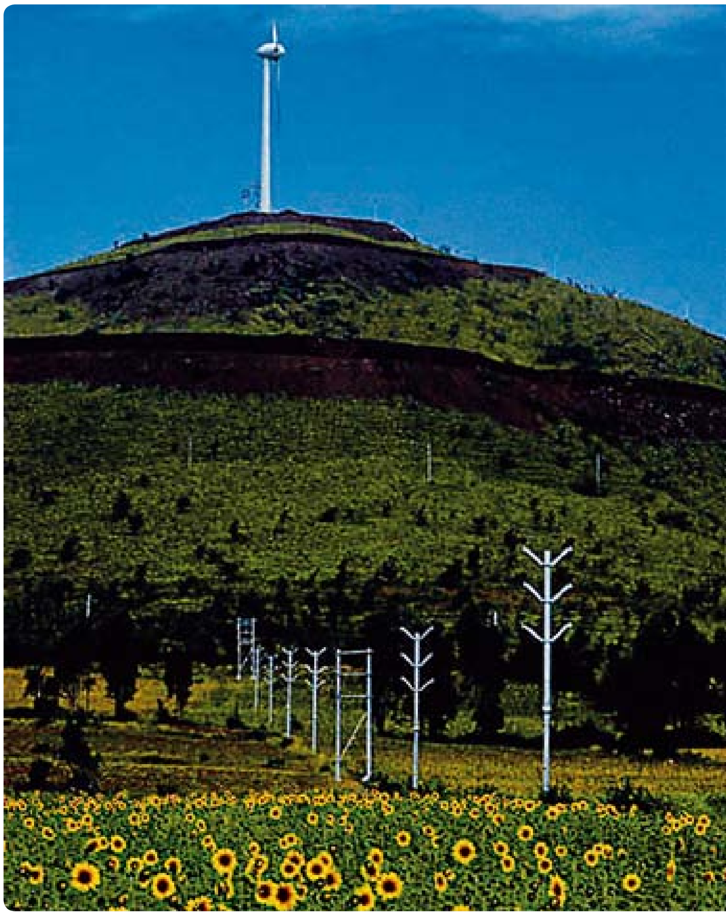
So, today the question that faces the international community is which of the following three options is the least worst:

a) continuing negotiations on an ongoing basis to try and come up with some agreement to which the United States will agree but which will not achieve the agreed objective;

b) wait for the United States to come around to the basic ideas in the Kyoto Protocol, which, after all, were invented by and for the United States in the 1990s to reduce the costs of mitigation and provide the impetus for the private sector to shoulder the majority of the burden in addressing the climate crisis, or;

c) gather the political will to move forward without the US, leaving the door wide open for them to join the global community as and when political conditions in the US permit.

Not being in a position to address these fundamental issues, negotiators spent the majority of their time last year discussing important if less fundamental subjects, the most important of which was the future and the development of the Clean Development Mechanism, and by extension the other flexible mechanisms (under the Kyoto Protocol) predicated on the **establishment of carbon as a new 'currency'** used to drive private sector investment.



Wind farm in Karnataka *© Enercon India*

Unless there is some other, as yet unforeseen, architectural arrangement, the CDM would cease to function at the expiration of the Kyoto Protocol's first commitment period at the end of 2012. Yet almost no one wants this to happen. A slim thread of hope was attached to the fact that Russia and Japan did not object to agreeing language in the final decision in Cancun that stated the objective of the negotiation was for the group to conclude its negotiations "as early as possible and in time to ensure that there is **no gap between the first and second commitment periods"**; implying that there will in fact be a second commitment period. India's Environment Minister (Jairam Ramesh), responding to a query on the same said that the decision will probably not come until the very end, which may mean that this state of affairs could continue until the first half of 2012.

Parties otherwise focussed on important but not fundamental issues such as the basket of gases to be included, what metrics should be used to compare the impact of different gases, and some forward progress on the operation of CDM mechanism itself. Most notable among these decisions was that 'standardized baselines' for CDM projects could be submitted, and governments requested the Executive Board to consider and adopt them. This could provide for significant streamlining of the project approval process, and yield substantial benefits to the wind industry; provided of course, that the CDM has a future going forward in 2013.

The parties inched closer to allowing carbon capture and storage projects to be included in the CDM, although no final decision has been taken. All of the same issues are under consideration, and still need to be resolved; but the political support among climate negotiators and key governments is very strong, despite the fact that there is no working example of the technology.

The reality is that we just have to wait for the politics to change, for the impacts of climate change to get much worse, or some combination of the two. But for those looking for a silver lining, there are several. First of all, the **RE industry is**

Jogimatti wind farm, Karnataka *© Enercon India*

powering ahead, and a vast array of regional, state, municipal and local initiatives to reduce emissions and promote green energy are being announced globally. Second, as the global economy develops, we are also seeing the first hints of leadership on the climate issue arising from the BASIC group (Brazil, South Africa, India and China). While BASIC is far from being a 'progressive' grouping within the UNFCCC, India in particular should be noted for playing a much more positive role in the negotiations than it has in the past. For the wind industry, this means that we watch, and wait for the political change which will allow real forward progress. In the meantime, we should focus our efforts on looking at ways for making wind power a key driver of India's march towards a truly green and sustainable economy that allows millions more to share in the fruits of balanced socio-economic growth.

6.2 GHG EMISSIONS AND WIND POWER

Modern wind technology has an extremely good energy balance. The benefit to be obtained from carbon dioxide (CO_2) reductions is dependent on the fuel that wind power displaces. Wind power is a clean, renewable source of energy which produces no greenhouse gas (GHG) emissions or waste products in itself. By directly reducing the use of fossil fuels, wind power significantly reduces CO_2 emissions, other particulate matter and pollutants (from coal plants). Depending upon the fuel being replaced, a single modern 1 MW wind turbine will save 2,000 tonnes or more of CO_2 emissions annually. It usually takes a wind turbine three to six months to produce the energy that goes into producing, operating and recycling the wind turbine after its 20-25 year lifetime[50]. After that, wind power produces no CO_2 emissions.

The expected CO_2 savings from wind power under the IEA's Reference scenario are 243 million tonnes globally in 2010, passing 500 million tonnes per year between 2015 and 2020, thereafter climbing to 843 million tonnes per year of CO_2 savings by 2030. The slow growth of wind power as envisaged by the Reference scenario would mean that by 2020, wind power would have saved just 5.5 billion tonnes of CO_2 globally, and this would rise to 13 billion tonnes by 2030 (GWEO 2010).

50 http://www.ewea.org/fileadmin/swf/factsheet/4_climate.pdf

A much faster growth such as the one outlined in the GWEO Moderate scenario would substantially increase the cumulative CO_2 savings, by achieving reductions of 8.5 billion tonnes by 2020 and 28 billion tonnes by 2030. Under the GWEO Advanced scenario, these savings would be as high as 10 billion tonnes by 2020 and 34 billion tonnes of CO_2 by 2030.

Incidentally India announced its intention to reduce the emission intensity of its GDP by 20-25% by 2020 in comparison to 2005 levels through domestic mitigation actions at the UN Climate Talks in Copenhagen (2009). With such international obligations India will be bound to support the transition towards a much larger share of renewable sources in the energy mix.

6.3 ENERGY SECURITY

In 2007 the Ministry of Environment and Forests (MoEF), Ministry of Power (MoP) and the Bureau of Energy Efficiency (BEE) issued a paper entitled 'India: Addressing Energy Security and Climate Change'[51]. This was the first time that these agencies had come together to recognise climate change as a legitimate concern for policy makers and also linked it with energy security. Further a major portion of the proposed solution for integrating climate change concerns with traditional sustainable development included 'diffusion of RE and energy-efficient technologies'. However to date we have not seen an integrated techno-economic road map to achieve this end.

That said, energy security can mean different things in different countries. The IEA in the past has defined energy security as the provision of reasonably priced, reliable and environmentally friendly energy. The UN in its "Report on Multi Dimensional Issues in International Electric Power Grid Interconnections"[52] describes energy security as follows:

A nation-state is energy secure to the degree that fuel and energy services are available to ensure: a) survival of the nation, b) protection of national welfare, and c) minimization of risks associated with supply and use of fuel and energy services. The five dimensions of energy security include energy supply, economic, technological, environmental, social and cultural, and military/security dimensions.

Currently, according to the Indian government, nearly 30% of India's total energy needs are met through imports[53]. In March 2011 world crude oil prices are well over the $100 per barrel mark. Also building nuclear or thermal plants under a business-as-usual pathway will only increase India's exposure to market fluctuations and political risks of controlled supply chains. It is definitely more efficient to make investments in improved energy efficiency and harnessing RE sources to meet the current demand-supply gap.

In India the need for expanding the role of domestic RE sources is a logical next step. In order to encourage large scale and sustained private investment in RE, a combination of measures is crucial to achieve cost competitiveness. Wind power is already in a position to provide a significant portion of India's planned capacity addition up to 2030, with simple regulatory and grid modernisation initiatives. Unlike oil, coal or LNG, wind power is not subject to fluctuating fuel prices which drain India's limited foreign reserves, and in addition, wind power helps reduce the carbon footprint of the economy.

6.4 ENERGY ACCESS

For India's growth to be truly inclusive, each and every citizen should be guaranteed a minimum standard of access to the electricity grid (decentralised or national) and clean cooking facilities. India, with over a billion people, today consumes 645 TWh of electricity[54] (comparable with Brazil which is home to only one sixth of this population). 404 million Indians have no access to electricity, and limited access to other modern fuels such as LPG. This scenario of low energy access is reflected in the Human Development Index which ranks India relatively low at 119 among 169 nations, according to the latest Human Development Index (HDI) released by the UN Development Programme (2010).

According to the IEA, India's economic growth will average 7.9% during the period 2008-2015 and then slow down to average 5.9% between the periods 2015-2035 (WEO,

51 http://moef.nic.in/modules/about-the-ministry/CCD/Addressing_CC_09-10-07.pdf
52 http://www.un.org/esa/sustdev/publications/energy/interconnections.pdf
53 http://www.eia.doe.gov/cabs/India/Full.html
54 Key World Energy Statistics , International Energy Agency (2010)

2010). Poverty reduction and economic growth are the prime objectives of the National Integrated Energy Policy and energy is the key driver of development in a modern economy. Whether this growth will lead to poverty eradication will depend on the political will towards developing a holistic growth model that allows for reforms across the board to deliver long-term socio-economic development.

In the last two decades, India has more than doubled its electricity capacity to 170 GW[55]. The Government of India has an ambitious mission of 'Power for all by 2012'.Since 2007, only around 12,000 villages were electrified. Approximately 100,000 villages are yet to be electrified, and over 44 million households do not have access to energy[56]. In comparison, 95% of urban households now have access, but even then, this is not guaranteed at all times as load shedding is a very common phenomenon in smaller towns and during the summer months.

6.5 MILLENNIUM DEVELOPMENT GOALS

The Millennium Development Goals (MDGs) were the international community's bold commitment to halving poverty in the world's poorest countries by 2015[57]. Lack of access to modern energy services is a serious hindrance to economic and social development and this must be overcome if the UN MDGs are to be achieved[58]. A large proportion of the developing world remains without any access to modern energy. Overcoming poverty requires self sustained economic growth. Electricity is essential for setting up small businesses, which serve the local markets. Further sustained services (healthcare, education) and predictable employment are the only means of lifting people out of poverty, which is why electricity is a key to development.

The eight UN MDGs adopted in 2000 were designed to eradicate extreme poverty and hunger by 2015. In 2010 at the 12th International Energy Forum (IEF) Ministerial in Cancun, Mexico, the IEF called for the International Community to set up a ninth goal, specifically related to energy, to consolidate the evident link between modern energy services and the achievement of the MDGs.

Anthiyur wind farm in Tamil Nadu *© NEGMicon*

Increasing access to modern energy services requires the integration of energy access into national development strategies, preferably with support from the multilateral agencies. The UN has decided to focus on an institutional framework for Sustainable Development Governance (SDG) and Green Economy (in the context of poverty eradication and sustainable development) as the two pillars of its dialogue with the world's governments in the run up to the Rio+20 Earth Summit in 2012. This is going to be an important gathering of the world's political leaders and thinkers – a time to take stock of where the world stands with respect to the two identified pillars. Between now and May 2012, there will be an ongoing process of consultations and stakeholder forums for providing input into the final outcome from the Earth Summit[59] – the fifth such meeting in history. Many experts argue that India is not likely to meet its MDG targets by 2015 and the results will be a mixed bag[60].

55 http://cea.nic.in/
56 http://www.brettonwoodsproject.org/art-567213
57 http://www.undp.org/energy/
58 http://www.worldenergyoutlook.org/docs/weo2010/weo2010_poverty.pdf
59 http://www.earthsummit2012.org/index.php/process
60 http://www.hindu.com/2010/10/20/stories/2010102053891200.htm

CONCLUSION

It is not an exaggeration to state that 'Humanity is facing a choice between a peaceful decision on its common energy future or wars for resources in the near future'[61]. The world population is set to grow by 0.9% per year on average, from an estimated 6.7 billion in 2008 to 8.5 billion in 2035 (UNDP, 2009). Currently 1.4 billion people do not have access to reliable electricity in developing countries with about 85% of those in rural areas (WWF, 2011).

With 404 million people in India still without access to electricity (IEA, 2010) – there is a whole new market waiting to be tapped by enterprising individuals and visionary investors. However it is clear that grid extension in rural areas is often not cost effective, so decentralised electricity generation with small wind, hydro and solar are best suited to provide the much needed options.

There is increasing public awareness and international consensus towards a global compact for addressing the problems of climate change and energy security. India is one of the key emerging economies yet a highly vulnerable country to both climate change and energy market fluctuations. Wind power, through its scalability and speed of deployment, can not only help reduce India's carbon footprint but also help towards achieving energy security by reducing its dependence on fossil fuel imports in the long term. It is important for the government to conduct an in-depth study of true costs of developing a low carbon green economy in the near future.

For now providing comprehensive regulatory support and exhibiting political will to strengthen the domestic renewables markets is an essential step towards mainstreaming RE. Further emphasis is needed to shift the paradigm of capital subsidies towards performance based incentives for building a truly global and competitive wind industry in India.

61 Sascha Mueller-Kraenner , 'Energy Security' (2008)

ANNEX 1: COMPARISON OF STATE LEVEL WIND POWER DEVELOPMENT IN INDIA

		STATES							
	Particulars	Andhra Pradesh	Gujarat	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Rajasthan	Tamil Nadu
1	**Total number of identified sites**	32	40	26	17	7	39	8	45
2	**Identified number of potential districts**	7	9	9	3	5	13	5	11
3	**Annual mean wind speed (m/sec) at 50 m mast height**	4.86–6.61	4.33–6.97	5.19–8.37	4.41–8.12	5.0–6.25	4.31–6.58	4.02–5.73	4.47–7.32
4	**Number of wind monitoring stations established till October 2010**	63	69	49	27	37	112	36	68
5	**Number of wind monitoring stations operating (as of Decemeber 2010)**	2	6	5	-	4	22	1	1
7	**Installable wind potential (MW)**	5,394	10,609	8,591	790	920	5,439	5,005	5,374
8	**Presently installed capacity (MW) till Dec. 2010**	176.8	2,005.30	1,576.20	28	230.8	2,201.60	1,353.40	5,502.90
9	**Untapped installable potential (MW) as in Dec. 2010**	5,217.20	8,603.80	7,014.90	762	689.2	3,237.40	3,671.70	-128.9*

** Note: Based on government estimated potential for wind power. Currently at least another 3000 MW of projects are in the pipeline in Tamil Nadu.*

Source: WISE, 2010

ANNEX 2: CAPACITY FACTORS IN KEY STATES

STATE	Gujarat		Karnataka		Madhya Pradesh		Maharashtra		Tamil Nadu	
	Generation (MU)	Capacity Factor %	Generation (MU)	Capacity Factor %	Generation (MU)	Capacity Factor %	Generation (MU)	Capacity Factor %	Generation (MU)	Capacity Factor %
1997	117.86	10.90	7.25	24.17	5.98	9.01	2.58	8.92	702.17	13.67
1998	132.41	9.96	11.72	15.37	7.43	8.25	3.31	6.93	779.80	13.01
1999	91.32	6.25	26.62	17.12	10.51	8.66	9.80	9.80	894.93	14.35
2000	122.36	8.37	39.47	19.29	23.45	13.71	45.70	12.58	1,155.08	17.90
2001	142.23	9.73	72.26	22.36	28.86	14.58	142.58	15.23	1,095.84	16.01
2002	134.76	9.22	92.86	20.91	28.24	14.26	332.75	15.69	1,245.76	17.26
2003	147.34	9.99	175.11	24.20	32.63	16.48	666.63	19.04	1,305.50	16.73
2004	138.30	8.76	308.16	24.17	19.78	9.99	643.17	18.23	1,592.63	16.78
2005	224.97	11.96	778.60	34.24	39.64	18.72	688.90	18.74	2,113.65	15.77
2006	264.07	10.98	1,113.82	28.00	53.12	19.10	790.00	24.98	3,845.80	19.50
2007	303.18	8.24	1,449.05	25.42	70.00	17.89	1,714.00	19.37	5,301.01	19.93
2008	987.47	13.85	1,505.78	19.22	69.00	10.53	1,804.00	8.97*	6,065.86	19.47
2009	2,104.00	18.02	1,723.00	17.78	N/A	N/A	2,207.00	13.98	6,206.00	17.91
2010	2,988.00	20.78	2,687.00	22.42	N/A	N/A	2,625.00	15.19	8,146.00	20.96

** Cable Theft*
MU: Million Units

Source: WISE,2010

ANNEX 3: AVERAGE SIZE OF WTG (KW) INSTALLED EACH YEAR

COUNTRY	2004	2005	2006	2007	2008	2009
	YEAR					
China	771	897	931	1,079	1,220	1,360
Denmark	2,225	1,381	1,875	850	2,277	2,368
Germany	1,715	1,634	1,848	1,879	1,916	1,977
India	767	780	926	986	999	1,117
Spain	1,123	1,105	1,469	1,648	1,837	1,897
Sweden	1,336	1,126	1,138	1,670	1,738	1,974
UK	1,695	2,172	1,953	2,049	2,256	2,251
USA	1,309	1,466	1,667	1,669	1,677	1,731

Source: BTM Consult ApS, March 2010

ANNEX 4: COMPARISON OF WTG TECHNOLOGY OPTIONS AND DEVELOPMENT TRENDS IN INDIA

MANUFACTURER	WTG rating (kW)	Generator type	Stall regulation	Pitch regulation	Fixed speed	Variable speed	Gear box	Gearless
Elecon	600	Induction	√	-	-	Dual	√	-
Enercon India	800	Synchronous	-	√	-	√	-	√
Essar Wind	1,500	DFIG	-	√	-	√	√	-
Emergya Wind Technologies*	750/900	PMSG	-	√	-	√	-	√
	2,000	PMSG	-	√	-	√	-	√
Gamesa	850	DFIG	-	√	-	√	√	-
	2,000	DFIG	-	√	-	√	√	-
GE Wind	1,500/1,600	DFIG	-	√	-	√	√	-
Ghodawat Energy*	1,650	DFIG	-	√	-	√	√	-
Global Wind Power Ltd	750	SIG	√	-	√	-	√	-
	2,500	Asynchronous	-	√	-	√	√	-
Inox Wind	2,000	DFIG	-	√	-	√	√	-
Kenersys India	2,000	EESG	-	√	-	√	√	-
Leitner-Shriram	1,350/1,500	PMSG	-	√	-	√	-	√
Pioneer Wincon	750	Induction	√	-	-	√	√	-
ReGen Powertech	1,500	PMSG	-	√	-	√	-	√
RRB Energy	600	Asynchronous	-	√	√	-	√	-
	1,800*	Asynchronous	-	√	-	√	√	-
RK Wind	600	SIG	-	√	-	√	√	-
Siemens*	2,300	Asynchronous	-	√	-	√	√	-
Suzlon	600	Asynchronous	-	√	√	-	√	-
	1,250	Asynchronous	-	√	√	Dual	√	-
	1,500	Asynchronous	-	√	√	-	√	-
	2,100	Asynchronous	-	√	√	-	√	-
Vestas India	1,650	Induction optslip	Active	-	√	-	√	-
	1,800	Asynchronous	-	√	-	√	√	-
WinWinD	1,000	PMSG	-	√	-	√	√	-
Xyron Technologies*	1,000	PMSG	-	√	-	√	-	√

i. Any < 250 kW rated turbine manufacturers are not considered because their market share in India is decreasing
*ii. The manufacturers in the above list highlighted * are not listed in the C-WET's RLMM list dated 19/01/2011*
iii. SIG- Squirrel-cage Induction Generator
iv. WTG: Wind Turbine Generator
v. RLMM stands for Revised List of Models and Manufacturers
vi. PMSG- Permanent Magnet Synchronous Generator
vii. EESG- Electrically Excited Synchronous Generator
viii. DFIG- Doubly Fed Induction Generator.

Source: WISE, 2010

ANNEX 5: STATUS OF RENEWABLE PURCHASE SPECIFICATION (RPS) & RENEWABLE ENERGY CERTIFICATE (REC) REGULATIONS OF STATE ELECTRICITY REGULATORY COMMISSIONS (SERCS) AS ON 11.01.2011

Sl. No.	States	Reference for RPS Order(s)/Regulations	Minimum Percentage for RE Procurement across States				REC Regulation Status (as on 11.01.2011)		Designation of State Agency
			RE Sources/ Eligible Entries	2010 / 2011	2011 / 2012	2012 / 2013	Draft Regulation	Final Regulation	
1	**Andhra Pradesh**	Order 27 Sep. 05 Extended up to 31 July 08, extended up to 31 March 09 vide order dated: 29 Jan 2009		5%	5%		-	-	-
2	**Assam**	Draft Regulation: 21 June 2010		1.40%	2.80%	4.20%	√	-	√
3	**Bihar**	Order dated. 21 May, 2010		5%	6%		√	√	√
4	**Chattisgarh**	Regulation dated: 14 July 2008	Biomass	5%			√	-	√
			Small Hydro	3%					
			Others	2%					
5	**Delhi**	Order dated: 23 Feb 2008	NDPL	1%	1%		-	-	-
			BYPL	1%	1%				
			BRPL	1%	1%				
			NDRC	1%	1%				
6	**Gujarat**	Order dated: 17 April 2010	Wind	4.5%	5%	5.5%	√	√	√
			Solar	0.25%	0.5%	1%			
			Others	0.25%	0.5%	0.5%			
			Total	**5%**	**6%**	**7%**			
7	**Goa**	Notification dated: 30 November 2010	Non-Solar	0.75%	1.70%	2.6%	√	√	-
			Solar	0.25%	0.30%	0.40%			
			Total	**1.0%**	**2.0%**	**3.0%**			
8	**Haryana**	Order dated: 15 May 2007		10%			√	-	√
9	**Himachal Pradesh**	Notification on 26 May 2010	Non-Solar	10%	11%	12%	√	√	√
			Solar	0%	0.1%	0.1%			
			Total	**10%**	**11.1%**	**12.1%**			
10	**Jammu & Kashmir**	Draft notification 2010	Non-Solar	1.48%	0.02%	1.5%	√	-	√
			Solar	1.48%	0.02%	1.5%			
			Total	**1.97%**	**0.03%**	**2.0%**			
11	**Jharkhand**	Notification on 21 July 2010	Non-Solar	1.75%	2.50%	3.0%	√	√	√
			Solar	0.25%	0.50%	1.0%			
			Total	**2.0%**	**3.0%**	**4.0%**			

ANNEX 5: **STATUS OF RENEWABLE PURCHASE SPECIFICATION (RPS) & RENEWABLE ENERGY CERTIFICATE (REC) REGULATIONS OF STATE ELECTRICITY REGULATORY COMMISSIONS (SERCS) AS ON 11.01.2011**

Sl. No.	States	Reference for RPS Order(s)/Regulations	Minimum Percentage for RE Procurement across States				REC Regulation Status (as on 11.01.2011)		Designation of State Agency
			RE Sources/ Eligible Entries	2010 / 2011	2011 / 2012	2012 / 2013	Draft Regulation	Final Regulation	
12	**Karnataka**	Order dated: 27 Sept' 2004, Amendment dated: 23 Jan'2008	BESCOM, MESCOM, CESE	10%			√	-	-
			HESCOM, GESCOM, Hukeri Society	7%					
13	**Kerala**	Regulation dated: 24 June 2006		3%	3%	3%	√	√	√
14	**Madhya Pradesh**	RPS Order dated: 7 Nov'2008	Wind	6%	6%		√	√	-
			Biomass	2%	2%				
			Co-generation & Others	2%	2%				
15	**Maharashtra**	RPS-REC Regulation dated: 7 June 2010	Solar	0.25%	0.25%	0.25%	√	√	√
			Non-Solar	5.75%	6.75%	7.75%			
			Total	**6%**	**7%**	**8%**			
16	**Manipur**	Notification May 2010		2%	3%	5%	√	√	√
17	**Mizoram**			5%	6%	7%			
18	**Meghalaya**	Notification dated: 21 December 2010	Wind	0.1%	0.15%	0.20%	√	-	-
			Solar	0.2%	0.3%	0.4%			
			Others	0.2%	0.3%	0.4%			
			Total	**0.5%**	**0.75%**	**1.0%**			
19	**Orissa**	Order dated: 20 Aug'2005		4.5%	5%		√	√	√
20	**Punjab**	Order dated: 13 Dec'2007		3%	4%		√	-	√
21	**Rajasthan**	Proposed order:31 Mar. 2006; Final RPS order-29 Sept. 2006, RPS Order for Open Access & Captive Power Plant: 7 April 2007	Wind	6.75%	7.5%		√	√	√
			Biomass	1.75%	2%				
			Total	**8.5%**	**9.5%**				
22	**Tamil Nadu**	Order dated: 20 March 2009		14%			√	√	√
23	**Tripura**	Regulation dated: 23 March, 2009		1%	2%		√	-	√
24	**Uttar Pradesh**	Regulation dated: 23 Mar' 06		7.5%			√	√	-
25	**Uttarakhand**	Regulation dated: 06 July 2010	Solar	4%	4.5%	5%	√	√	√
			Non-Solar	0%	0.025%	0.050%			
			Total	**4%**	**4.53%**	**5.05%**			
26	**West Bengal**	Regulation dated: 31 May 2010		2%	3%	5%	-	-	-

ANNEX 6: TYPE OF INCENTIVES AVAILABLE UNDER STATE ELECTRICITY REGULATORY COMMISSIONS

SCHEME	INCENTIVES
Feed-in tariff	• 13 SERCs have declared preferential feed-in tariff for purchase of electricity generated from wind power projects established in respective states. • All the 13 SERCs have adopted cost plus methodology to fix the tariff which varies across the states depending up on the state resources.
Renewable Purchase Specifications	• 26 SERCs have specified the mandatory purchase obligation under Section 86, 1(e) of the Electricity ACT, 2003, for purchase of fixed percentage of energy generated from RE sources. • The RPS percentage varies from 0.5% to 14%, depending on the local renewable resources and the electricity distributed in that area. • RPS obligation can be fulfilled trough tradable REC mechanism which can further generate revenue for wind power projects. The state-wise RPS percentage is analyzed and shown in **Annex 5**
Grid connectivity	• As per the Electricity Act, 2003, the respective State Transmission Utility (STU) is responsible for creation of grid interconnection infrastructure for connectivity up to the proposed wind farm at its own cost. However, with present poor financial health of these STUs and the time required to create such infrastructure, states adopt different practices for creation of the required infrastructure. • **Annex 8** shows State level grid interconnection, metering practices and charges.

Source: WISE, 2010

ANNEX 7: MANUFACTURERS OFFERING CLASS II AND CLASS III WIND TURBINES.

WTG MAKE	TECHNOLOGY COMPARISON				
	Rating, kW	Drive	Speed	Generator	Wind Class
ESTABLISHED PLAYERS					
Enercon	800	Gearless	Variable	Sync	II-S
GE Wind	1,500	Geared	Variable	DFIG	IIA
Suzlon	1,250	Geared	Dual	Async	II
	1,500	Geared	Variable	Async	IIIA
	2,100	Geared	Variable	Async	IIA
Vestas India	1,650 / 1,800	Geared	Variable	Async	IIB/IIIA
RRB Energy	1,800	Geared	Variable	Async	II/III
ReGen Powertech	1,500	Gearless	Variable	Sync	IIIA
NEW ENTRANTS					
Essar Wind	1,500	Geared	Variable	DFIG	IIIA
Emergya Wind Technologies	750 / 900 / 2,000	Gearless	Variable	Sync	IIA/IIIA
Gamesa	850 / 2,000	Geared	Variable	DFIG	IIIB/IIIA
Ghodawat Energy	1,650	Geared	Variable	DFIG	IIA
Global Wind Power Ltd	2,000 / 2,500	Gearless	Variable	Sync	IIIA
Inox Wind Ltd	2,000	Geared	Variable	DFIG	IIIB
Kenersys India	2,000	Geared	Variable	Sync	IIA
Leitner-Shriram	1,350 / 1,500	Gearless	Variable	Sync	IIA/IIIA
Siemens	2,300	Geared	Variable	Async	NA
WinWinD	1,000	Geared	Variable	Sync	IIIB
Xyron Technologies Ltd	1,000	Gearless	Variable	Sync	IIB

ANNEX 8: STATE LEVEL GRID INTERCONNECTION, METERING PRACTICES AND CHARGES

State	State Nodal Agency	Grid connectivity & metering practice	Avg. Grid connectivity costs	Billing/ Payment
Andhra Pradesh	**NEDCAP**	• Up to pooling S/S execution & investment by WFD. • Pooling S/S onward by WFD +10% supervision (APTRANSCO). • Metering at HT side of pooling S/S	Avg. cost of evacuation Rs.5 million per MW	Distribution Company (DISCOM)
Gujarat	**GEDA** (Project facilitator)	• Up to S/S execution & investment by WFD. • Pooling S/S onward by WFD +7.5% supervision (GETCO) up to 100 km, beyond 100 km GETCO shall erect facility. • Metering at HT side of pooling S/S	Avg. cost of evacuation Rs.5 – 6.5 million per MW	DISCOM
Karnataka	**KREDL** (Project facilitator)	• Up to S/S execution & investment by WFD. • Pooling S/S onward by WFD +10% supervision (or Rs. 1.5 Million) whichever is lower to be paid to BESCOM. • Metering at HT side of pooling S/S.	Avg. cost of evacuation Rs. 5-6.5 million per MW	BESCOM / DISCOM
Madhya Pradesh	**MPURJA** (Project facilitator)	• Up to pooling S/S & bay expansion execution by WFD +5% supervision (MPTCL). • Metering at WTG site	Avg. cost of evacuation Rs. 2 million per MW	DISCOM
Maharashtra	**MEDA** (Project facilitator)	• Up to pooling S/S execution by WFD onward by WFD/MSETCL. 50% of evacuation cost is given as subsidy to developer after one year of commissioning from **Green Cess.** • Balance 50% invested by developer are given as interest free loan by utility which will be repaid to in five equal instalments by utility to developer after one year from commissioning. • Metering at feeder.	Avg. cost of evacuation Rs. 4-5 million per MW	MSEDCL
Rajasthan	**RRECL** (Project facilitator)	• Up to pooling S/S execution and investment by WFD onward by RRVPNL. • Metering at HT side of receiving S/S	Avg. cost of evacuation per MW	RRVPNL/ DISCOM
Tamil Nadu	**TNEB** (Project facilitator)	• Up to pooling S/S execution and investment by WFD with 11% E&S charges to TNEB. • Pooling S/S onward execution and investment by TNEB. • Metering at WTG site.	Avg. cost of evacuation Rs. 3.5 -4 million per MW	TNEB

S / S – Sub station
WFD – Wind Farm Developer
WTG – Wind Turbine Generator
NEDCAP – Non-Conventional Energy Corporation
GEDA – Gujarat Energy Development Agency
KREDL – Karnataka Renewable Energy Development Company Ltd.
MPURJA – Madhya Pradesh Urja Nigam
MEDA – Maharashtra Energy Development Agency
RRECL – Rajasthan Renewable Energy Corporation Ltd.
TNEB – Tamil Nadu Electricity Board
APTRANSCO – Andhra Pradesh Transmission Company
Discom – Distribution Company
BESCOM – Bangalore Electricity Supply Company
MPTCL – Madhya Pardesh Transmission Company Ltd.
MSEDCL – Maharashtra State Electricity Distribution Company Ltd.
RRVPNL – Rajasthan Rajya Vidyut Prasaran Nigam Ltd.

Source: WISE,2010

ANNEX 9: **DISTRICTS IN KEY STATES WITH WIND FARMS**

1. ANDHRA PRADESH

Districts with wind farms in Andhra Pradesh

District with wind turbine installation

2. GUJARAT

Districts with wind farms in Gujarat

District with wind turbine installation

3. KARNATAKA

Districts with wind farms in Karnataka

District with wind turbine installation

4. KERALA

Districts with wind farms in Kerala

District with wind turbine installation

ANNEX 9: **DISTRICTS IN KEY STATES WITH WIND FARMS**

5. MADHYA PRADESH

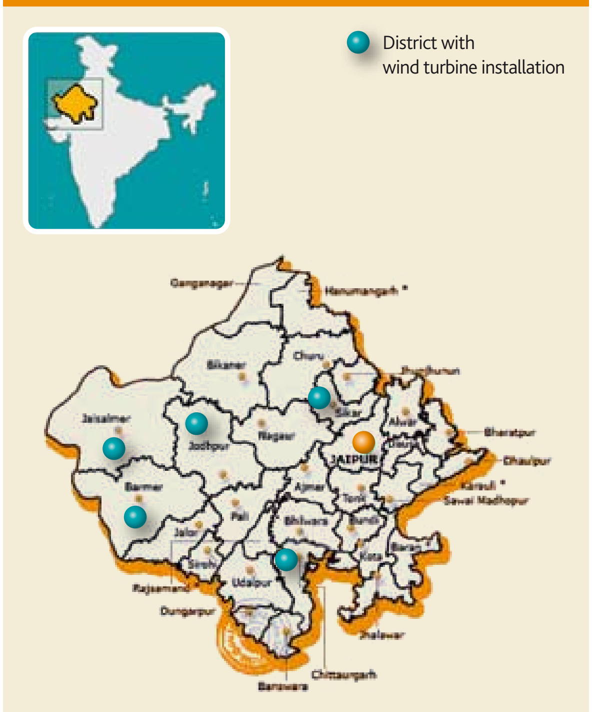
Districts with wind farms in Madhya Pradesh

6. MAHARASHTRA

Districts with wind farms in Maharashtra

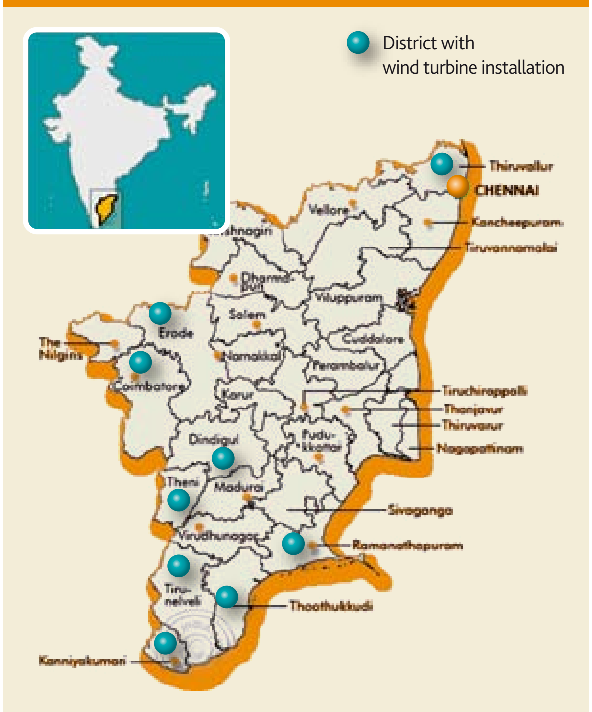
7. RAJASTHAN

Districts with wind farms in Rajasthan



8. TAMIL NADU

Districts with wind farms in Tamil Nadu



Source: WISE, 2010

ANNEX 10: **INSTALLED WIND CAPACITY STATISTICS**

A) GLOBAL INSTALLED WIND POWER CAPACITY (MW)-REGIONAL DISTRIBUTION

Region	Country	End 2009	New 2010	End 2010
AFRICA & MIDDLE EAST	Egypt	430	120	550
	Morocco	253	33	286
	Tunisia	54	60	114
	Iran	92	0	92
	Other [1]	37	0	37
	Total	**866**	**213**	**1,079**
ASIA	China	25,805	18,928	44,733
	India	10,926	2,139	13,065
	Japan	2,085	221	2,304
	Taiwan	436	83	519
	South Korea	348	31	379
	Philippines	33	0	33
	Other [2]	6	48	54
	Total	**39,639**	**21,450**	**61,087**
EUROPE	Germany	25,777	1,493	27,214
	Spain	19,160	1,516	20,676
	Italy	4,849	948	5,797
	France	4,574	1,086	5,660
	UK	4,245	962	5,204
	Denmark*	3,465	327	3,752
	Portugal	3,535	363	3,898
	Netherlands	2,215	32	2,237
	Sweden	1,560	604	2,163
	Ireland	1,310	118	1,428
	Turkey*	801	528	1,329
	Greece	1,087	123	1,208
	Poland	725	382	1,107
	Austria	995	16	1,011
	Belgium	563	350	911
	Rest of Europe [3]	1,610	1,070	2,684
	Total	**76,471**	**9,918**	**86,279**
	of which EU-27 [4]	*75,090*	*9,295*	*84,278*
LATIN AMERICA & CARIBBEAN	Brazil	606	326	931
	Mexico	202	316	519
	Chile	168	4	172
	Costa Rica	123	0	123
	Caribbean	91	8	99
	Argentina	34	27	60
	Others [5]	83	23	106
	Total	**1,306**	**703**	**2,008**
NORTH AMERICA	USA	35,086	5,115	40,180
	Canada	3,319	690	4,009
	Total	**38,405**	**5,805**	**44,189**
PACIFIC REGION	Australia	1,712	167	1,880
	New Zealand	497	9	506
	Pacific Islands	12	0	12
	Total	**2,221**	**176**	**2,397**
	World total	**158,908**	**38,265**	**197,039**

1 *South Africa, Cape Verde, Israel, Lebanon, Nigeria, Jordan, Kenya*
2 *Thailand, Bangladesh, Indonesia, Sri Lanka, Philippines, Vietnam*
3 *Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Faroe Islands, Finland, Hungary, Iceland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Romania, Russia, Slovakia, Slovenia, Switzerland, Ukraine*
4 *Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK*
5 *Colombia, Chile, Cuba*

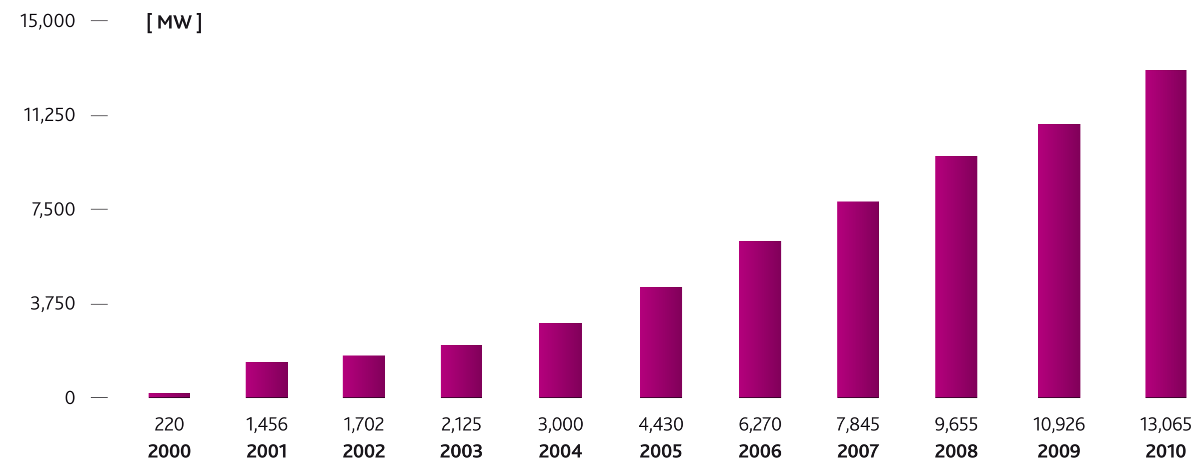
* *Provisional figures*

Please note: Project decommissioning of 151 MW and rounding affect the final sums

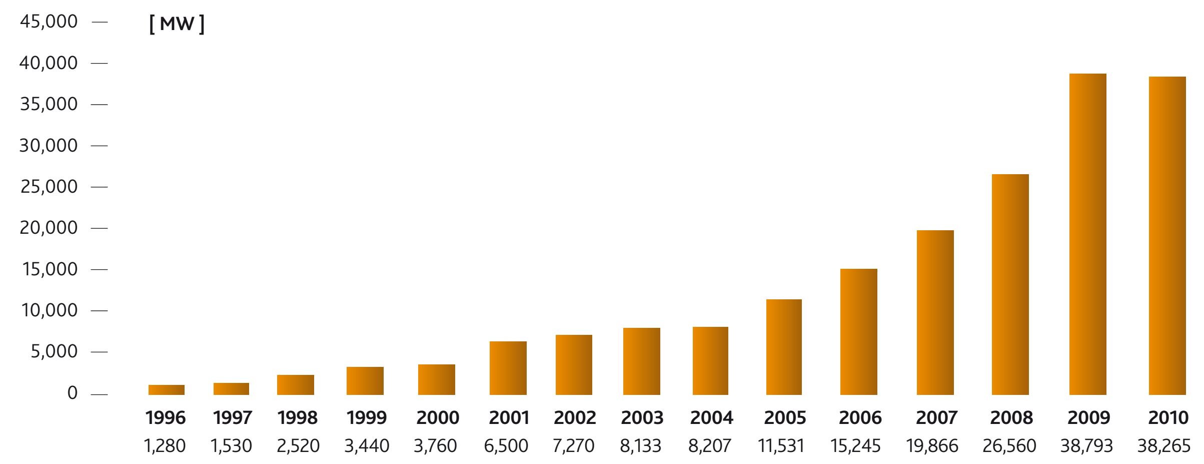
Source: GWEC

ANNEX 10: **INSTALLED WIND CAPACITY STATISTICS**

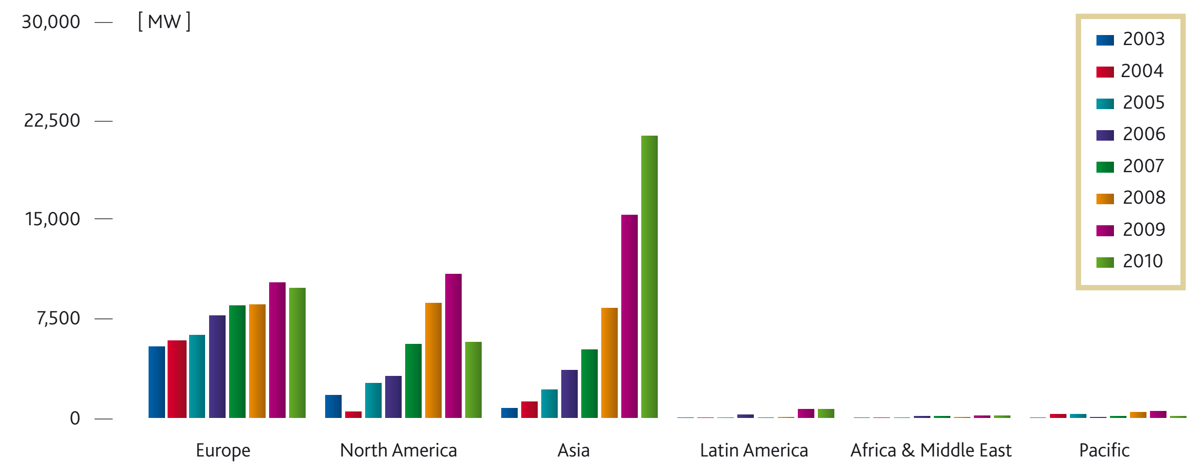
B) INDIA CUMULATIVE INSTALLED WIND CAPACITY 2000-2010



C) GLOBAL ANNUAL INSTALLED WIND CAPACITY 1996-2010



D) ANNUAL INSTALLED CAPACITY BY REGION 2003-2010



ABOUT GWEC
GLOBAL REPRESENTATION FOR THE WIND ENERGY SECTOR

GWEC is the voice of the global wind energy sector. GWEC brings together the major national, regional and continental associations representing the wind power sector, and the leading international wind energy companies and institutions. With a combined membership of over 1,500 organisations involved in hardware manufacture, project development and power generation, finance and consultancy ,as well as researchers, academics and associations, GWEC's member associations represent the entire wind energy community.

THE MEMBERS OF GWEC REPRESENT:

- Over 1,500 companies, organisations and institutions in more than 70 countries
- All the world's major wind turbine manufacturers
- 99% of the world's installed wind power capacity

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ABOUT WISE
WORLD INSTITUTE OF SUSTAINABLE ENERGY

The World Institute of Sustainable Energy (WISE) is a not-for-profit institute committed to the cause of promoting sustainable energy and sustainable development, with specific emphasis on issues related to renewable energy, energy security and climate change.

Since its inception in 2004, WISE has pioneered many important initiatives in the above areas. These include, piloting a model Renewable Energy Law for India, proposing a roadmap for generation-based incentives (GBI) for wind and solar power, drafting an innovative policy framework for solar energy development, developing state-level action plans for clean energy technologies, engaging in developing state-level RE policies, capacity building for state RE development agencies, communication and outreach activities to propagate the need for renewables, research initiatives to prove the long-term viability of renewables.

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ABOUT IWTMA
INDIAN WIND TURBINE MANUFACTURING ASSOCIATION

The Indian Wind Turbine Manufacturers Association (IWTMA) is the only industrial body representing the country's wind turbine manufacturers, providing a single contact point for policy makers at national and state level, regulators and utilities. IWTMA's main objective is to promote wind energy in India, facilitate the extension of knowledge in the field and interact with national and global energy bodies.

IWTMA is a founding member of the Global Wind Energy Council (GWEC), alongside other national and regional associations including the European Wind Energy Association and the American Wind Energy Association.

IWTMA is also associated with industrial bodies in India, including FICCI, ASSOCHAM and CII. It also has close cooperation with ECN, RISO and EWEA through the European India Wind Energy Network (EIWEN).

IWTMA is represented on all Committees, Councils and Advisory groups constituted by the Ministry of New and Renewable Energy (MNRE),C-WET and others, including financial institutions like IREDA.

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