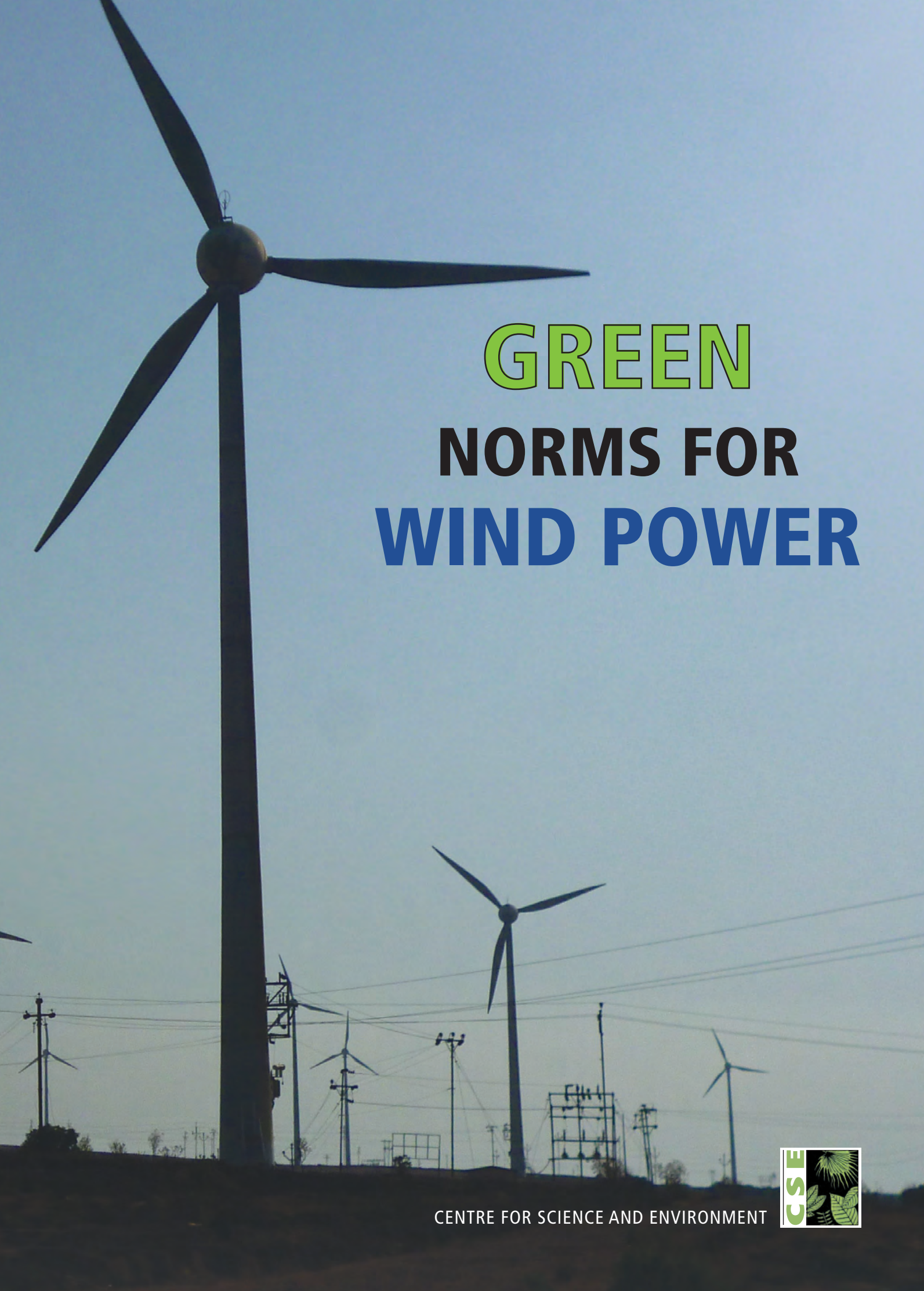

GREEN NORMS FOR WIND POWER

CENTRE FOR SCIENCE AND ENVIRONMENT

GREEN
NORMS FOR
WIND POWER

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Contents

WIND POWER

THE USE OF WIND POWER IN INDIA HAS BEEN GAINING IMPORTANCE WITH RAPID INSTALLATION IN THE LAST FEW YEARS. THE 12TH FIVE YEAR PLAN TARGETS TO ADD 15,000 MW. HOWEVER, MOST OF THE NEW WIND FARMS ARE COMING UP IN FOREST AREAS AS THESE AREAS ARE EASY TO ACQUIRE, WITHOUT THE REQUIREMENT OF ANY ENVIRONMENT IMPACT ASSESSMENT. THE WIND POWER SECTOR NEEDS EFFECTIVE ENVIRONMENTAL NORMS TO MAKE IT ACTUALLY GREEN

PHOTOGRAPH: KANCHAN KUMAR AGRAWAL

Wind energy makes up the majority — about 70 per cent — of the total renewable energy capacity installed in India. By the end of March 2013, India had a total installed capacity of 19,051 megawatt (MW), with 1,699 MW installed in 2012-13[1]. The total wind power generation in 2011-12 was 23,399.5 gigawatt hour (GWh)[2], or about three and a half times the output of a new 1,000-MW nuclear reactor.[3]

The 12th Five Year Plan aims to install 15,000 MW between 2012 and 2017, which will almost double the total capacity of wind power in India. Assuming an average wind turbine capacity of 1.5 MW[4], this means a total of 10,000 new turbines in the country. Most of the installed wind power in India is concentrated in two areas — the southern states of Tamil Nadu, Karnataka and Andhra Pradesh and the western states of Maharashtra, Rajasthan and Gujarat (*see Table 1*).[5]

The most heavily utilised area is a corridor of high wind speed running east-westerly through Tamil Nadu and into Karnataka (*see Map 1*). With many of the sites in Tamil Nadu being saturated, and with other problems such as delayed payment and lagging grid

TABLE 1 Wind power – state-wise achievements and potential

State	Estimated potential at 80 metre hub height (MW)	Achievement (MW) till August 1, 2012[6]
Andhra Pradesh	14497	264
Gujarat	35071	3016
Karnataka	13593	2025
Maharashtra	5961	2772
Rajasthan	5050	2079
Tamil Nadu	14152	7072
Others	14464	40
Total	**102788**	**17644**

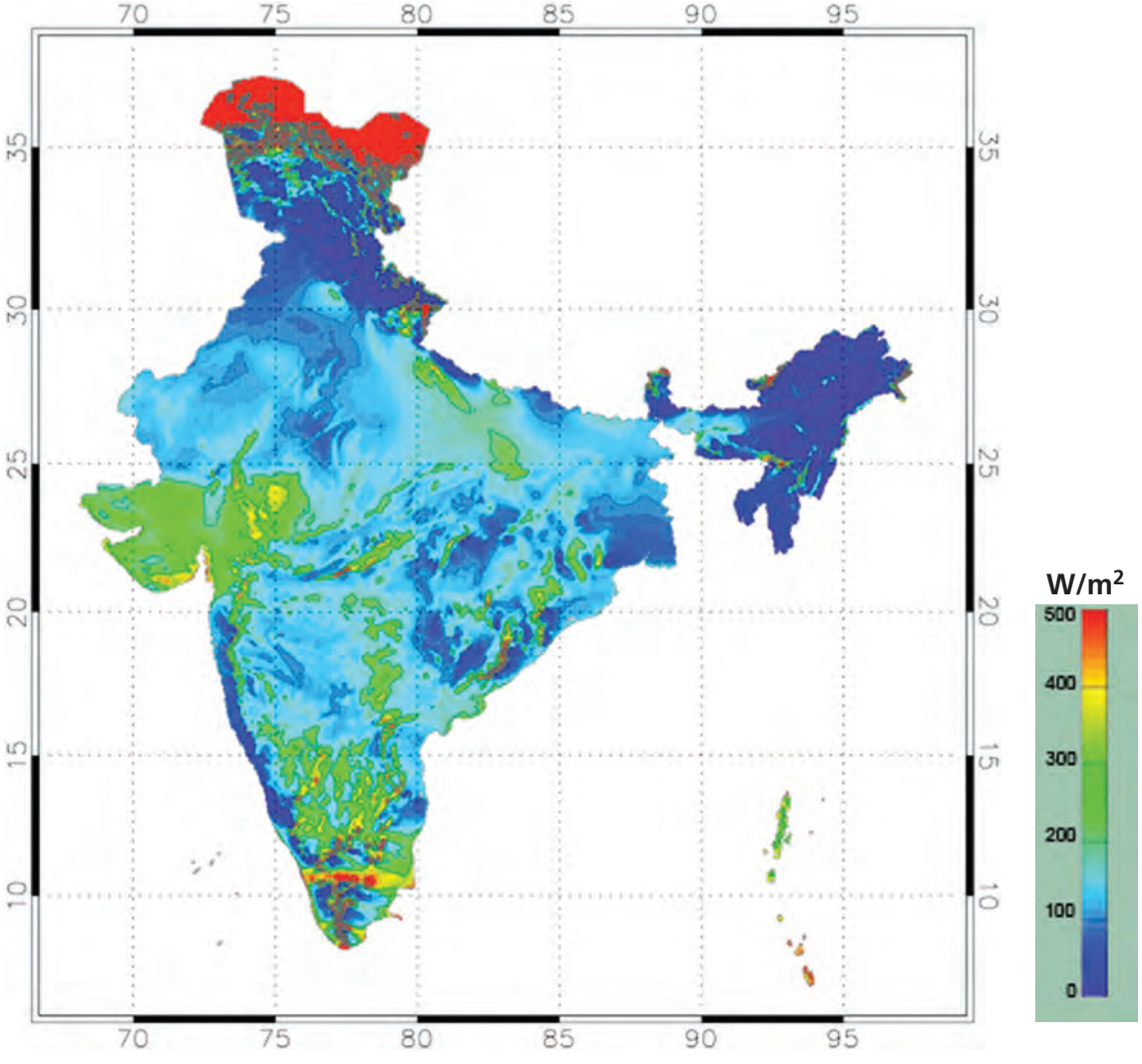
Source: http://www.cwet.tn.nic.in/html/departments_ewpp.html

extension dodging the southern states, it is probable that much of the planned 15,000 MW will come up in new, hitherto untapped areas.

Despite the planned surge in growth, the sector has been hamstrung by multiple constraints. Historically, wind power capacity installation had come about through accelerated depreciation benefits, which were tax benefits. This facility has since been removed as it did not improve the generation efficiency of the plants.

The sector also suffers from a lack of sufficient grid capacity to evacuate power from wind projects. In most of the states, availability of land for wind farms is another contentious issue. Even if private lands are available, conversion of land use status from agricultural to non-agricultural is a time consuming process. This is why forest land is seen as an easier alternative and developers want forest land for wind power development.

MAP 1 Wind power density (W/m^2) at 80 m hub height



Source: http://www.cwet.tn.nic.in/html/departments_ewpp.html

IMPACTS OF WIND POWER PROJECTS

In a country like India, where population density is very high, a wind power project may cause significant impacts if it is set up in an area occupied by or close to human settlements. Projects sited on forest land or in the sea can affect local biodiversity; those sited on hilly areas exert higher impacts on forests, wildlife and water resources, compared to projects located in the plains.

Commercial wind power turbines can have multiple effects. These turbines have a total height of 100-150 meters[7]. They are often placed on ridge-lines and hills and are therefore, visible from long distances — this exerts an aesthetic impact on scenic landscapes. When operational, such turbines generate noise and shadow flicker which can disturb nearby communities.

Wind turbines need access roads and power-lines which may affect the local environment, especially in hilly and forested terrains where blasting and tree-felling may be required.[8] In one case, over 300,000 trees were felled for a 113-MW project (that's over 2,600 trees per MW!).[9]

Building roads in forests can cause linear fragmentation. Cutting roads not only means traffic that can scare away or hit animals, but in hilly areas it entails cutting into the sides of the hill to make level roads. These cuttings are often many meters high and cannot be scaled by animals whose migration and search for food is, therefore, hindered.[10,11]

Road building in hilly areas also causes erosion. Loss of nutrient-rich topsoil makes it hard for new plant-life to come up on the hillside, which in turn leads to more erosion as there are no root-systems to hold the soil in place. Erosion can, in turn, lead to silt going into streams and silting up water tanks which feed agriculture.[12]

CASE STUDY

AVIAN COLLISION THREAT ASSESSMENT AT BHAMBARWADI WIND FARM PLATEAU, NORTHERN WESTERN GHATS

There has been a rapid increase in the number of wind farms all over the country. Some of the key sites with optimal wind velocities are the plateaus on the Western Ghats, a global biodiversity hotspot. The rocky plateaus on the Western Ghats are terrestrial habitat islands facing extreme micro-environmental conditions; however, scant information is available on the ecology of these plateaus. Ela Foundation, a Pune-based organisation working on nature conservation, undertook a two-year study to assess the impact of wind farms on birds. It also documented the avian diversity at Bhambarwadi Plateau in the northern Western Ghats. This is the first such study in India — 89 avian species were recorded on the plateau, 27 of which flew in the risk area swept by the rotor blades, and hence are potentially at risk of collision.

The collision index (the number of bird collisions with wind turbines over a period of one year assuming that the birds do not take any avoidance measure) for each species was estimated. The report also identified species at risk from collision with transformers and wind-masts, and at risk from electrocution. Reduction in avian activity in the study area was evident with the progress of wind farm erection.

Even after construction of the wind turbines and other related human activities had ceased, the avian displacement effect was conspicuous. Though the footprint of an individual wind turbine is small, the associated infrastructure development activities like road construction, establishment of power substations, and laying of power cables cause an effectively greater level of habitat destruction, and modification, which could explain this displacement effect.

The study did not observe the presence of an avian winter migratory corridor in the study area. Of the 27 bird species flying in the risk zone in the study area, 11 were raptors. Out of the 12 birds (belonging to seven species) that were found dead, five were raptors belonging to three species. This indicates that raptors are at a higher risk of collision. Moreover, the seasonal variation in collision index was highest in raptors. The overall risk of collision for all species, including raptors, was highest in winter.

In addition to the risk zones created by the turbines, the wind masts are supported by very thin steel wires that are not visible from a distance, which lead to avian collisions and subsequent mortality. The report has recommended that the supporting wires of the wind mast and the mast itself should be marked in bright colours or flags to make them prominently visible from a distance.

PHOTOGRAPH: JONAS HAMBERG

Hill sides are cut to make roads to transport heavy equipment. This leads to erosion and lanslides

Impacts on wildlife

In the absence of scientific research on the subject and of any environmental impact assessments, most records of impacts of wind power projects on wildlife are based on observations by activists and locals. Anecdotal evidence suggests that the sound and vibration of wind turbines scares away grazing animals. Blasting carried out during the construction phase can disturb wildlife.[13,14]

Bird and bat deaths have been confirmed from wind farms, both in India and abroad.[15,16] Birds fall prey to turbine rotors — the tips of the blades of a commercial turbine can reach a speed of 360 km/h.[17] Globally, the issue is not the number of birds killed (there are other, much bigger threats to birds),[18,19] but that the birds being hit by wind turbine rotors are often larger predators[20] and other large and threatened bird species[21], which fly at a higher altitude. These predators exist in smaller numbers and any impact on some of them can be detrimental to the survival of whole colonies. Bird

INTERVIEW

BHIMASHANKAR – WIND POWER IN THE WESTERN GHATS: AN INTERVIEW WITH RENEE BORGES

The Bhimashankar Wildlife Sanctuary is in Maharashtra, in the northern part of the Western Ghats. Bhimashankar is a sacred grove and the origin of the Bhima river, a major tributary of the Krishna. It has not been earmarked as an environmentally sensitive area, though it falls in the stipulation of lying within 10 km surrounding a protected area. Enercon, a wind turbine manufacturer, has set up a project in the area. Madhav Gadgil and Renee Borges of the Indian Institute of Science, Bengaluru, have studied this project for the Western Ghats Ecology Expert Panel (WGEEP), and have found multiple negative impacts. CSE interviewed Professor Borges in Bengaluru.

What is the main problem with the wind power project in Bhimashankar?

The problem is that the roads and construction surrounding the wind turbines are breaking up a continuous system. The mountain area where the project is located is a continuous ecological system and should be treated as such. There are no cumulative assessments of the impact taken together with everything else going on.

What are the issues with the access roads?

The roads running at the crestline of the mountain cause huge amounts of erosions. To get these 70-80 meter high wind towers up you need the same kind of cranes used for constructing highrises. Because of this the roads are built 13-16 meters wide using bulldozers and blasting, in an ecologically sensitive area. There has been no effort to fix hill-sides that were cut to make the road. This has led to heavy erosion and land-slides during and after the monsoon with the rubble ending up in rivers and farmland below.

How come this was not checked or stopped by the forest department?

Enercon ignored forest clearance and pushed through the project as a 'green tech', stating it was for the greater common good. There is a lack of understanding in the forest department for ecologically important areas that do not have big trees on them. Forest officials are trained in silviculture, and the MoEF is dominated by forest officials. If they don't see large trees, it isn't an ecosystem worth protecting. On hill-ridges any trees or plants will by necessity be stunted to deal with high wind-speeds, this doesn't mean it isn't an important ecosystem but when forest officials see it they don't understand that and write it up as shrub and define the area as wasteland of no value due to their own lack of understanding of the ecology.

Note: *The WGEEP says that according to forest department estimates, about 28,000 trees have been cut for the project.*

PHOTOGRAPH: KANCHAN KUMAR AGRAWAL

Roads cut through forests and hills to enable movement of heavy-duty trailers lead to linear fragmentation

deaths from electrocution by transmission wires and transformer stations built for wind power projects have also been recorded in India.[22]

Bats can be affected by the changing air-pressure around wind turbines.[23] The Western Ghats and other hilly and forested areas, considered good wind locations, are also home to many threatened species of bats.

In India, cases have been documented where wind farms are being set up inside wildlife sanctuaries. The status of wind power as 'green energy' may give it an unofficial stamp as being less disturbing, but roads and power lines will still have to be built for the project, which disrupt the environment.[24]

However, studies done on wildlife have swung from one extreme to the other. Research on elk[25] and pronghorn (a North American antelope)[26] indicate that the animals' numbers did not go down after construction of wind turbines in their habitats. Neither were they seen to be avoiding the project site.

The effect of wind power on reindeer may seem far removed from the issues in India, but a study of these effects can give a good insight on the impact on pastoralist communities and their animals. One of the few controlled studies done involved putting semi-domesticated reindeer in an enclosure with a wind turbine at one side in Norway. The wind turbine was turned on and off to test the behaviour of the reindeer — it was observed that the reindeer did not find the turbine very disturbing.[27]

Another report says that cattle seem to congregate around turbines (which, ironically, may be a reason for increased bird deaths as the dung of the cattle attracts insects, and birds feed on these insects)[28]. Still, the resistance from local pastoralists is strong,[29] which may have more to do with a perceived threat after earlier infrastructure projects came in claiming to have no effect and then actually causing destruction to habitats.

One of the largest synthesis reports done shows that there is a lack of knowledge on the actual effect on large mammals, and that the construction of roads at project sites remains the most important concern. Large mammals avoid roads with heavy traffic. Although smaller access roads to wind farms may not be carrying heavy traffic, they can open up for more exploitation and unrelated traffic (such as wildlife tourism). The general presence of humans and any industrial activity can increase flight and attention behaviour among ungulates which will give them less time for feeding, mating and child-rearing. The impact is especially notable in areas where no, or little, human activity has been present before, such as in forests and hills.[30]

The report does not indicate any larger impact on mammals from power lines, but it does say that the findings are inconclusive so far and more research is needed.

Linear fragmentation of landscapes

The tower footprint of a wind power turbine is no more than 10 x10 meters and farming as well as grasslands can exist below these turbines — so what is the problem?

TABLE 2 Impacts of linear fragmentation

Detrimental effect	Roads	Powerlines
Wildlife mortality (road kill)	Yes	
Wildlife mortality (electrocution)		Yes
Habitat loss and degradation	Yes	Yes
Barriers causing habitat fragmentation	Yes	Yes
Conduits for invasive alien species	Yes	Yes
Effects on population genetics	Yes	Unknown
Landslides and soil erosion	Yes	Yes
Disruption of canopy continuity for arboreal animals in closed-canopy forests	Yes	Yes
Ecological traps	Yes	Possible
Change in animal behaviour in or along linear intrusion	Yes	
Increased human presence and pollution (including noise and electrosmog)	Yes	Possible
Effects on local and indigenous peoples	Yes	Yes
Drain on public money due to poor maintenance practices stemming from lack of ecological understanding	Yes	Yes
Higher light penetration and desiccation of vegetation	Yes	Yes
Higher daytime temperatures and greater range of temperature extremes	Yes	Yes
Higher wind speeds and wind-throw of trees in forest areas	Yes	Yes
Cutting of all vegetation resulting in weed proliferation and suppression of native vegetation regeneration	Yes	Yes
Disturbance related to construction and maintenance	Yes	Yes
Clearance of vegetation even far from lines (as in valleys with overhead lines)	No	Yes
Penetration of difficult terrain and very steep, otherwise undisturbed areas	No	Yes
Increased risk of fires, deliberate and due to desiccation	Yes	Yes
Pollution, sedimentation, and changed discharge regimes into water bodies	Yes	Yes
Impairment of natural aesthetic and scenic values due to built structures	Yes	Yes

Source: National Board for Wildlife, Ministry of Environment and Forests, India

The problem arises with turbines coming up inside forested areas, often on hill-ridges. To reach the sites with the cranes necessary to raise an 80 meter tower, roads of 10 meters or wider have to be constructed. These roads cut through forests and hills, fragmenting what used to be one ecosystem into two or more. They open up wildlife areas for easier human exploitation (poaching, timber removal and encroachment by farmland) as well as create problems for flora to spread and for fauna to migrate. When roads cut through water catchment areas, they change the hydrology of the area with streams changing courses or being blocked or silted (*see Table 2*).[31]

More and more research is being done on the effect of such linear intrusions into ecosystems. A 10-hectare (ha) road or powerline project can have a much larger impact than a 10-ha square used for a non-linear infrastructure project.[32] Powerlines as opposed to roads can allow some vegetation beneath them, but will still need cutting of larger trees. Electrocution from powerlines is a common concern for wildlife, with elephants killed in just the last few years and endangered bird species dying and having their migration disturbed by powerlines (*see Table 3*). In Gujarat, over 150 flamingo deaths have been reported because of electrocution from powerlines near their breeding grounds.[33]

Because of the decentralized nature of wind power and the large number of turbines needed to provide the same amount of power as provided by a conventional plant (3,000 wind turbines could be needed to replace one coal plant), the amount of power lines increases dramatically.

CASE STUDY

TIMBAKTU COLLECTIVE AND THE KALPAVALLI WIND FARMS

For over two decades, the Timbaktu Collective and the Kalpavalli Tree Growers Collective, including the villagers of the Kalpavalli area, had been restoring forest cover to an area that had been one of the most drought prone in India. With soil restoration, tree planting and water harvesting, the area was turned from being a semi-desert into a forest with over 400 indigenous tree species. It was giving livelihoods to over 400 families. In 2004, Enercon, a German wind power manufacturer and developer, received an approval from the New and Renewable Energy Development Corporation of Andhra Pradesh (NEDCAP), the nodal agency for renewable energy in the state, to set up a 50.4-MW wind power project (63 wind turbines each with a capacity of 0.8 MW) under the name of Nallakonda Wind Farm. This project has raised the heckles of the Kalpavalli tree growers and the Timbaktu Collective; its request for Clean Development Mechanism funds has been challenged by the Society for Promotion of Wasteland Development (SPWD).

No approval was granted for road construction, but the company went on to build several roads of up to 40 km in length, according to Leena Gupta of SPWD. The company also destroyed 79 ha of forest land (more than 50,000 mature trees and shrubs).[1] Construction of the roads led to landslides, erosion and silting of water bodies. The project developer did not take any measures that could have limited the impact (such as replanting trees or regvegetating the area around the turbines). Hill sides that were destroyed because of the road building could have had retaining walls that would have prevented soil erosion. Creating diagonal or stepped slopes on the now vertically cut hillsides would have made it possible for goats and sheep to once again graze the hills.

PHOTOGRAPH: JONAS HAMBERG

Hills in Kalpavalli area that were in the process of afforestation have been cut into to make roads and to place turbines. This has led to erosion of the hills, loss of trees and loss of grazing land for goats and sheep as they cannot easily navigate up the hills anymore

According to C K Ganguly, chairperson of Timbaktu Collective, the hill that the turbines have been set up on is a so-called 'sheep head' — an easily recognized geological feature to which sheep and goats congregate from as far away as 20 km as it is one of the few places where they can find grass for grazing. About 50,000 sheep and 6,000 cattle from 20 villages use the hills. After the erection of the turbines, the amount of grass available has come down from 60,000 to 6,000 cartloads and fewer sheep and goats are using the area.[2]

Below the hills on which the wind turbines have been erected is the large Mushtikovila tank which irrigates rice fields. The tank is only 1-1.5 km from the wind turbines, and is also a roosting ground for a multitude of birds, including painted storks. Since there was no EIA required for the project, the presence of these birds was never discovered or discussed. High tension transmission lines run close to the tank. Both the turbines and the transmission lines are risk factors for the birds[3]: the Timbaktu project has recorded bird strikes at the turbine site. Soil erosion from the hill (after its top was levelled) along with the changed and interrupted streams that the access roads bisect has led to sand and silt entering the Mushtikovila tank, thus lowering its capacity.

According to a report by SPWD, "*All the major hilltops are cut which has already affected the water channels. Last year and this year monsoon could not help the Mushtikovila tank to get sufficient water, not even for one crop cultivation, from the river streams, because the catchment area is destroyed and the removal of parts of mountains (for site and roads construction) which is then dumped in the water channels and streams.*"

The Project Design Document of Nallakonda Wind Farms says, "*Alos [sic], the project activity does not cause any negative impact on the environment, no EIA study was conducted.*"[4] Points out Leena Gupta: How can a project claim to have no negative environmental impact if no assessment has ever been done?

TABLE 3 Death by power: Electrocution of major species reported in India

Animal	2007	2008	2009	2009	2011
Elephant	35	24	30	38	37
Leopard	2	1	4	4	1
Hyena	–	–	1	3	–
Lion	6	–	–	1	1
Peacock	1	1	3	30	6
Rhinoceros	–	–	–	–	2
Sloth bear	–	–	–	–	1
Tiger	1	1	2	–	2

Source: Wildlife Protection Society of India

Shadow flicker

Shadow flicker occurs when the shadow cast by the moving blades of a wind turbine passes through a window or a door. The effect of the shadow moving around with the blade makes it seem as if a shadow is flickering with each blade passing by (most large wind turbines have three blades, so three times per rotation) — comparable to someone turning on and off the light in rapid succession. There is anecdotal evidence internationally that shadow flicker could lead to stress and headaches. There is also a fear that shadow flicker, especially in the range of 2.5-50 Hertz (2.5-50 cycles per second) could lead to seizures in epileptics and may also scare away livestock.

Shadow flicker is most pronounced at sunrise and sunset when shadows are the longest, and at high windspeeds (faster rotating blades leading to faster flicker). A UK government report recommends that for inhabitants near wind turbines, shadow flicker should be limited to 30 hours in a year and 30 minutes in a day.[34]

Noise pollution

The MoEF guidelines for wind power projects in forest areas state that: *"The turbine of the wind mill produces a humming sound, which may cause disturbance for the avian habitat."*[35] During the operation of a wind turbine, the rotation of the turbine blades creates a sound; there are, also,

SETBACK DISTANCE IN DIFFERENT COUNTRIES

In order to avoid the impact of noise, different countries have fixed setback distances from the nearest settlement. For example, in Denmark, to avoid noise nuisance, the prescribed distance limit from a neighboring home is four times the turbine's total height. In the US, some states follow a setback distance of 4,500 feet from any residence. Some other examples are as follows:

TABLE A Setback distance from habitation

Country/states	Setback distance from habitation
Rural Oregon (US)	2 miles (minimum)
Victoria and New South Wales, NZ	2 km (minimum)
As per UK Noise Association (UKNA)	1 to 1.5 miles
Beech Ridge Wind Farm (West Virginia)	1 to 4 miles
Michigan (US)	Audible Noise Standard: From 6:00 A.M. until 10:00 P.M. – within 1 miles, the noise limit shall not exceed 35 dBA or shall not add more 5 dB on the background noise (i.e. backgrond noise+5dB)
	From 10:00 P.M. until 6:00 A.M. – within 1 mile, the noise limit shall not 3 dBA on the background noise (i.e. background noise+3dB)

Source: htt://theenergycollective.com/node/84293

PHOTOGRAPH: KANCHAN KUMAR AGRAWAL

A turbine (seen here being transported to a wind power location) can cause significant noise pollution

mechanical sounds from gearboxes, cooling fans and generators. The aerodynamic sound — the sound from the rotating blades — is directly proportional to wind speed. Higher the wind speed, more will be the aerodynamic sound. When the sound is unwanted, it becomes, by definition, noise. The people who stay closer to wind turbines are more likely to be affected by the noise caused by the turbines. The magnitude of noise impact depends on many variables, such as distance of human settlement from the turbine, local topography of an area, water bodies, type of weather, background sound levels, etc.

A wind turbine produces both high and low frequency noise. It is broadband in nature; hence, it is distributed over a wide frequency spectrum that ranges from infrasound to ultrasound (<20 Hz to >20 kHz). For example, the median human hearing threshold at 8 Hz is 100 dB, at 20 Hz is 80 dB, and at 200 Hz is 14 dB. It has been found that lower frequency sound is less attenuated by the atmosphere and building materials than sounds at higher frequencies.

Noise has been recognised as a major nuisance by the Supreme Court of India; it falls under Article 21 (the Right to Life) of the Indian Constitution.[36] Noise is defined as a type of air pollution in Indian law and is therefore, regulated under the Air (Prevention and Control of Pollution) Act (1981): *" 'Air pollutant' means any solid, liquid or gaseous substance [(including noise)] present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment."* Noise is further regulated under the Environment Protection Act (1986) Schedule III through the Noise Pollution (Regulation and Control) Rules (2000). Noise limits have been set depending on areas (*see Table 4*).

Monitoring of, and compliance to, noise regulation is handled by the State Pollution Control Boards when it comes to point sources such as wind power plants. The local police is responsible for non-point sources such as drums and crackers. Which zone a wind power plant would come up in would define its noise limit. State governments are supposed to categorise the four different areas, with silent zones extending 100 meters around hospitals, educational institutions and courts. There is, however, no category or limit specifically for natural areas (forests, wildlife areas, sanctuaries, or national parks) even though the noise from wind turbines in forests can potentially disturb wildlife.

There is no definition of the distance that the noise limits are measured at. How far from the source the decibel level is measured is important as

TABLE 4 Noise limits set by law

	Noise limit – Daytime in dB(A) Leq	Noise limit – Nighttime in dB(A) Leq
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone	50	40

Note: dB(A) Leq: Decibel as weighted for human hearing frequency and averaged over a defined period of time
Source: http://moef.gov.in/citizen/specinfo/noise.html

CASE STUDY

NOISE STANDARD — OREGON, US

In the US, Oregon state has set a noise standard for wind power projects. According to the standard set by the Oregon Department of Environmental Quality, a wind development project should not increase the median background sound greater than 36 dBA or lead to an increase of 10 dBA over the measured background sound levels. The sound level may be relaxed if local community or landowners have the option to waive this standard; in this case, the proposed facility can increase outdoor sound levels up to 50 dBA. For instance, if the background sounds level is 26 dBA, a wind turbine facility cannot increase the outdoor hourly L50 sound level at the receptor beyond 36 dBA.

it will define the area where the noise has impact. The MoEF guidelines recommend that wind farms should not be set up closer than 300 meters from habitation, but this is not mandatory. There are no requirements to monitor noise from wind turbines.

Tribal lands and the Forest Rights Act

In general, rights of tribals living in forest areas are protected by the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (the Forest Rights Act, 2006 in short). The Act recognises the rights of tribals over forests for their livelihood.

In 2012, the FRA covered 18 lakh ha of land — much of this in states where renewable energy is an upcoming sector: Andhra Pradesh (5.9 lakh ha), Madhya Pradesh (2 lakh ha) and Maharashtra (2.6 lakh ha).[37] The Act invests the gram sabha with the power to determine the nature and extent of forest land diversion. However, in 2013, a circular excluded linear projects such as roads and transmission lines (needed for any renewable energy project) that passed through 'several' gram sabhas, from having to acquire the sabha's approval. In areas inhabited by "Primitive Tribal Groups" and "Pre-Agricultural Communities" (such as the Jarawas of the Andaman Islands), the gram sabha will have to give approval for new linear projects.[38]

According to the Campaign for Survival and Dignity, a national platform of tribal and forest dwellers' organisations in 10 states, the FRA has been routinely ignored by the Forest Advisory Committee when recommending forest clearances. Only in one case has the lack of consent been a reason for opposing clearance for a project.[39]

As far as wind power is concerned, there have been allegations that wind power developers have flouted the Act. One case of tribal land being bought for wind power development has been recorded in Attapaddy, Kerala. Located inside the Nilgiri Biosphere Reserve, Attapaddy houses 6,000 tribal families and is part of the government's Integrated Tribal Development Project (ITDP). Sarjan Realties, a Pune-based company, has bought land here to install windmills for Suzlon Energy.

A report from the local ITDP official states that Suzlon has been buying and encroaching upon tribal land to lay roads that will transport huge blades and other components needed to erect wind towers. The report also mentions that more than 60 ha where the company has put up 12 windmills, belonged to 36 tribals who were paying tax for the land.[40]

In Kerala, non-tribals cannot buy land from tribals: the Kerala Restriction on Transfer by and Restoration of Lands to Scheduled Tribes Act, 1999 prohibits it.[41]

ENVIRONMENTAL LAWS AND REGULATIONS

India

Environmental Impact Assessment

Wind power projects are not covered under the 2006 EIA notification and are, therefore, exempt from the EIA process.

Wind power is also categorised as "green" by a majority of the State Pollution Control Boards[42]. Projects under this category are rarely scrutinised, unless complaints are lodged against them. They are given Consent to Establish (often called 'No-objection certificate') and Consent to Operate for five years. The Consent to Operate is usually automatically extended for another five years if there are no complaints against the project.[43]

Forest clearance

As the biggest environmental impact of wind power is on ecosystems, the process of forest clearances becomes important. The issue of forest clearance is not linked to EIA — any project being set up in a forest area would need a forest clearance, regardless of its inclusion under the EIA notification.[44] The forest clearance process, however, does not need any impact assessment report or environment management plan.

The MoEF has issued guidelines on how to give forest clearances for wind power projects[45]; these guidelines incorporate afforestation, forest value being paid into CAMPA (Compensatory Afforestation Fund Management and Planning Authority) funds, and a minimum capacity per plant in forest areas (1 MW or above, or below 10 KW for plants not connected to the transmission grid). The guidelines prohibit wind power projects in natural parks, sanctuaries, national heritage sites etc. They also mandate a "safe distance" from these areas, but do not define what that distance is. A safe distance of 300 meters from the nearest village habitation is suggested in "normal circumstances", but what these circumstances are remains unclear (*see Table 5*).

The forest clearance process is a two-stage process with an in-principal approval first, followed by a final approval given after funds for reforestation have been submitted by the project proponent (*see Table 6*). The application for clearance is submitted to the nodal officer in the state forest department. This is then sent to the field district office where an inspection is done. The application and evaluation is then sent back through the forest department to the principal secretary of forests. Depending on the size of the project, the proposal can either be approved by the state government or

PHOTOGRAPH: LEENA GUPTA

The impact due to cutting of hill sides and clearing forests is not taken into account while granting forest clearance

TABLE 5 Key provisions for diversion of forest land for non-forest purposes under the Forest Act

Provisions	Remarks
Areas like national parks and sanctuaries, areas of outstanding natural beauty, natural heritage sites, sites of archaeological importance and sites of special scientific interest and other important landscapes should not be considered for wind energy farms.	Guideline is silent on safe distance from the sensitive receptors. **Violation of guidelines:** The 113-MW Andhra Lake Wind Power Project promoted by Enercon (India) Limited, spread over 14 villages, covering 194.66 ha of reserve forest land near the Bhimashankar Wildlife Sanctuary, was slammed by the Western Ghats Ecology Expert Panel (WGEEP). **Rejection by court:** Moorkangudda Windmill Project in Karnataka was rejected by the courts and conservationists on account of threat to endangered wildlife. The project site is in a critical corridor between the southern and northern Western Ghats. The developer had been given permission in June 2009 to install a 25-MW wind farm.
The tips of wind turbines shall be painted orange to avoid bird hits. The state government should take sufficient precautions in siting the windmills so that they do not stand in the migratory paths of birds and are not located near breeding sites.	Painting of wind farms is a good precautionary measure. However, without an EIA or biodiversity assessment, this provision cannot be implemented.
Turbines should be located at a safe distance from highways and village habitations; in normal course, a distance of 300 metres would be considered safe.	The safe distance as given in the guideline is widely violated. Also, the "normal course" remains undefined.
Windmills of capacity less than 500 KW shall not be allowed in a forest area. However, windmills of capacity 1 MW should be promoted to ensure optimum use of forest land.	While they may be good initiatives for land optimisation, the guidelines are silent on monitoring.
Proposal for forest land required shall include land required for corridors between successive windmills, statutory buildings, earthling pits, transmission lines and roads including provisions for repose, breast walls, drains, curvature etc.	The guideline discusses the project activities and the total area that will be diverted. However, it fails to give any directions on how to optimise this area or how mitigation measures on land should be implemented.
Cost-benefit analysis of the project is an essential requirement. Details of employment generation should also be given in the proposals.	No such document is prepared. A broad figure on employment is provided. Most reports submitted simply state that 'a lot of employment will be generated', without giving the numbers. Wind farms may create between 0.4 and 1.4 jobs per MW during the construction phase; during operation and maintenance (O&M), it is around 0.06 to 0.2 jobs per MW. A 50-MW wind farm may create 20 to 70 jobs during construction and three to 10 jobs during O&M.
The lease period initially shall be for a period of 30 years. The forest land will first be leased in favour of the developers and within a period of four years of state-II approval, the lease shall be transferred in the name of investors/power producers. In case the developers fail to develop wind farms, the land shall be reverted back to the forest department without any compensation.	The guideline fails to mention any time-line or validity period for transfer of forest land from developer to forest department in case the developer fails to develop wind farms. As per the EIA notification of 2006, for industrial projects, an EC is valid for five years; after the lapse of five years, a fresh EIA must be conducted for the same project.
Land area (circle) of 100 meter in diameter shall be provided for installation of a wind mast for every 500 ha. A one-time payment of Rs 1 lakh per wind mast shall be charged. The wind mast shall be removed within a maximum period of two years.	Focus is more on money collection rather than environmental protection. Also, the guideline is silent on monitoring. For instance, there is no provision for a report to show that the lease rent has been used for providing gas connections.
A lease rent of Rs 30,000/MW shall be charged from the user agency by the state government as a one-time payment for the entire period of the lease. This is in addition to charges payable for compensatory afforestation, net present value etc. This amount shall be utilised in providing gas connections to local villages under the Joint Forest Management Programme and for other conservation measures. This amount shall be deposited with CAMPA.	
65 to 70 per cent of the leased out area shall be utilised for developing medicinal plant gardens where feasible.	Good guideline, but no implementation.
Soil and moisture conservation measures like contour trenching shall be taken up on the hills supporting windmills.	Good guideline, but no implementation.

Continued…

TABLE 5 ...continued from page 12

Provisions	Remarks
Since the output of a windmill is only 25 per cent of its capacity, a cost-benefit analysis of the project would be an essential requirement. Details of employment generated, cost of electricity produced by wind energy, economic viability of the project etc should also be given in the proposal.	No detailed report available on these issues.
The alignment of roads shall be done by a recognised firm and be approved by the divisional forest officer concerned. Further, the transmission lines from the farms to the grid should also be aligned, as far as possible, collaterally along the roads.	Good initiative, but the guideline is silent on tree felling and environmental measures during road construction.

Source: Compiled from different sources by CSE team.

TABLE 6 The forest clearance procedure

	Approved forest clearance wind power projects[54]	Advising/Recommending body	Route	Final clearance given by
< 1 hectare	0	–	–	State government[55] (principal secretary of forests)
1–5 hectare	8	State forest department	State government to regional office of MoEF	Regional office MoEF
5–40 hectare	20	State Advisory Group	State government to regional office of the MoEF; then to the MoEF with State Advisory Group recommendations	MoEF
> 40 hectare	28	Forest Advisory Committee	State government to MoEF	MoEF

Source: Based on interview with nodal officer, Karnataka Forest Department, March 21, 2013

PHOTOGRAPH: KANCHAN KUMAR AGRAWAL

India has not yet mandated EIA for wind power projects

CASE STUDY

THE BOMBAY NATURAL HISTORY SOCIETY STUDY ON AVIFAUNA AND BATS

At a meeting of the Forest Advisory Committee held on October 12, 2011,[1] it was noted that requests for forest clearance for establishing wind farms have been increasing. The Committee recommended that the Bombay Natural History Society (BNHS) should conduct a study on the impact of wind power projects on avifauna and bats. The study and outcome report were supposed to build on international research and would provide a "framework of suitability of areas after conducting sample studies". The report was to include criteria for future site-specific studies, assessing importance of each site, identifying key issues and creating a framework for mitigating negative impacts.

In the same meeting, it was recommended that a committee chaired by the chief conservator of forests should be set up at the southern regional office in Bengaluru to formulate guidelines to define the impact zone of wind power projects, so as to determine the forest land's net present value (NPV). The Forest Advisory Committee recommended that projects with stage-1 clearance (in-principal clearance) be allowed to get forest clearance with the condition that they follow mitigating measures suggested in the BNHS report. The Committee stated that no new projects would be cleared until the impacts of "these windmills" were studied and analysed.

According to BNHS, the draft report has been submitted to the MoEF. Asad Rahmani, director, BNHS says the study is mainly a literature review of international experience. He adds: "The impact of wind power is site-specific, we would have to do a study of each project and its surrounding area and ecology and the proposed siting of their turbines to give our recommendations. We would need at least a year for such a study."[2]

It is difficult to say how projects are being given clearance with the condition to follow mitigating measures suggested by the BNHS study could fulfil conditions such as siting — before the study is even out. If conditions entail moving and re-siting turbines to lower the impact on avifauna and bats, it seems improbable that the recommendations would be followed.

It is also unclear from the minutes of the meeting of the Forest Advisory Committee what is meant by "these" in "All new proposals would be considered only after the impact of these windmills is finalized" (preceded by a discussion about projects that have already been given in-principal forest clearance). Does it mean that project-wise impact studies need to be done for all earlier projects before new projects can come up, or does it mean that new projects need impact studies?

In a meeting of the Forest Advisory Committee on September 18, 2012 many projects had their forest clearance deferred until the report by BNHS was finalised, mitigating measures could be recommended and the committee to look into wind power impact zone had been set up.[3]

At least one new (without stage-1 clearance before the FAC meeting) project, a 16-MW plant by Enercon in Penukunda, Anantapur district, Andhra Pradesh, taking up 39 ha of forest land, has been approved and cleared without any site-specific study (but with the caveat in the forest clearance document that it needs to follow the recommendations to be given by the BNHS study).[4] This may have been possible since the project was below 40 ha and did not require the Forest Advisory Committee's approval.

by the MoEF. In case of projects between 5 and 40 ha, a State Advisory Group gives its recommendations to the regional office of the MoEF; in cases above 40 ha, a Forest Advisory Committee at the Central level gives its recommendations to the ministry.[46] For projects under 1 ha of "public utility" there is a general acceptance given by the state government.

TABLE 7 **How much forests for wind power ?**

Time period	Wind power capacity installed (MW)	Forest area cleared (hectares)	Wind power installed per hectare of forest land cleared (MW/hectare)
Till March 2006	4351	478	9.10
April 2006 to March 2013	14701	3454	4.25

Source: Forest clearance database of the MoEF

"Non-conventional sources of energy" are included among these projects.[47]

Forest diversion – an analysis

A large number of wind power projects have been commissioned on forest land, mostly in Karnataka, Maharashtra, Andhra Pradesh and Madhya Pradesh. According to the MoEF database, till March 2006, wind power projects of total capacity 4,351 MW had managed to divert 478 ha of forest land. From April 2006 till today, projects of total capacity 14,701 MW are taking up 3,454 ha of forest land. The total number of cases approved (both final and in principal approval) for wind power projects since 1980 is 72, over an area of 3,932 ha. This does not include separate clearances for roads and transmission lines. The project taking up the maximum forest land is a 225-MW plant set up on 212.5 ha in Maharashtra.

Forest clearances given by the MoEF, as indicated in the ministry's database, show that on an average a project uses between 1-2 ha per MW of forest land. It is hard to set an exact standard as landscapes change, but if we go by industry measurements that turbines should be five rotor diameters between each other and road width needs to be 10 meters, then each turbine should only need an effective area of about 0.5 ha.

Quick clearances

The majority of wind power projects given forest clearance are of the size where the final decision lies with the MoEF.

The median for time taken until final approval of forest clearance is 7.5 months. However, in-principal clearance is given faster than this — in some cases in less than a month, with the lowest being 10 days (for an above 40-ha project!).

TABLE 8 Forest clearance statistics for wind power projects

	Wind turbine capacity (MW) per hectare of forest given
Average	1.85
Median	1.5
Highest	6.53
Lowest	0.1

Source: Based on information on 28 projects in the forest clearance database of the MoEF, accessed March 20, 2013

Considering the many stages that a project using above 40 ha of forest has to go through, it is hard to imagine that any real study of the project's effects on the environment would be done (*see Table 8*).

CASE STUDY

SUZLON'S WIND FARM IN KOYNA WILDLIFE SANCTUARY

The 423-sq km Koyna Wildlife Sanctuary in Maharashtra has 14 villages inside its boundaries. In Maharashtra, sanctuaries have three types of land — forest, government and non-forest private. As per law, once a sanctuary is notified, the district collector is supposed to conduct a hearing in the areas where there is private land, to ascertain if people want to be a part of the sanctuary; in case they decide against it, the collector can ask for deletion of such lands from the sanctuary area.

In the case of Koyna, the hearing was conducted 13 years after the notification of the park in 1998. At the hearing, the villagers wanted to be kept out of the sanctuary. Their wish was duly noted and a proposal to delete their lands was conveyed to the state government, which should have forwarded it to the Centre (as per a 1992 amendment to the Wildlife Protection Act, deletion of land from a notified sanctuary cannot be done without the approval of the Centre). The state did nothing.

In 2000, a Supreme Court decision made it mandatory for states to seek the Court's approval for reducing the area of any notified sanctuary. The Maharashtra government, however, did not send the proposal to the Supreme Court either.

Meanwhile, it allowed the sale of land of 14 villages to wind power giant Suzlon. Legal provisions allow for such land deals to take place once the deletion of private lands has been okayed by the Centre and the apex court. As neither had been done, these land deals were illegal.

Suzlon, however, set up a wind farm in the purchased land and invited large corporations to buy and own windmills. Accordingly, corporate entities like Bajaj and Tata bought a number of windmills in the wind farm operated and maintained by Suzlon. It was functioning fine till 2010, when activists in the area pored over a map of the park — by then, it had been notified as Koyna Tiger Reserve — and found that the wind farm was functioning in contravention of laws.

Through an RTI query, activist Nana Khamkar found out that 235 windmills were operational in the farm. In 2010, he filed a petition in the Bombay High Court asking for removal of the wind farm, since the land on which it was located was purchased in violation of Section 20 of the Wildlife Protection Act; further, the setting up of windmills in an area that was still within a reserve was a violation of section 2 of the Forest Conservation Act (which implies forest clearance was not taken). The High Court directed the forest department to take a decision — the department, in turn, ordered the eviction of 235 windmills and around 10 resorts from the land that was still within the park.

Following this, the investors in the windmills, along with Suzlon, approached the court and obtained a stay on the court's earlier decision; they argued that the petition was filed in 2010, while the wind farm was in operation since 2000, and large amount had been invested in producing "green energy".

Following the petition in the High Court, the Maharashtra government has filed an application in 2010 before the Centre regarding the deletion of 14 villages from the reserve. If the Centre approves the deletion, the matter will go to the Supreme Court, which will send it to the Central Empowered Committee for clearance. If the villages are deleted from the reserve, a heavy fine may be levied on the owners of the wind farm. According to local wildlife activist Rohan Bhate, the wind farms have caused considerable damage to wildlife in the area and will continue doing so till they are evicted.

No consistency – clearances accorded by SPCBs

State Pollution Control Boards (SPCBs) give consent under multiple acts, most prominent of which are the Air Act and Water Act. The SPCBs use a categorisation of Red, Orange and Green to classify how potentially environmentally disruptive an industrial sector is and how much attention should be paid to it. There has been an effort to standardise the lists, but there is still a lack of classification in some states and not all lists are the same. The Boards do not yet have complete knowledge of new technologies such as solar power. In fact, the MoEF has issued a notification to the CPCB to conduct a study on solar PV and solar thermal and their potential environmental impacts.[53] This study has not yet been initiated (the CPCB claims it is unaware of any such notification!).[54] Even with more established technologies, the classifications vary as can be seen from our survey of SPCBs (*see Table 9*).

Wildlife Board's linear clearance and guidelines

The National Board for Wildlife (NBWL) has put out guidelines on how to handle linear intrusion (roads and powerlines) into natural areas including state forests, protected forests, reserve forests, river areas, protected areas, sanctuaries, national parks, reserves and areas 10 km from the nearest protected area. For reserve forests, state forests and protected forests — areas that have been used extensively for wind power projects — the guidelines state that: *"Guidelines are not applicable to sites listed in 2.2 (reserve forest, state forest and protected forest) if credible independent environmental impact studies and scientific evidence can be obtained or adduced showing that powerlines or roads do not have any detrimental effects on the natural areas by virtue of being in the defined vicinity."*

This would mean that any roads and transmission lines leading to a wind power project would need an EIA and "scientific evidence of no detrimental effects on the area" to be established.

The guidelines are extensive and focus firstly on how to avoid the need for new roads and

TABLE 9 Renewable energy and the State Pollution Control Boards

	Wind	Small hydro	Solar PV	Solar thermal	Biomass
Is Consent to Establish/Consent to Operate needed?					
Haryana	No	Yes	No	No	Yes
Rajasthan	Yes	Yes	Yes	Yes	Yes
Sikkim	Nil projects	Yes	No	Nil projects	Yes
Uttarakhand	No	Yes	No	No	Yes
If yes, under which Acts? (Air Act (A), Water Act (W), Hazardous Waste Rules (H), Noise Pollution Rules (N)					
Haryana	–	A,W,N	–	–	A,W,N
Rajasthan	A,W	A,W	A,W	A,W	A,W
Sikkim	–	W	–	–	A
Uttarakhand	–	A,W,H	–	–	A,W,H
Category of project (Red - most concern, Orange - medium concern, Green - least concern)					
Haryana	Green	Green	Green	Green	Red
Rajasthan	Green	Green	Green	Green	Red
Sikkim	Categorization of industries is under process				
Uttarakhand	–	Red	–	–	Red
Whether water cess is collected					
Haryana	If using water	Yes	Yes	Yes	Yes
Rajasthan	Yes in all processes using more than 10 kiloliter per day				
Sikkim	The matter is under consideration and awaiting government approval				
Uttarakhand	–	No	–	–	Yes

Source: Based on e-mail survey sent to State Pollution Control Boards in March 2013. Uttarakhand noted that it had no applications for solar PV, solar thermal or wind power projects so far.

PHOTOGRAPH: KANCHAN KUMAR AGRAWAL

Windmills have come up inside sanctuaries which are restricted areas

powerlines in natural areas, by restoring unused roads and power corridors. Only after avoidance is ruled out, do the guidelines go into details of how roads and powerlines should be built to minimise and mitigate damage. Roads – rule the guidelines — should be no wider than 12.5 meters for primary roads and 8.5 meters for secondary roads. But in reality, roads leading to wind power projects are often wider than this to enable the cranes to reach the sites (*see Table 10*).

Eco-sensitive zones

In 2002, the MoEF decreed that an area of 10 km around national parks and sanctuaries should be assigned as eco-sensitive zones, with restrictions to development. This was later changed to let the states decide the range of the zone and the restrictions on a case-to-case basis. Even now, most of these zones have not been notified by the states. If not notified, the 10-km zone is upheld by default and any project (including wind power projects) that falls inside the zone has to seek approval from the NBWL. The NBWL may conduct a study if it feels the project may have large-scale impacts.[55]

This guideline has been violated in at least one case — that of the wind power project in Bhimashankar in the Western Ghats. This may have to do with the fact that guidelines of the MoEF on eco-sensitive zones not only permit renewable energy projects, but say that they should be actively promoted.[56] There are no records of NBWL asking wind power projects to conduct a study.

Coastal Regulation Zone

India has just begun to explore the wind resources off its coasts. Off-shore wind power is generally more expensive as installation, maintenance and transmission are complicated tasks. Installation requires either floating wind farms or under-water foundation structures and turbines that can take the harsh conditions at sea. Transmission also becomes more complicated, with a need for underwater

TABLE 10 Major elements of the guidelines for linear intrusion into natural areas

Social and Environmental Impact Assessment	
Public consultation	Involve local community and NGOs
Project budget allocations for mitigation/protection	Include budget for housing and transportation of workers outside natural areas, removal of debris, conservation, protection and post-implementation monitoring
Cumulative impact	Consider cumulative impact of all projects fragmenting area/landscape
Workers	Provide housing outside natural area and transportation there and back
Waste	Ban dumping of waste inside natural area, top-soil should be conserved on site and re-used. Removal of all outside material (plastics, cartons, sheds, oil etc.) after
Invasive species	Avoid clear-cutting as it encourages invasive species, remove invasive species present
Native species	Do not remove trees over 30 cm in girth at human chest-height and species valued and deemed useful to local community (including banyan, neem, peepal etc. Any planting along roads and powerlines should use native species only
Periodic 'jungle/weed' clearing mitigation	No general slashing of undergrowth as it can hurt native species. Target removal at alien species. Employ locals/ tribals and consult botanists/ecologists for knowledge of native species. As much vegetation as possible should be kept under powerlines, trees should be lopped or pollared not felled.
Removal and restoration of unused roads and defunct power lines	Ministry should conduct a nation-wide study to ascertain which roads and power-lines in natural areas are no longer used and then restore these to natural conditions
Alignment	When one linear intrusion has been made, new projects should align with it so as not to cause further destruction (e.g. power lines running along roads)
Construction phase	Keep construction phase as short as possible, avoid night-time work as it disturbs animals
Crossing of linear intrusion	Where possible, retain natural vegetated crossings existing across linear intrusions such as tree canopy overlapping overhead. Create artificial crossings such as underpasses (tunnels and pipes for amphians, fish and small terrestial animals), overpasses and canopy bridges.
Height of powerlines	To avoid electrocution of elephants powerlines should be a minimum of 6.6 metres above ground on level terrain and a minimum of 9.1 metres above ground on steeper terrain
Avoiding bird deaths from powerlines	Maintaining 1.5 metre spacing between energized components, cover and insulate energized hardware, include reflectors and perch deterrants. Install underground cables. Monitor effectiveness of measures
Minimising width of vegetation clearing along roads	Width of vegetation clearing from edge of roadbed shall be not more than 1.5 metres in general in all natural areas (except tourism areas) and0 metres where the vegetation is low (grassland, scrub, wetlands)
Avoiding impact on streams and waterbodies	Install soil and debris traps and soak pits alongside drains. Maintain along streams and other waterbodies a vegetated buffer zone of width not less than 10 meter in level terrain and 30 meter in steep terrain with native species as appropriate to the specific natural vegetation type to prevent soil erosion or drift of debris and pollution into the waterbody.
Avoiding physical barriers for animal movement	Structures, such as retaining walls that can act as barriers to animal movement should not be installed along roads, especially in hilly terrain. Structures permitted to be installed in natural areas should have sufficient gaps of at least 2 metres width incorporated at regular intervals (every 8 metres) and in the case of retention walls/side walls have a height not exceeding 45 cm. In the case of fences, not be installed as a matter of policy, unless specifically evaluated and advised regarding height, placement, and animal passages by a competent wildlife scientist after field assessment.
	Structures should preferentially use crash-guards with single bar (at 0.6-1 metre height) over continuous sidewalls, with periodic gaps, as this will facilitate movement of both smaller animals under the bars and larger species through gaps.
Reducing width of road	For existing roads reduce and maintain width of primary roads to less than 7.5 metres (less than 12.5 m including graded portion and shoulders) and width of secondary roads to less than 4.5 m (8.5 m including shoulders)

Source: National Board for Wildlife - Guidelines for linear infrastructure intrusions in natural areas: roads and powerlines

cables. Maintenance crews need to be shipped or flown by helicopter to the turbines at every breakage. Naturally, there has been little interest in off-shore wind as long as there are good wind sites on-shore. In fact, there is still a knowledge gap about the actual potential of Indian off-shore wind power. Preliminary assessments have shown that the coasts of Gujarat, Tamil Nadu and Maharashtra may be ideal for wind power projects. A steering committee has been set up in the MNRE in March 2013 to look at India's potential in off-shore wind power.

Since large off-shore wind farms are a relatively recent phenomena, there are not many preliminary studies which point to their environmental impacts. Impacts that have been largely studied are the effects

CASE STUDY

WIND POWER ENVIRONMENTAL CLEARANCE PROCEDURE IN SWEDEN

In Sweden, quite like India, one of the largest impacts is on traditional pastoralists — the 'Same' people, traditionally reindeer herders. The Same have been the most ardent opponents to wind power as they see the roads and turbines as hindrances for migrational grazing of reindeer.[1]

The Swedish Energy Agency (Energimyndigheten) has set up an internet site collating all information on obtaining permits for establishing wind power plants (vindlov.se). Wind power projects are categorized into one of six categories dependent on placement, height (hub height plus rotor radius), rotor diameter and number of turbines (*see Table: Wind project categories*).

Most commercial size wind power turbines are above 50 m in height. The standard size of turbines in India is around 1.5-2 MW which corresponds to a total height of about 80-120 m. The S-88 2.1-MW turbine by Suzlon, with over 4,100 MW of installed capacity globally, has a hub height of 80 m and a blade diameter of 88 m, giving a total of about 124 m.[2] This would put most Indian wind farms under either the medium or large-scale category.

Sweden has harmonised its EIA rules with the EU, although the process and thresholds may still be somewhat different from other EU states[3]. Wind power falls under 'Annex 2' projects where the member state decides the threshold when EIA is necessary. In Sweden, an EIA is mandatory for a large-scale project, while for medium-scale projects the district level government (municipality) can deem it necessary for an EIA to be used, especially if the area considered is under a district detailed plan. It is also mandatory to get clearances from the local municipality (comparable to district level government), stating what are the impacts if any on the environment.

An EIA for wind power in Sweden covers both positive and negative impacts. Twenty-three parameters have been taken into account in a 'check-list'[4]; not all of these are mandatory. On the positive side, the impacts include avoiding greenhouse gases, lower energy consumption from polluting sources, and employment. On the negative side is the impact on the visible landscape (both during the day and the warning lights visible in the night), impact on outdoor recreation opportunities, noise pollution, impact on birds and animals, impacts on vegetation and agriculture, shadowing effects, impact on local reindeer herding (comparable to impact on goats, sheep and cattle in India), impact on wetlands and the hydrology of the area and the impact on cultural heritage sites and national parks.

As part of the EIA process, photographs are taken of the landscape; the wind turbines to be used are super-imposed through computer software to give an idea of how the area will look after the project is completed. Measurements of sound impact and shadowing are done. Archaeological survey maps and maps of national parks and forest reserves are also super-imposed on the site of the plants to show where there would be overlaps. Mapping of all local villages (even as far down to single households) have been done and super-imposed on the sites of proposed wind turbines. A list of all birds, animals and endangered flora present in the area is made.[5] The Swedish wind power EIA also needs to contain a discussion on three alternative scenarios (*see Table: Alternative scenarios*)[6].

TABLE A Wind project categories

Category	Description	Permit process
Mini	Single plant, maximum 20 m total height, maximum 3 m rotor diameter	No building application, no EIA. Has to be placed further from land boundary than the height of turbine. Neighbours have to be informed.
Farm-based plant	Single plant, 20-50 m total height, maximum 3 m rotor diameter	No EIA, but building permits mandatory i.e. acceptance by municipal building committee.
Medium-scale	One plant over 50 m or two plants of any size under 150 m for up to seven plants and under 120 m for seven or more plants	Building permit mandatory. EIA dependent on preliminary screening of possible environmental impacts.
Large-scale	Two plants of over 150 m each or seven or more plants over 120 m each	Building permit and EIA mandatory.
Off-shore (in territorial waters)	Any size or number of turbines	EIA mandatory along with acceptance by central government.
Off-shore (in economic zone)	Any size or number of turbines	EIA mandatory along with acceptance by central government.

Source: Swedish Energy Agency (Energimyndigheten), www.vindlov.se

Continued on next page

Cumulative effects of wind power

In the Swedish EIA process (based on the EU directive[7]), a cumulative assessment is an integral part. This assessment takes into account the effect of the project together with the effect of other projects that can impact the same ecosystem. One road leading to one wind turbine may not have much impact, but hundreds of turbines in the same area, all being individual projects, with hundreds of roads (and transmission lines) may exert a heavy impact on the local environment.

In wind power, cumulative impact could come from overlapping sound, overlapping visual impact, cumulative traffic increase, cumulative impact on bird-strikes, cumulative impact of noise from construction, cumulative erosion (loss of topsoil), cumulative impact on hydrology and cumulative loss of biodiversity (both flora and fauna).

Environmental management plans

The Swedish EIA process involves aspects that can be compared to an environmental management plan, often called 'damage ameliorating activities'. These include — for example — how to ameliorate and manage impact on streams, or the creation of habitats and roosts for predators further away from the project site.

One wind EIA describes the potential to replant/revegetate some of the area flattened by cranes. The only caveat the EIA puts is that the soil needs to be easy to remove if in case a turbine or tower falls or needs to be replaced. In this case, grasses can be replanted (for grazing) while keeping bushes and trees away.[8] According to another EIA for a large-scale wind power project, developers held meetings with affected local people, including traditional reindeer herders, and facilitated their visits to a nearby wind power project to give them a sense of the impacts.[9]

As per the Swedish Energy Agency, it takes 27 months on an average for a renewable energy project (mostly wind) to get all the permits needed to begin building. This includes permits from the Swedish Defence Forces, which has been one of the staunchest opponents to wind power turbines. The 27 months also include the granting of permits for connecting to the electricity grid. For wind power, the goal is to have a decision on the environmental clearance within six months – however, it is unclear if this goal is met.[10]

TABLE B Alternative scenarios

Alternative	Description
Alternative placement	Description of pros and cons of alternative placements
Alternative design	Ideas of alternatives of size, number, internal placement and why they were rejected
Null (zero) alternative	Describe future development of land and water area if wind project is not erected

Source: Swedish Energy Agency (Energimyndigheten), www.vindlov.se

on birds and marine life. Some studies have shown that sea birds avoid areas with wind farms[57] and there is a risk that marine wind farms may come in the way of the routes of migrating birds.[58] The pattern for marine life is more complex — although piling to build foundations can be heard by (and scare off) fish and sea mammals up to 80 km away, the finished foundation can actually act as an artificial reef and potentially help marine life growth.[59]

The Coastal Regulation Zone (CRZ) Notification[60], in effect since 2011 and building on the Environment Protection Act, limits industrial and developmental projects along the coasts. The CRZ has bearing not only on off-shore but also on coastal wind farms, as it stipulates different restrictions for different coastal areas.

Coastal wind farms already exist in India: a 10-MW wind farm was set up in 2006 by the Nuclear Power Corporation of India next to the Kudankulam nuclear power plant in Tamil Nadu. In countries such as Brazil, coastal wind power projects set up on sand dunes on the shore are common. However, CRZ which includes sand dunes, salt marshes and nesting grounds for birds, does not allow any non-conventional power producing facilities, including wind power projects.

CRZ allows such facilities off-shore (it regulates the coastal area from the low-tide mark to 12 nautical miles or 22.2 km). For all near-coastal, coastal and off-shore wind power plants (and any renewable energy project) in the CRZ, an impact assessment study is mandatory.

Global best practices

Environmental Impact Assessment

The need for Environmental Impact Assessment (EIA) of wind power varies throughout the world. In Europe and North America, environmental study is needed in areas with high wind power density. Some examples of frameworks and rules are presented below:

- *The US:* Environment assessment (EA) and environmental impact statement (EIS) are applicable for wind power projects. EA is conducted to decide the requirement for the EIS study, which is a detailed and comprehensive investigation. In addition to EA/EIS, the construction of wind turbines also requires to comply with the other federal, state and local laws, policies and guidelines, and seek other permits, wherever applicable. EIA is required for plants of over 50,000 KW (common for all power plants).
- *China:* Threshold limit is 50,000 KW and above.
- *The UK:* Screening is used to decide the requirement of EIA under following conditions (a) installation of more than two turbines (b) height exceeding 15 m. According to a DETR Circular 02/99 (Environmental Impact Assessment), EIA is more likely to be required for commercial establishments – with five or more turbines or a generation capacity more than 5 MW.
- *Denmark:* EIA is required if the height of a turbine is greater than 80 m or the number of turbines are more than three.
- *Ireland:* EIA is mandatory for wind farms if there are more than five turbines, or total generation output is greater than 5 MW. In these conditions, an environmental impact statement must be submitted with relevant planning. Furthermore, if planning authority is convinced that the wind power project is below the threshold limit but has significant impact on the environment, then it will ask for an EIA.
- *The Netherlands:* EIA is required if total capacity is equal to or above 10 MW or the number of turbines is 10 or more.
- *Spain:* Threshold limit is 50 turbines and over; for Ramsar Convention wetland areas, it is 10 turbines and over.
- *Germany:* The mandatory threshold limit is 35 m height or 10 MW, over with 20 turbines.
- *France:* Tower height of over 50 m is the limit.
- *India:* No EIA is required for wind power projects irrespective of size and location. EIA is not mandatory even if forest land is diverted for siting of wind farms; there are only guidelines issued by the MoEF.
- *Sri Lanka:* All renewable energy-based electricity generating stations exceeding 50 MW.

Standards and guidelines

On shadow flicker

- *The Netherlands:* Should not be more than 20 minutes per day, 17 days per year.
- *France:* No recommendation as such, but EIA needs to assess the shadow flicker on the neighbourhood.
- *Denmark:* Maximum of 10 hours/year allowed with average cloud cover.
- *Belgium:* 30 hours per year and 30 minutes per day
- *Germany:* 30 hours a year at clear sky
- *India:* No standard or guidelines

On noise

- *The Netherlands:* Limit is 40 dB from the nearest habitation. Also uses noise correction with wind norm curve — according to this curve, noise can be 44 dB (A) at wind speed of 8 m/s and 50 dB at 12 m/s.

PHOTOGRAPH: LEENA GUPTA

Countries have mandated a minimum distance from eco-sensitive zones for setting up wind farms

- *France:* Noise measured at the neighbourhood. Based on the difference of noise measurement before and after turbines are commissioned, the authorized emergence is fixed up to 3 dB A at night and 5dB A during daytime.
- *Denmark:* Statutory limit is 39 dB (for wind speeds of 8 m/s) and 37 dB (for wind speeds of 6 m/s) for dwellings, summer cottages, etc; 44 dB (for wind speeds of 8 m/s) and 42 dB (for wind speeds of 6 m/s) for dwellings in open country.
- *Belgium:* Threshold limit is 40 dB (A) in Wallonie region. A wind turbine produces noise when it operates above a wind speed of 5m/s; the Dutch noise curve is used to find out the real impact of noise.
- *India:* No sector-specific standard.

On the distance between two wind parks

- *The Netherlands:* No fixed distance, it varies and is regulated by regional and municipal zoning plan.
- *France:* Minimum 1.5 km.
- *Denmark:* If two groups are closer than 2.5 km, both groups must be considered in landscape planning.
- *India:* No specified distance as such.

On the distance from housing

- *The Netherlands:* No rules, but distance from nearest habitation is estimated based on noise and shadow nuisance.
- *France:* Usually not allowed in housing areas as defined by the municipal spatial plans (PLUs). No specific rules, the distance from nearest habitation is estimated based on noise nuisance.
- *Denmark:* 4 times the total height, sometimes 500 m.
- *Belgium:* No regulation, distance is calculated on the basis of noise and shadow flicker. In Flanders, the minimum distance considered from nearby houses is 250 m.
- *India:* No standard in case of non-forest land diversion; however, as per MoEF guideline a minimum distance of 300 m is recommended between windmill and highways or village habitation.

On the distance from roads, railways and waterways

- *The Netherlands:* Estimated based on diameter of rotor or at least 30 m from the nearest railways, highways and waterways. Risk assessment is also done to ensure safety.
- *France:* No specific rules, but there are defined distance for every types of roads (communal, main roads, motor-way) where no construction is allowed. Rules are laid down in local town planning documents.
- *Denmark:* Decided at country level, in case of major roads usually four times the total height of the tower and for other roads and railways, it is the total height of the tower.
- *Belgium:* In the Walloon Region, recommended distance is equal to the height of the turbine for national roads and railways. For waterways, no distance is pre-defined. In Flemish region, a risk assessment is recommended for projects close to highways and railways..
- *India:* No specified distance as such.

On the distance from high voltage line

- *The Netherlands:* Distance equal to diameter of rotor to the nearest line, otherwise at least 30 m.
- *France:* No clear rules, at least distance equal to the total height of the turbine to the nearest lines. Sometimes, a distance is also given in local planning documents.
- *Denmark:* No general rules, decision for distance is with reference to the planning permissions.
- *Belgium:* In the Walloon Region, recommended distance is equal to the height of the turbine from the power lines.
- *India:* No specified distance as such.

On the distance from historical monuments or cultural/archaeological sites

- *The Netherlands:* Distances are regulated by the municipalities through zoning planes.
- *France:* If the project is within 500 m from historical monuments, it requires an approval from the Architect of Ancient Monuments (AAM). In practice, such distance applies for every historical sites and buildings.
- *Denmark:* Between 100-300 m, or distance is based on landscape considerations.
- *Belgium:* Locating a turbine close to places with remarkable viewpoint, cultural, historic or aesthetic interest areas to be avoided. In such cases, advice of the competent authority (Regional Commission of Monuments and Sites) is needed.
- *India:* Not applicable in case of non-forest land diversion.

On the distance from natural reserves and other protected areas

- *The Netherlands:* Wind turbines are not permitted in the ecological network area (network of existing and developing important nature reserves in the Netherlands). Also wind turbines are permitted in areas protected under bird's directive, except nearby highways and/or railways passing through those areas.
- *France:* Permission from the ministry of environment is required if project is proposed in the protected areas.
- *Denmark:* A distance of 300 m is the normal distance in case of forests, but in areas like

Ramsar sites, a normal distance of 500-800 m is considered.

- *Belgium:* The siting of wind turbines is not recommended close to ecological connection, probable natural risk or major geotechnical constraint and protection perimeter in the sense of legislation for the protection of fauna. The project is allowed only if the EIA study illustrates that there is no significant impact. However, the competent authorities' or experts' advice is a prerequisite. In the Flanders region, if the project is proposed close to areas with important natural wildlife or fauna, additional research has to be carried out by the institute of nature conservation. Broadly, buffer areas of 200 to 700 m are considered.
- *India:* Prescribed guideline states safe distance for siting of wind farm from National Parks and Sanctuaries, areas of outstanding Natural Beauty, Natural Heritage Site, sites of Archaeological importance and sites of Special Scientific Interests and other important landscapes. But the guideline does not specify the safe distance from the said sensitive receptors.

On distance from water bodies

- *The Netherlands:* A distance of 50 m is considered from waterways; however, no limit is specified for water bodies.
- *France:* Construction is not permitted at a distance of less than 500 m from sea or lakes. The distance from the water bodies is guided by the local documents of town planning.
- *Denmark:* Following distance is allowed (a) 150 meters from a lake and a river (area above 4 ha) (b) special planning and landscape consideration for 3 km from sea, however, wind turbines are permitted at 100 meters distance from the coast except in industrial areas (e.g., harbours).
- *Belgium:* In Flanders, waterways are quite often used for siting of wind turbines (preferably along canals). The safe distance is usually considered i.e. at least the rotor radius. In Wallonie, potential impact and risk of siting of wind turbines along water bodies is carefully studied in the EIA.
- *India:* No specific distance as such.

On distance from forests

- *The Netherlands:* No specified distance, regulated as per regional and zoning plans.
- *France:* No distance is specified, guided by town planning documents.
- *Denmark:* 300 m from forest.
- *Belgium:* In Flanders, the distance is specified based on the value of the forest such as presence of wildlife, birds etc. It is a part of the evaluation of the Institute of Nature Conservation. In Wallonie, no buffer area is specified but the legal measures are used by government to build or not build a site in relation to location of wind turbine in forests and silent areas.
- *India:* Forest land is used for siting of wind farms. As of now, wind power has diverted 3,349 ha of forest land from 2006 to 2012.

On the protection of flora and fauna

- *The Netherlands:* Project developer need to undertake the fauna study before developing wind energy.
- *France:* In every case, the location of project site is preliminarily verified by DIREN (Environmental Regional Direction) and also evaluated considering the environmental limitation. The wildlife impact study is the integral part of EIA. A flora and fauna (especially birds) impact analysis is required on a period of one year.
- *Denmark:* EIA study must include a fauna study. In case of smaller projects, environmental impact study should include fauna impacts. The project is rejected in case it falls in bird migration routes.
- *Belgium:* If the proposed site falls in Natural 2000 areas and natural reserves, authorization from the competent authority is required. The proposal may be rejected based on location sensitivity and the kind of species in the area. In the Walloonie region, an EIA study needs to evaluate the impact on wildlife particularly birds, impact on breeding area, identification of the species which use it as a resting or feeding spot, or is a part of a migration corridor for migrant species, assessment of potential losses of biotopes (habitat) and other permanent impacts. If the project has the potential to affect bird's resting, feeding or reproduction areas or migratory corridors, then a detailed study needs to be conducted.
- *India:* EIA or biodiversity assessment is not applicable; thus protection of flora and fauna is hardly considered.

Benefit sharing

Many countries practice benefit sharing, where landowners and local affected communities are compensated in some way. This is sometimes voluntarily done, or set in law. For landowners (usually farmers), this is a rental agreement like any other, although compensation can be based on generation from the wind farm. Many long-term conflicts between the local community and project developers can be resolved at the project planning stage by involving landowners or affected people in project benefit schemes (*see Table 11)*.

TABLE 11 Wind farms and benefit sharing

Countries	Benefit sharing
India	No benefit sharing as such if private land is used for siting of wind farm. Land is purchased at a certain amount and then there are no further transactions in terms of lease payments or royalties.
Belgium	Enervest Wind Energy Company offers financial allowance to affected people – 200 to 250 €/ha/year is offered to affected people living close to the wind farm, whereas financial allowance of between 5,000-12,000 €/turbine/year is offered to landowners whose land has been used by the company for wind turbines . Similar type of financial grants are offered by another energy company, Wind Vision .
Canada (Ontario)	Landowners are likely to be presented with the following choices: • One time lump sum payment • Rent payment per year per turbine or per MW • Royalty Percentage of Gross Revenues with Minimum Payment Wind developers in Ontario offer minimum rent payments from $1,250 - $5,000 per turbine and royalties from 1.75% - 3% of gross revenues from the turbine or turbines on the landowner's property. The amount that a developer offers to compensate the landowner is dependent upon a number of factors, including: • Annual energy output • Power purchase agreement • Value of property to project Royalties in Ontario range from 1.75% to 3% due to developing nature of the Ontario wind market and the subsidized cost of electricity paid by consumers. Prince Edward Island (PEI) is one of the windiest places in Canada. The landowners get revenues on the basis of distance from the wind turbine See PEI Royalty Revenue Sharing, a 90 meter diameter turbine generate around $14,000 CAD per year revenues to landowners, whereas a turbine located at 100 meter away generate $4,000 CAD per year; and $2,000 CAD per year to those within 300 meters. *http://www.wind-works.org/articles/LandownerLeases&RoyaltyPayments.html*
Germany	Many share cooperatives in Germany post their brochure on the internet. The royalty paid to landowners is clearly stated in the financial summary documents
France	In Le Haut des Ailes, landowners with wind turbines on their land receive only 70% of the royalties paid for land leases. The remaining 30% is paid to adjoining landowners who have to live with the wind turbines. Le Haut des Ailes has leases with 40 individual landowners. Royalties amount to about 2,000 Euros/MW or 4,000 Euros per turbine. At the tariffs available under the French feed law, this is equivalent to ~10% of gross revenues per turbine.
The US	In US, the landowners receive $3,000 to $5,000 per year as a rental income from each wind turbine and farmers also carry on growing crops or graze cattle in the field . Other additional payments might come in the form of other allowances for the staging of auxiliary equipment, utility transmission lines, and access roads, etc., but only if the landowner insists and ensures that it is in the contract. Royalties as a percentage of the gross revenues generated by the wind turbines on the landowner's property usually provides the bulk of compensation to landowners from selling their wind rights. Royalties in the U.S. reaches up to 6%.
	Some published payment amounts from different states
	Indiana: Paid $1.10 per megawatt hour and not less than $3,500 per megawatt rated capacity per year. North Dakota: $4,000 to $6,000 per megawatt of rated power or royalties of three to five percent of gross electricity sales. Western New York: $3,500 per two megawatt turbine per year plus royalties of four to five percent of the electricity produced
	Source: http://www.ehow.com/info_8337416_much-farmer-make-wind-turbine.html

The UK	• Depending on the size of turbine and the wind speed, farmers can earn £2000-£4000 per annum for each turbine, which typically uses less than one acre of land, when taking into account the foundations, cables and access roads. These payments can provide a stable supplement to a farmer's income,
	• Other Benefits of installing a wind turbine at a farm include:
	  • Income for up to 30 years
	  • Rental income in excess of £2000 per turbine

Denmark	• According to new Danish legislation, there must be an option to purchase shares in wind developments project. • In order to support the idea of local ownership, residents who live within 4.5 kilometres of the site must be offered 20% of the shares. • Additionally, for the first 22,000 peak load hours an establishment of a community fund is required as per the legislation. This can be used by the municipality to fund projects aimed at increasing landscape and recreational value or local, cultural and informative activities aimed at increasing acceptance of renewable.

Source: Compiled from different sources by CSE team.

RECOMMENDATIONS

Need for Strategic Impact Assessment: to be implemented by the ministry of new and renewable energy (MNRE)

1. Identification of potential area followed by district level mapping of wind energy potential with the help of C-WET and other related agencies.
2. Based on feasibility study, detailed Environment Impact Assessment (EIA) needs to be carried out to assess the overall impact of wind farm (*see Table 12)*.
3. Decide on probable wind farm locations excluding sensitive areas as indicated by EIA study.
4. Develop Environment Management Plan (EMP) for each wind farm location.
5. The EMP should be put as condition while granting Consent to Establish (CTE) and Consent to Operate (CTO).

EIA for individual project

1. If the project is greater than 50 MW then the project is classified under Category "A" and needs to undergo EIA process.

TABLE 12 Recommendations for a robust environmental impact assessment study for wind power in India

Environmental Impact Assessment	Impact on local environment	Including flora and fauna, sound and noise (during construction and operation), visual landscape impact, shadows, roads and power lines.
	Public hearing	Well advertised public hearing inviting local people, local leaders, NGOs, local government and any other affected stakeholders
	Cumulative assessment	Any EIA should include how the effects of the wind power project would interact with other nearby projects. Sound, visual landscape impact and impact on wildlife are all examples where more than one project in the same area could increase the total impact.
	Alternative scenarios	The EIA should include possible alternative placements, design, sizes, time-lines and a scenario of the impact of the project not being set up "null-scenario" and the consequences of this (both positive and negative)
Environmental Management Plan (as part of EIA or separate)	Construction phase management	Limiting traffic, disposal of waste and scheduling and minimizing noise from blasting and avoiding and mitigating changes to the hydrology of the area through planning of access roads to avoid waterway crossings and creating dams or pipes if a crossing is necessary.
		Minimizing road-building and new transmission lines. Stabilize hill roads to avoid erosion through stepped slopes and shrink road surface area after erection of turbines if width of roads is more than needed. Replanting to be done on exposed soil to avoid erosion.
	Operations phase management	Sound monitoring, continued replantation and road reparation to avoid erosion.
	Decommissioning phase management	Proper dissassembleing of the tower and turbine, removal and recycling of all parts and all waste, restoration of hills and roads no longer needed. Replanting of tower area (if forest land).
	Biodiversity action plan	If project affects an area with rich biodiversity, endangered species, and areas with large numbers of bats and birds a biodiversity action plan is needed on how to minimize impact (siting, design, preparing alternative habitats for affected wildlife)
Forest clearance	Total forest area diverted	Forest clearance should include all diversion (including roads) together to understand the cumulative impact
	Alternative land-use	Alternatives to using forest land should always be looked into. Wind power causes linear fragmentation through roads and transmission lines.
	After the fact studies	Wind Power projects need to be inspected by the forest department to make sure that plans for roads and management are complied with.
Benefit sharing		Creating a system where local affected communities can share in the profit from the project would decrease the risk of conflict and would reimburse the community for any losses in terms of grazing-land and income from non-timber forest produce.

Source: Compiled from different sources by CSE team.

2. If the project is greater than 10 MW and falls in the forest area, it is classified under Category "A" and needs to undergo EIA process.
3. If the project is greater than 10 MW and less than 50 MW, then the project is classified under "B" category and should undergo screening to ascertain possible environmental impact.

Recommendations for the formulation of standards

Some of the best practices are:

1. *On shadow flicker:* The Netherlands which stipulates it to be not more than 20 minutes per day, 17 days per year.
2. *On Noise:* The Netherlands which sets the limit at 40 dB from the nearest habitation.
3. *On the distance between two wind parks:* In Denmark if two groups of wind farms are closer than 2.5 km, both groups must be considered in EIA.
4. *On the distance from housing:* The MoEF guideline recommends a minimum distance of 300 m between windmill and highways or village habitation. However there is no standard in case of non-forest land diversion.
5. *On the distance from roads, railways and waterways:* Denmark stipulates that in case of major roads, the distance is usually four times the total height of the tower and for other roads and railways, it is the total height of the tower.
6. *On the distance from high voltage line:* The Netherlands recommends distance equal to diameter of rotor to the nearest line, otherwise at least 30 m.
7. *On the distance from historical monuments or cultural/ archaeological sites:* Denmark mandates for a minimum distance of 100-300 m.
8. *On the distance from natural reserves and other protected areas:* Belgium mandates for EIA to determine the distance from ecologically sensitive areas.
9. On distance from water bodies: France does not permit construction of wind turbines at a distance of less than 500 m from sea or lakes.
10. On the protection of flora and fauna: France mandates for EIA to determine the impact on flora and fauna.

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