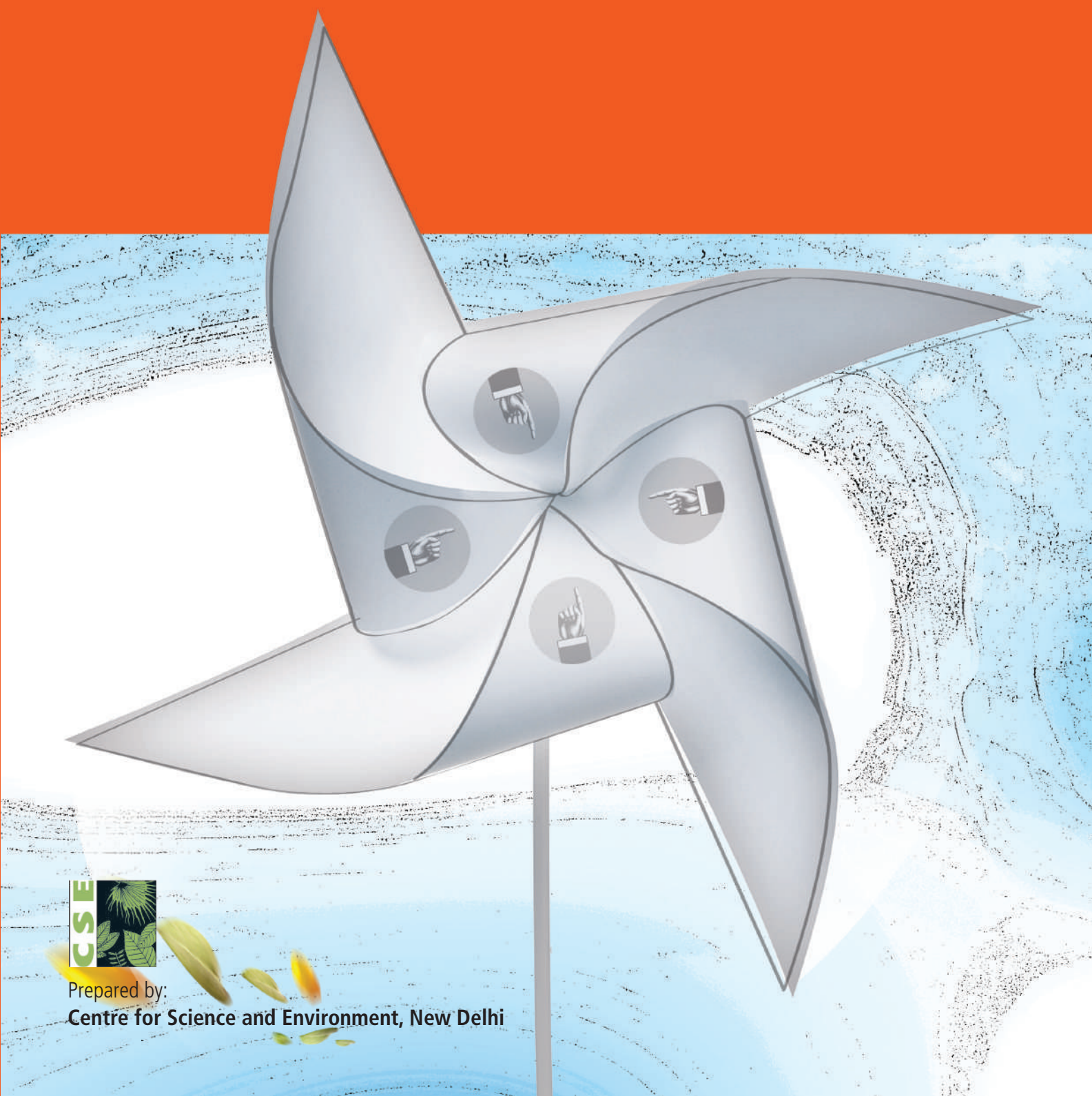
EIA GUIDELINES

WIND POWER



Prepared by:
Centre for Science and Environment, New Delhi

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FOREWORD

India suffers from chronic energy poverty. Even after 66 years of independence, 45 per cent of the households in rural India largely depend on kerosene to light their homes and shops. Those villages and cities connected to the grid cannot be termed 'energy rich' either, since the electricity supply there is erratic and lasts only for a few hours. In fact, very few cities in the country can claim to have 24x7 electricity supply. Consequently, the country is paying huge developmental costs for this energy poverty—education, health and economic development are being hindered because of this lack.

At the same time, however, India's energy poverty also provides an opportunity to leapfrog from polluting fossil fuels to clean renewable energy. Wind energy can play a major role in this transition.

Wind power has grown rapidly in the country in the past 10 years. As of March 2013, the installed capacity of wind power in India reached 19,051 megawatt (MW), making India the fifth largest producer of wind energy in the world. In terms of capacity, wind power is now the third largest source of electricity in India after coal and hydropower. The 12th Five Year Plan aims to install additional 15,000 MW between 2012 and 2017, which would almost double the total capacity of wind power.

But, not all is well with the way in which wind power is being developed in the country.

In the past five years, more and more people in the country have started to raise concerns regarding the ecological impacts of wind power development, especially in the forest and other ecologically sensitive areas. From Timbaktu in Andhra Pradesh to Koyna in Maharashtra, communities have started opposing wind power projects. The reasons for their opposition range from forced land acquisition to forest destruction, as well as linear fragmentation, destruction of water bodies and impacts on wildlife. All this is happening primarily because the wind power sector has very little regulatory oversight.

In India, wind power projects don't have to follow any environmental norms—the Environmental Impact Assessment (EIA) notification does not cover wind power. This means wind projects, irrespective of their size or capacity, do not require EIA studies. Wind power is also categorized as "green" by almost all state pollution control boards. The green tag ensures these projects are rarely scrutinized.

For wind projects coming up in forest areas, forest clearance is mandatory. But the process is so lax that developers now see getting forestland as an easy alternative, than buying land from farmers. According to the Ministry of Environment and Forests' data, more than 3,900 hectares of forestland has been diverted for wind power, including in ecologically sensitive areas such as in the vicinity of wildlife sanctuaries, without carrying out any EIA. In fact, nearly 45 per cent of the total wind power installed in India is in forest areas.

If we want to upscale wind power generation in the country, the current state of regulatory negligence cannot continue. We will have to incorporate sound environmental management practices in the wind power development plan. And, EIA is an important tool that can be used to make wind power development much more ecologically sound.

Realizing the importance of EIA for the wind sector, we decided to make an EIA guideline simply because none exists. Our aim is two-fold: one, to convince the government of the need for an EIA law in this sector, and two, to assist project developers who want to undertake EIA studies, even if there is no formal EIA law in place.

To make this guideline, my colleagues have travelled across the country to understand environmental and social issues related to wind power development. One of my colleagues travelled to Europe to understand their regulatory framework and environmental planning processes. We have incorporated the learning in the guideline. Not only have we detailed out the processes and procedures for undertaking an EIA study, we have also documented the international best practices in regulations and environmental planning for the wind power sector. The practice of benefit sharing being followed in many parts of the world, to resolve conflicts between local communities and project developers at the project planning stage, has also been documented in the guideline.

Our hope is that the regulatory agency and EIA practitioners will use the guideline to understand the areas of concern and employ that understanding to enhance the quality of the EIA studies. Our hope is also that policymakers will use this guideline as the basis to enact an EIA law for better planning and development of the wind power sector. This, we believe, is the way ahead.

Chandra Bhushan

CONTENTS

List of tables

List of figures

ABBREVIATIONS

AONB	Area of Outstanding Natural Beauty
AAM	Architect of Ancient Monuments
ADB	Asian Development Bank
ATC	Air Traffic Control
BNHS	Bombay Natural History Society
CCA	Community Conserved Area
CWIF	Caithness Windfarm Information Forum
CERC	Central Electricity Regulatory Commission
CEC	Central Empowered Committee
CAS	Compensatory Afforestation Scheme
CTE	Consent to Establish
CTO	Consent to Operate
CSR	Corporate Social Responsibility
CWET	Centre for Wind Energy Technology
CAD	Canadian Dollars
CIA	Cumulative Impact Assessment
CRZ	Coastal Regulation Zone
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
DIREN	Direction Régionale de l'Environnement (Regional Directorate of Environment)
dB	decibel
DEM	Digital Elevation Model
EWEA	European Wind Energy Association
EU	European Union
EIS	Environmental Impact Statement
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EC	Environmental Clearance
EAC	Expert Appraisal Committee
EMI	Electromagnetic Interference
GIS	Geographic Information System
GW	Gigawatt
GBH	Girth to Breast Height
ha	hectare
IUCN	International Union for Conservation of Nature
IEE	Initial Environmental Examination
ITDP	Integrated Tribal Development Project
IFC	International Finance Corporation
KLD	Kilolitres per day
kV	kilovolt
kW	Kilowatt
LVIA	Landscape and Visual Impact Assessment
LADAR	Light Detection and Ranging
MW	Megawatt
MNRE	Ministry of New and Renewable Energy

MEDA	Maharashtra Energy Development Agency
MoEF	Ministry of Environment and Forests
NOC	No Objection Certificate
NPV	Net Present Value
NOC	No Objection Certificate
NOP	No Objection Permission
NGOs	Non Governmental Organisations
NSW	New South Wales
NBWL	National Board for Wildlife
PAP	Project Affected People
PV	photovoltaic
PPE	Personnel Protective Equipment
PM	Particulate Matter
R&R	Resettlement & Rehabilitation
RTI	Right to Information
RE	Renewable Energy
REDA	Rajasthan Energy Development Agency
rpm	revolutions per minute
EIA	Strategic Environmental Impact Assessment
SPCB	State Pollution Control Board
SEAC	State Expert Appraisal Committee
SC	Supreme Court
SEIAA	State Environmental Impact Assessment Authority
SEA	Strategic Environmental Assessment
SACON	Salim Ali Centre for Ornithology and Natural History
SODAR	Sonic Detection and Ranging
SACON	Salim Ali Centre for Ornithology and Natural History
ToR	Terms of Reference
USEPA	US Environmental Protection Agency
UNEP	United Nations Envrionment Programme
WHO	World Health Organisation
WGEEP	Western Ghats Ecology Expert Panel
WPD	Wind Power Density
WTG	Wind Turbine Generator
ZVI	Zone of Visual Influence

Introduction

1.0 Wind Energy: India and the world

Wind power is an inexhaustible resource and one of the key alternatives to fossil fuels. Globally, wind power is one of the fastest growing sectors and holds the second largest potential after solar power among renewable energy (RE) sources.

Generating energy from wind is capital-intensive, but it is clean, freely available, sustainable and pollution-free. However, it does exert some environmental impacts *(see Chapter 2)*.

One of its major shortcomings at present is that it cannot be the main source of power supply to meet the entire demand till an appropriate storage technology is developed. As of now, wind energy can only supplement the electric grid.

1.1 Global scenario

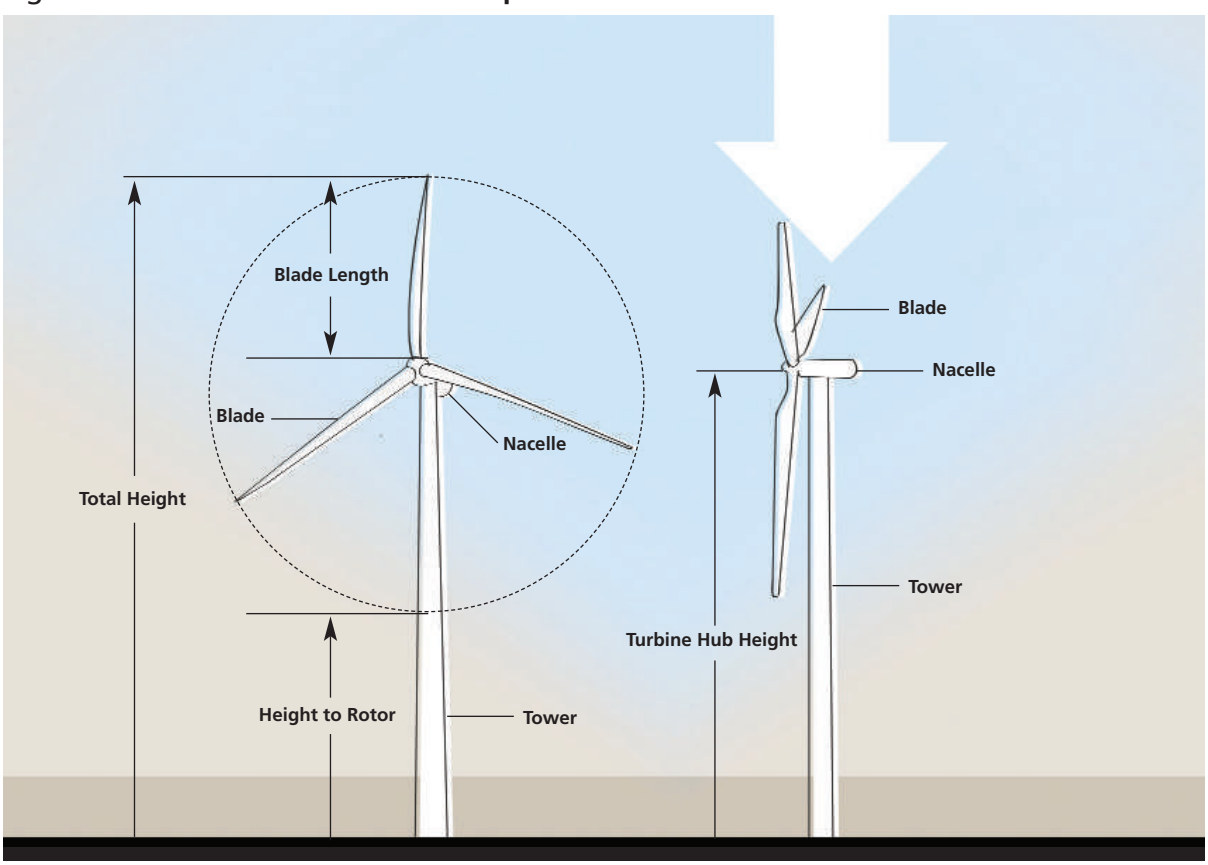
At present, the global wind power capacity is 2,82,587 MW.[1] The five global leaders in wind energy are China (75,224 MW), the US (60,007 MW), Germany (31,308 MW), Spain (22,796 MW) and India (18,421 MW). Their cumulative share is 74 per cent of the global wind power installed capacity.

China is expected to increase its wind power capacity to 300 GW. One study predicts that the figure for China would reach 400 GW by 2030[2]. According to the US Department of Energy, by 2030, wind power will supply 20 per cent electricity in the US[3].

Over the last two decades, Europe has witnessed an enormous growth in wind power capacity. From 1994 to 2011, the capacity has grown by 98 per cent. According to the European Wind Energy Association (EWEA), currently, the total wind power installed capacity has crossed the figure of 100 GW.

In terms of capacity addition, cumulatively EU member states are the world leaders. According to 2012 figures, their share in the global wind power capacity was 37 per cent with 94,000 MW. The combined capacity of Germany and Spain is 52,103 MW which is 21 per cent of the global share, according to 2012 figures[4]. The other

Figure 1.1: **Wind turbine and its components**



Note: The circle indicates the swept area of blade which is useful for calculating the total energy potential in a given area of wind.

Wind power: The fundamentals

A wind turbine is a structure that comprises of a tower, blades, a rotor hub, a generator and a transformer enclosed in a nacelle (see Figure 1.1: *Wind turbine and its components*). A wind turbine traps the energy of moving wind, and converts the mechanical energy to electrical energy, thus, generating electricity. There are two types of wind turbines — vertical axis and horizontal axis. The more commonly used are the horizontal axis turbines. When a number of wind turbines are in a cluster, it is referred to as a 'wind farm'. A typical wind farm consists of turbines, access roads, transformers, office buildings, a grid connection point and transmission lines.

Parts of the turbine

- **Tower:** Vertical structure which supports the turbine and its auxiliary parts. The height of a tower is site-specific and depends on the rotor diameter and available wind at the site. The tower structure can be tapered, tubular steel or with a concrete base with steel upper sections. Sometimes, lattice towers are also used.
- **Blades:** A typical modern wind turbine has three blades, although other designs are also available. The blades are usually made of fiberglass reinforced-polyester, epoxy resin or carbon fibre.
- **Nacelle:** An enclosure which contains the main components of the turbine like the gear box, the generator and other auxiliary parts (see Figure 1.2: *Working of a wind turbine*).
- **Rotor hub:** Structure on which the blades of the turbine are attached. It circulates at a rate of 10 to 25 revolutions per minute (rpm). The speed of the rotor varies depending on the size of turbine and its design. It is further attached to a low speed shaft connected to the gearbox.
- **Gear box:** It is enclosed in the nacelle. It is a vital component, which converts the slow rpm to a high speed ranging from 1,000 to 1,500 rpm[1].
- **Generator:** It is also enclosed in the nacelle and converts mechanical energy to electrical energy.
- **Transformer:** Its main function is to step-up medium voltage in between 10 kV to 35 kV depending on the grid's requirement.

Wind speed

The operation and performance of wind turbines vary at different wind speeds. A wind speed in between 3.5-5.5 m/sec is suitable for the operation of a low speed windmill. The wind speed beyond 3.5 m/sec, also referred as cut-in wind velocity, is the minimum wind speed at which the turbine blades set in motion to overcome friction and rotate[2]. The cut-in wind speed also varies from turbine to turbine; some of the newer generation modern turbines have low cut-in wind velocity to exploit a wider range of lower wind sites[3]. Some manufacturers in India supply turbines of 2 MW capacity which can start operating at 3 m/sec.

Wind speeds ranging from 5.5-8 m/s can power a high speed turbine; maximum power is generated at wind speeds ranging from 13.9-17.2 m/sec. Wind speed beyond 17 m/sec is risky and may damage the turbine. The cut-out speed is the speed at which a turbine is brought to stall to avoid damage from high winds — not all turbines have a well-defined cut-out speed.

Wind power density/wind speed available at 50 m above ground

Class	Speed (m/s)	WPD (W/Sq m)
1	0-5.6	0-200
2	5.6-6.4	200-300
3	6.4-7.0	300-400
4	7.0-7.5	400-500
5	7.5-8.0	500-600
6	8.0-8.8	600-800
7	8.8-11.9	800-2000

Source: Dr. S.Gomathinayagam Executive Director, 2012, C-WET Wind resource Assessment techniques, presented in ASEAN –India workshop on Co-operation in Renewable Energy, Vigyan Bhavan, New Delhi

Location of wind farms

The location of the wind farm site is classified mainly based on wind speed and wind power density at a designated height. There are seven classifications used in India for determining wind power density/wind speed at 50 metre (m) height above ground (see Table). For instance, in India, a height of 50 m and 80 m is considered. If we go from 50 to 80 m height, then the wind power density and wind speed increases substantially and wind energy potential also changes. The direction of wind is also an important factor that dictates the location of the wind farm. For example, if the site receives major share of wind energy from a specific direction, then it is crucial to avoid any hindrance to wind flow in that particular direction[4].

The power which can be generated by the wind turbine is estimated by the equation given below:

$P = 0.5*\rho*A*Cp*V^3/1,000$

Where, P = Power in kw

ρ = Air Density in Kg/m³ (about 1.225 Kg/m³ at sea level, less higher up)

A = Rotor Swept Area ($\pi/4.d^2$) in m²

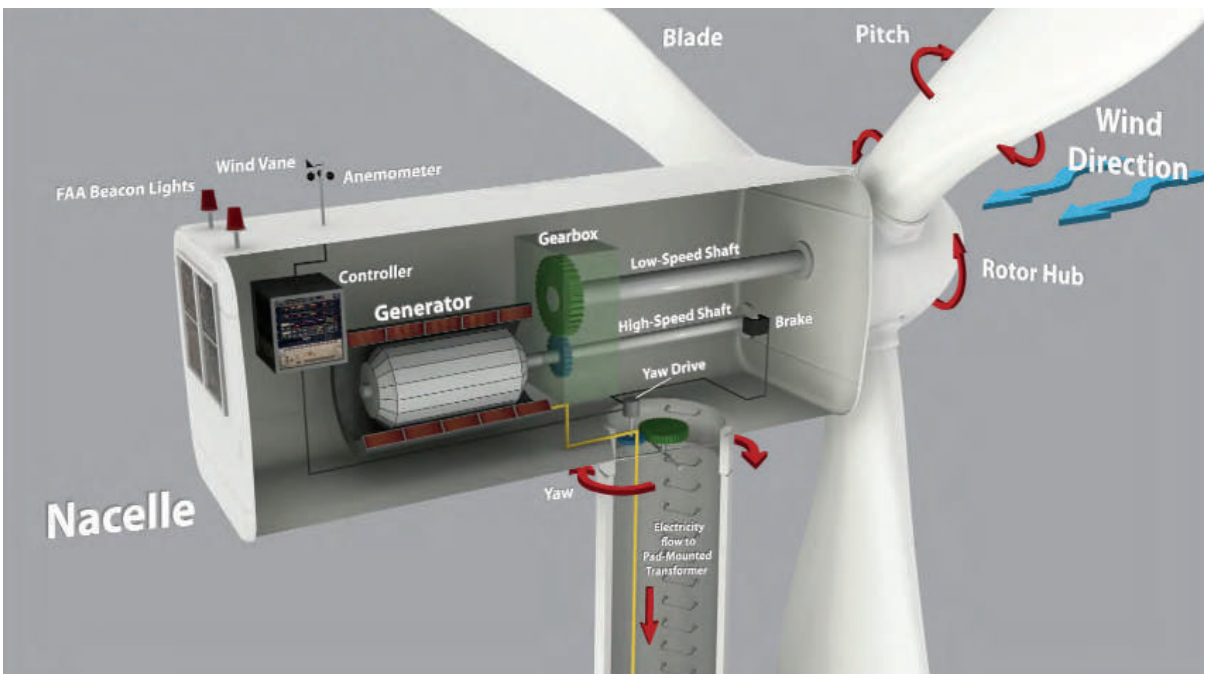
d = Rotor diameter in meter

Cp = Power Co-efficient (approx 0.35), max theorotical (Betz number = 0.593)

V = Wind speed in m/sec

The swept area depends on the total length of the blades [5]. When the rotor diameter is doubled, the power output is increased by a factor of four.

Figure 1.2: **Working of a wind turbine**



EU leaders in wind power capacity are France, Italy and the UK.

Globally, the average capacity of wind turbines is around 1.16 MW. Today, most of the new projects use high capacity turbines, ranging from 2 to 3 MW. In the market, models of up to 6.125 MW turbine capacities are also available.

1.2 The Indian scenario

Wind energy makes up the majority — about 70 per cent — of the total renewable energy capacity installed in India. According to the Union Ministry of New and Renewable Energy (MNRE), India's total installed capacity of wind power is estimated to be 19,051.45 MW as of March 2013[5].

The total wind power generation in 2011-12 was 23,399.5 gigawatt hour (GWh), or about three and a half times the output of a new nuclear reactor.

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.[6] Assuming an average wind turbine capacity of 1.5 MW, this means a total of 10,000 new turbines in the country.

These estimations notwithstanding, India's real wind energy potential remains a debatable issue — mainly because different organisations present different data. For instance, the Centre for Wind Energy Technology (CWET), which is an autonomous research and development institution under MNRE, estimates the total potential at around 49,130 MW at 50m height and 1,02,788 MW at 80m height[7] (see Figure 1.3: *Wind power potential at 50 m and 80 m height*).

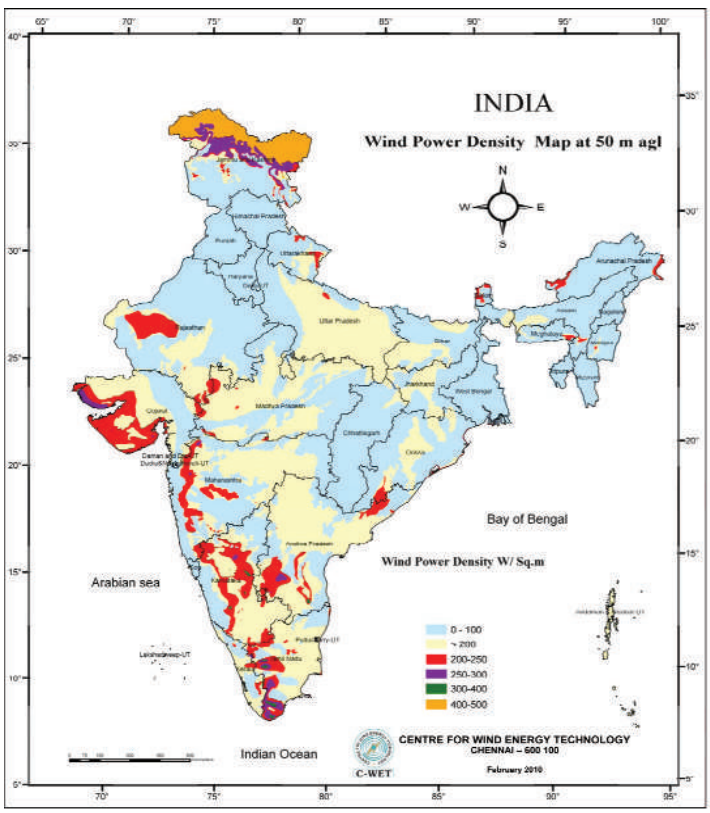
According to International Energy Studies, a consortium of scientists and experts from the Environmental Energy Technologies Division, the total techno-economic potential of wind power potential is 543 GW at 80 m hub-height, which is five times higher than the official estimate.

During early 1990s, the wind turbines installed were mostly in the range of 225 kW to 600 kW. Today, the wind turbines being installed are in the range of 1.5 MW and above as they are more economical. The range of wind turbine available in the market today is 225 kW to 2250 kW.[8]

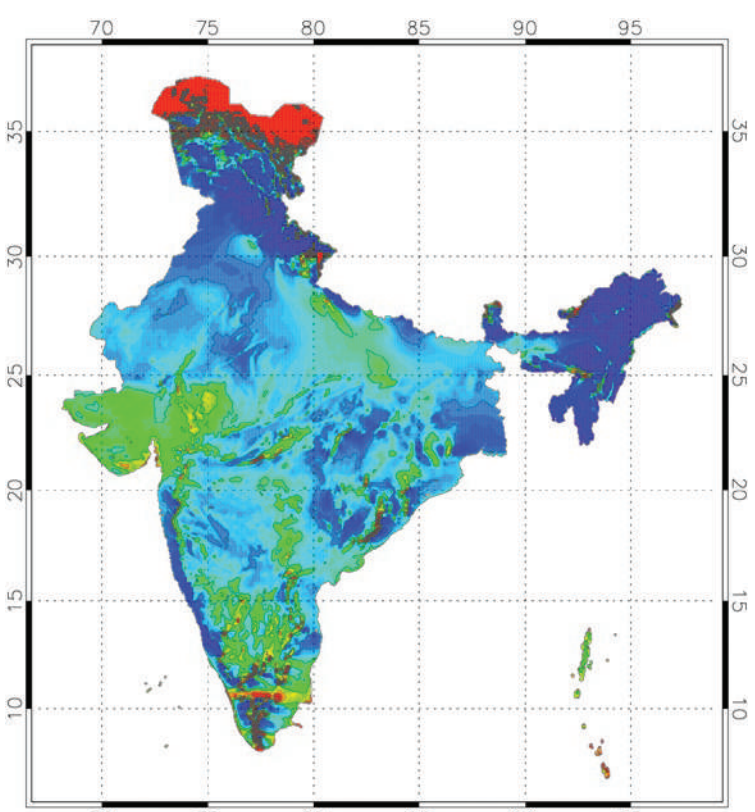
Over 95 per cent of the country's total wind energy potential is concentrated in the southern and western states — Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra and Gujarat.

The maximum wind energy potential sites are located in Karnataka, but most of them are located in the forest areas. However, in terms of wind quality, the most favourable state is Tamil Nadu.

Figure 1.3: **Wind power potential at 50 m and 80 m height**



Source: http://www.cwet.tn.nic.in/html/departments_wpdmap.html as viewed on January 23, 2013



Source: http://www.cwet.tn.nic.in/html/departments_ewpp.html as viewed on January 23, 2013

CHAPTER 2

Environmental and socio-economic impacts

2.0 Introduction

Energy generated from wind power is much cleaner compared to what is derived from fossil fuels. Except during the initial stages of construction, a wind power project does not pollute air or water and is not resource-intensive. It does not generate any radioactive or hazardous waste either.

Wind power projects can exert considerable environmental and social impacts during construction, which involves site preparation, construction of access roads, tower foundation, erection of towers and transmission lines and the movement of vehicles. However, these impacts are usually temporary and localised. In a country like India, where the population density is very high, wind power projects may cause significant impacts if they are proposed in areas occupied by human settlements or close to populated locations. If the wind farm is proposed to be set up in a forest area or in the sea, concerns such as impacts on biodiversity become significant (see Table 2.1: *Potential environmental and socio-economic impacts of on-shore wind power projects*).

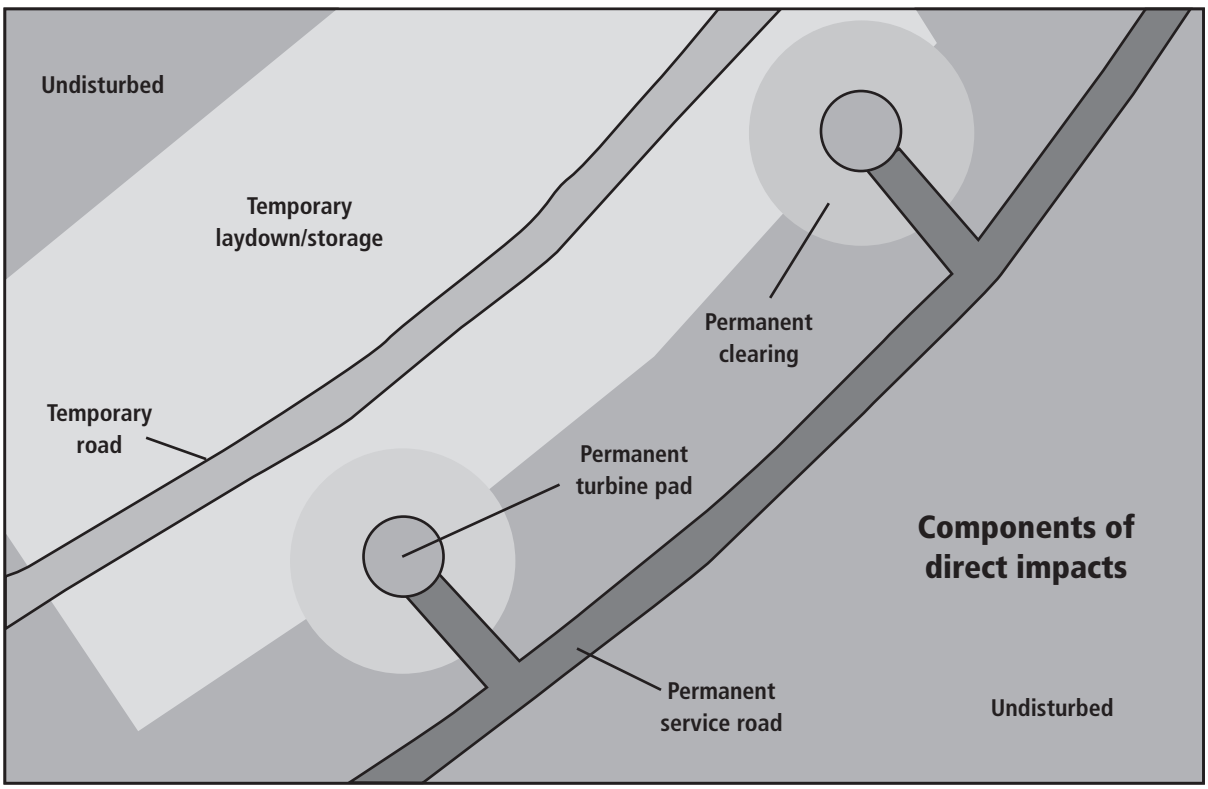
Some of the globally documented adverse environmental impacts of wind power projects during operation stage include noise pollution, shadow effect, impacts on birds and bats, impacts on landscape, and operational risks which could lead to accidents and fatalities. Wind power projects also pose a threat to low flying aircrafts

Table 2.1: **Potential environmental and socio-economic impacts of on-shore wind power projects**

Project activity	Potential impacts
Site clearance and initial stage of project construction	• Land acquisition: Displacement and loss of livelihood. • Construction of access roads: Loss of local biodiversity, felling of trees, increase in erosion, air and noise pollution. In hilly areas, construction of roads also involves blasting which causes slope destabilisation and migration of local species due to noise and vibration. • Land degradation and change in land use pattern. • Civil works such as erection of tower and transmission lines cause dust and noise pollution, loss of local biodiversity, health impacts on workers and occupational risks. • Influx of construction workers increases pressure on local resources and amenities. • Heavy equipment movement and operation leads to noise, dust generation, inconvenience to local people and pressure on existing road and people safety.
Operation stage	• Noise pollution • Risk of bird and bat collision, decline in home and foraging lands, disturbance to breeding and resting sites, barrier effects for local and migratory birds, and impacts on endangered/endemic and restricted species, if present. • Shadow flicker. • Electromagnetic interference (EMI). • Aeronautical safety. • Landscape and aesthetic impact. • Land contamination in the transformer area. • Occupational hazards such as electrical hazards, fall from a height and operational risks which include explosions, fire hazards, blade failure, etc.
Positive impacts	• Renewable energy • No burning of fuel thus no air and water pollutants generated • No significant generation of solid or hazardous waste except used hydraulic and lubricating oils and transformer oil.

Source: Centre for Science and Environment, 2013

Figure 2.1: **Permanent and temporary disturbance of land in wind farm projects**



Source: Paul Denholm *et al* 2009, 'Land-Use Requirements of Modern Wind Power Plants in the United States'

and can cause radar and telecommunication interference if the site is located near an airport or known flight routes.

2.1 Impacts on land

Wind power projects can result in both temporary and permanent disturbances to land. The permanent disturbances are caused due to construction of wind turbine pads, access roads, substations, service buildings and other infrastructure. Temporary disturbances are caused by temporary construction of access roads, storage of equipment, and lay-down or storage facilities (see Figure 2.1: *Permanent and temporary disturbances of land in wind farm projects*).

Access roads have the highest footprint among all cases of permanent disturbance; they can account for 80 per cent of the total land utilisation, followed by turbine area (10 per cent), substations (6 per cent) and transmission lines (2-4 per cent). In the case of temporary land disturbances, the staging area and temporary access roads can account for more than 90 per cent of the total land required (see Table 2.2: *Land disturbance due to direct impact*).

However, if the wind turbine is sited in a forested area, additional land is needed; thus, the impact on land is higher in a forests compared to the plains.[1] With lower land disturbance in the plains, the remaining land can be used for grazing, farming and other activities.

Table 2.2: **Land disturbance due to direct impact**

Permanent impact category	Area (%)	Temporary impact category	Area (%)
Turbine area	10	Staging area	30
Roads	79	Temporary roads	62
Substation	6	Sub/Trans construction	6
Transmission	2	Other	3
Other	2		

Source: Paul Denholm *et al* 2009, 'Land-Use Requirements of Modern Wind Power Plants in the United States'

Impact of wind power projects in hilly and forest areas

The Maharashtra government has been criticised by the Western Ghats Ecology Expert Panel (WGEEP) for clearing the 113 MW Andhra Lake Wind Power Project, promoted by Enercon (India) Limited. The project came into limelight due to its location in an ecologically sensitive area.

The project is just 3.5 km from the Bhimashankar Wildlife Sanctuary in the Western Ghats. It was opposed by the Chakan range forest officer (under whose jurisdiction the project falls) on the grounds that the area is densely forested and rich in biodiversity.

Substantial land clearing and forest destruction by the project proponent has not only affected farmland and water bodies, but has also caused massive impact on biodiversity and has affected the tributaries of the Krishna river. Some of the project-related activities have led to the following impacts on the forest:

- Over 300,000 trees have been felled during the construction of a 13 m wide and 20 km long road along the hills. The project had received permission to cut only 26,000 trees.
- The villagers have alleged that most of the trees cut down were 30 to 50 years old, including valuable species like *mahua*, *beheda, jamun, chaar* and wild mango.
- Few endemic species such as *karvi* (*Strobilanthes callosus)* which flowers once in eight years have been destroyed due to dumping of rubble from blasted rocks.
- Due to noise pollution caused by blasting, birds and the Malabar Giant Squirrel (threatened species) have disappeared from the area.
- Villagers fear that potential landslides may affect farmlands in the hilly areas.[1]

Broadly, the actual land footprint due to erection of turbines, construction of access roads and setting up of other infrastructure is in the range of 1-3 per cent of the total wind farm area.

In the US, the estimated direct impact (permanent and temporary impact) ranges from 0.4-1.2 ha per turbine. whereas in Australia, some of the wind power projects have utilised only 0.7 per cent of the total land area.[2] In case of farmland or grazing land taken over by a project, these activities can resume on the remaining 97-99 per cent of the wind farm area.[3]

The magnitude of impact of wind power projects in a hilly terrain, on forests, wildlife and water resources is much higher compared to that in plain areas. In hills, activities such as road construction, erection of transmission lines for grid connection, and cutting and felling trees can lead to siltation of water bodies and slope destabilisation. They can also trigger landslides and pose a significant threat to the local biodiversity (see Box: *Impact of wind power projects in hilly and forest areas*).

JONAS HAMBERG / CSE

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

Wind farms in forest areas: The Indian experience

In India, wind farms set up in forest areas have been reported to have caused adverse impacts on environment and violated guidelines set by the Ministry of Environment and Forests (MoEF) dated May 14, 2004 for the diversion of forest land for non-forest purposes under the Forest (Conservation) Act, 1980.

There is a long list of projects which have diverted forestland for setting up wind farms; many more are awaiting forest clearance. A number of wind power projects have been commissioned on forest land mostly in the states of Karnataka, Maharashtra and Madhya Pradesh. Also, there have been cases where ecologically restored areas have been drastically affected by a wind power project (see Box: *Wind project affects decades of eco-restoration efforts*).

Wind project affects decades of eco-restoration efforts

In Kalpavalli region in Anantapur district, Andhra Pradesh, the 50 MW Nallakonda wind farm, a venture of Tadas Wind Energy Limited, is laying waste a lot of good work done by the locals. In 1990, Kalpavalli's desolate and desert landscape was regenerated into a forest through the efforts of a local organisation, Timbaktu Collective, and the local people of the region.[1] The area has also been recognised as a biodiversity-rich Community Conserved Area (CCA).[2]

The company and the Andhra Pradesh government have gone ahead with the project by demarcating the area as "wasteland" as per old revenue records. The various project-related activities have led to the following impacts in the region:

- Large-scale deforestation affecting water bodies and local biodiversity
- Flattening of hilltops
- Massive soil erosion due to cuts made during road construction, affecting pasture routes
- Damage to internal water aquifers leading to severe decline in water availability
- Water pollution and depletion of livestock resources due to spillage of construction debris
- Use of water from traditional water bodies of the village community for construction purposes without any prior consent from the villagers

Dr LEENA GUPTA / SPWD, NEW DELHI

Vegetation destroyed on contours and other parts for road construction for windmill material transportation

Dr LEENA GUPTA / SPWD, NEW DELHI

Massive soil erosion

The wind power potential estimates indicate there are several high wind density sites with capacities of 20,000 MW located in forest areas.[4] According to the MoEF database, from 2006 till today, wind power projects have diverted 3,454 ha of forest land.[5]

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. On the other hand if one considers forest land given per MW, then average figure is 1.85 ha per MW (see Table 2.3: *Forest clearance statistics for wind power projects*). It is hard to set an exact standard as landscapes change, but if we go by industry measurements — turbines should have a distance of five rotor diameters between each other and road width needs to be 10 m — then each turbine should only need an area of about 0.5 ha.

Table 2.3: 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, www.envfor.nic.in, accessed March 20, 2013, Ministry of Environment and Forests, Government of India

2.2 Land allocation

The status in India

The land required to set up a wind turbine depends on many factors, the key ones being land availability, wind energy potential and respective state policies that govern allocation of land for wind turbine projects.

Different states in India have different policies for land allocation. For instance, in Rajasthan, the Rajasthan Energy Development Agency (REDA) policy[6] on wind power sets the maximum allotted land footprint to the developer as 5 ha/MW. The policy also states:

"No wind generation project can be set up if the land falls in areas like National Parks and Sanctuaries, Area of Outstanding Natural Beauty (AONBs), Natural Heritage Site, sites of Archeological importance and sites of Special Scientific Interests and other important landscapes".

Suzlon's wind farm in Koyna Wildlife Sanctuary

The 423 square 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 the 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, 1972, deletion of land from a notified sanctuary cannot be done without the approval of the Centre). The state government 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 a Right to Information (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,1972; 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, 1980, 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 that a 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 removal 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 (CEC) for clearance. If the villages are removed from the reserve, a heavy fine may be levied on the owners of the wind farm.[1]

Maharashtra has optimal wind potential only at a height of about 800-1,200 m. Usually small farmers sell their land to middlemen who in turn sell the land to wind power companies. As per the Maharashtra Energy Development Agency (MEDA), only sparse forest land can be diverted for wind power development and in such a case, compensatory afforestation needs to be carried out as per the rules laid down by the MoEF.

The policy further states "Forest land will be leased for 30 years initially. It will be first leased in favour of developer and then transferred in the name of investor/power producer within a period of four years. If developers fail to develop wind farms, land will be reverted back to Forest Department without any compensation" (see Box: *Suzlon's wind farm in Koyna Wildlife Sanctuary)*.

In Gujarat, in many instances, wind power developers have bought a small patch of agricultural land, leaving the remaining land intact for agricultural and other uses. The land footprint required per 1.5 MW wind turbine is about 1.6 ha, including the footprint for approach roads. Developers can buy revenue land from the government on lease for a fixed term of 25-30 years.

Karnataka also has wind farms, mostly in forest areas. The land footprint in the state per turbine of 2 MW capacity is, on an average, 1.2-1.6 ha. However, since the locations are high up in the hills, the construction of approach roads accounts for most of the land footprint.

In Tamil Nadu, wind farm development started as early as the 1990s. A lot of land was available during the initial period of development; now, most of the high potential wind energy sites have been taken. Hence, wind power developers are turning to agricultural land to develop new

capacities. The land footprint for wind power is similar to other states which is approximately 1.2-1.6 ha per wind turbine.

2.3 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 wind speeds (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.

2.4 Noise pollution

The MoEF guidelines for wind power projects in forest areas state: "The turbine of the windmill produces a humming sound, which may cause disturbance for the avian habitat."

During the operation of a wind turbine, the rotation of the turbine blades creates a sound; there are, also, mechanical sounds from gearboxes, cooling fans and generators. The aerodynamic sound — the sound from the rotating blades — is directly proportional to wind speed. The higher the wind speed, more will be the aerodynamic sound.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 and background sound levels.

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 – >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

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.

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. 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).

The MoEF guidelines issued for wind power project recommend that wind farms should not be set up closer than 300 m from habitation, but this is not mandated. Also, there are no requirements to monitor noise from wind turbines. However, noise generation due to wind turbines is regulated in other countries (see Box: *Noise standards, Oregon, US*).

2.5 Social impacts

Unlike mining and manufacturing sectors, the actual land requirement in wind power projects is much less. Therefore, displacement is not a serious concern.

However, a project may cause impact to indigenous communities, if the forest land or grazing land (on which it is coming up) is inhabited by them. Usually in such cases, these communities do not hold land rights and can be easily evicted. This is a serious concern, as most of the indigenous communities are dependent on forests for their very survival and livlihood.

Cases have been reported where wind projects have taken over indigenous community lands. For instance, there are reports from Kerala on violation of the Kerala Restriction on Transfer by and Restoration of Lands to Scheduled Tribes Act, 1999. In Kerala, non-tribals cannot buy land from tribals: the above mentioned Act prohibits it. There have been allegations that wind power developers have flouted the Act. The 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 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.

2.6 Impacts on biodiversity

Some of the potential impacts on biodiversity due to wind turbine construction, installation and associated activities (like erection of transmission lines) include habitat fragmentation, injuries to and mortality of birds and bats, habitat loss, wildlife mortality due to electrocution, disruption of canopy continuity for arboreal animals in closed-canopy forests, cutting of vegetation resulting in weed proliferation and suppression of native vegetation regeneration. It also leads to a reduction in common property resources like pasture land.

There are documented studies on bird and bat mortality in different countries like USA, UK, Canada, New Zealand, Ireland, Denmark, Spain, Belgium and Australia.[7] However, bird and bat mortality has not been studied much in India; almost no scientific literature is available on this subject.

A few cases of bird mortality have been reported in India. Some examples of bird mortality (see Box: *Impact of wind turbines on birds in Gujarat and Western Ghats)* indicate that the magnitude of impact on birds varies geographically due to different types of topography, habitat, weather conditions, flyways, species diversity and species abundance.[8]

Bats can be affected by the changing air-pressure around wind turbines. 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.

Impact of wind turbines on birds in Gujarat and Western Ghats

CASE STUDY 1: Avian collision threat assessment at Bhambarwadi Wind Farm Plateau in northern Western Ghats

Ela Foundation[1] (a Pune based non-government registered charity devoted to nature education and conservation) conducted a two-year study to assess the impacts of wind farms on avian population at Bhambarwadi Plateau of northern Western Ghats. The study area already has 10 wind turbines and 13 more have been proposed. The project site is just 5 km from Chandoli Wildlife Sanctuary. The study has concluded the following impacts on avian fauna and other animals:

- Out of the 89 avian species on the plateau, 27 were recorded in the risk area.
- The average collision rate per year was 1.9 birds per turbine; an estimated 25 birds are killed annually by the turbines.
- Of all species, raptors were at the maximum collision risk. Out of the 27 bird species, 11 were raptors found to be flying in the risk zone. And 12 other birds belonging to seven different species were found dead, of which five were raptors belonging to three species. The study also recorded the maximum incidence of collision of raptors during the monsoon season.
- During the study period, 19 birds and mammals were found dead due to collision with the rotor blades or due to electrocution caused by contact with overhead transmission lines or transformers.
- The study also reported the death of some animals like Asian palm civets (*Paradoxurus hermaphroditus)* whose remains were found in the transformers area. Swallows and martins were found dead in the post-monsoon period and two black kites *(Milvus migrans)* and one changeable hawk eagle *(Spizaetus cirrhatus)* collided with wind masts.
- The population of the Malabar crested lark *(Galerida malabarica),* commonly found in the Western Ghats, declined drastically. The study also concluded that the thin steel wires that support the wind masts which are not visible from a distance lead to avian collisions resulting in mortality.

CASE STUDY 2: Vultures disappearing because of windmills

According to an article published in *The Indian Express* dated September 19, 2007, wind farms in Suthari village of Kutch, Gujarat have led to a drastic decline in the vulture population. According to a 2007 study titled "Breeding vultures: The other side of the story", conducted by Vibhu Prakash, principal scientist, Bombay Natural History Society (BNHS), who was in charge of the vulture breeding programme, it was reported that over a period of time the number of white-backed vultures, widespread in the area, have reduced from 70 to 15.

The study concluded that there has been a decrease in the number of nests in the region from 10-15 to just one, indicating a decline in the breeding pattern of the vulture species.[3] The study further added that windmills create severe problems for large birds like raptors which can get trapped in the blades and die.

Kutch has nearly 300 wind mills, and those in Dumra, Suthari, Adikhana, Pingleswar, Kotharia, Lala and Lathedi have particularly disrupted the behaviour of birds in the region.

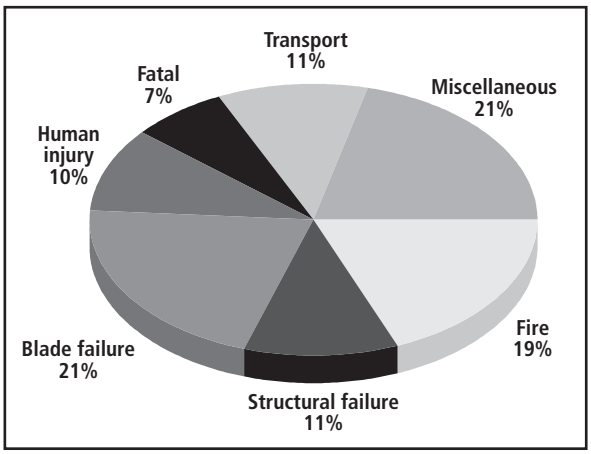
2.7 Risks and accidents

Wind turbine construction and operation may lead to accidents and fatalities. The most common causes for accidents worldwide are structural failure, blade failure, fires and other miscellaneous incidents.

Some are recorded, many are not. According to the data compiled by Caithness Windfarm Information Forum (CWIF) on wind turbine accidents from 2000 to 2012, accidents due to blade failure account for 21 per cent of the total wind accidents and fire incidents account for 19 per cent. Transport and structural failure have also been responsible for many wind turbine accidents (see Figure 2.2: *Types of accidents caused due to wind turbines, 2000-12).*

According to documented data, the US has the highest number of accidents reported followed by the UK, Germany and Denmark. In India, a lot of fatalities and accidents due to wind power projects usually go unreported, but this report has documented some of the incidents that occurred recently (see Box: *Wind turbine accidents in India).*

Figure 2.2: **Types of accidents caused due to wind turbines, 2000-12**



Source: www.caithnesswindfarms.co.uk/fullaccidents.pdf

Wind turbine accidents in India

As per the CWIF data, the total reported accidents in India so far have been:

1. On June 18, 2006, a fire broke out at a 2 MW wind power unit at Chettikulam, Madurai, Tamil Nadu. It was reported as the biggest fire-related wind turbine accident in Asia. The turbine was located only a few kilometres from the Koodankulam nuclear power project site.
2. Another accident happened at the Brahmasagara, Karnataka wind farm during the construction work of the turbine. The rotor assembly fell from the nacelle and crashed to the ground, injuring a worker.
3. A recent accident reported was in Anna Nagar, Panagudi, Tamil Nadu on June 25, 2012 where a six-years old 500 KW turbine was completely destroyed in a fire.

http://www.industrytap.com

Wind fire incidents can be a major operational hazard

3
CHAPTER

Introduction to EIA

3.0 Introduction

According to the United Nations Environment Programme's (UNEP) Division of Technology, Industry and Economics, an Environmental Impact Assessment (EIA) is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims at predicting environmental impacts at an early stage in project planning and design, exploring means and techniques to reduce the adverse impacts, customising projects according to the local environment and presenting options to decision-makers.

An EIA can lead to both environmental and economic benefits for a project, such as reduction in cost and time taken for implementation and design of a project and lesser intervention in terms of legalities and regulations.

A properly conducted EIA decreases conflict by promoting community participation, informing decision-makers, and helping lay the base for environmentally sound projects.

3.1 Generic steps in the EIA process

The EIA process includes six key steps:

i. **Screening**: This first step helps decide whether an EIA is required for a project. An appropriately designed screening system can prove to be an effective tool to prevent the waste of time and money on assessing projects with insignificant environmental impacts.

ii. **Scoping**: Scoping is considered as the backbone of an EIA process, and is ideally undertaken at the project planning stage. The main objective of scoping is to establish environmental and social priorities, set the boundaries for the study and define the Terms of Reference (ToR). Systematic and well planned scoping forms the basis of an effective and efficient EIA process. It also helps avoid unfocused and voluminous reports. Ideally, the role of scoping is to determine three key issues — site alternatives, design alternatives, and the rationale for the project.

iii. **Baseline data generation**: Baseline data provides a detailed description of the existing status of the various environmental and social components of the study area. Both primary and secondary data is collected to describe this status.

iv. **Impact assessment**: In this step, the characteristics of potential impacts are identified, evaluated and predicted using the baseline information on the one hand and the features of the project on the other hand (cause-effect relationship). Impact predictions are often done by using common methodologies and models.

v. **Mitigation of impacts**: At this stage, the possible preventive, remedial and compensatory measures for each adverse impact are determined and recommended.

vi. **Environmental Management Plan (EMP)**: An EMP, also referred to as an impact management plan, is usually prepared as part of the EIA reporting process. It translates recommended mitigation and monitoring measures into specific actions and steps that have to be carried out by the proponent. Depending upon specific requirements, the plan may be included in the EIA report or can be prepared as a separate document (for more details refer Chapter 7: *Environmental Management Plan and best practices for wind power project*).

Answers to questions after scoping

- What are the issues that need to be addressed?
- How should one proceed with the EIA study?
- What is the extent of the analysis needed?
- What kind of infrastructure and expertise is needed?
- What kind of people should be involved in the assessment process?

3.2 Best EIA practices

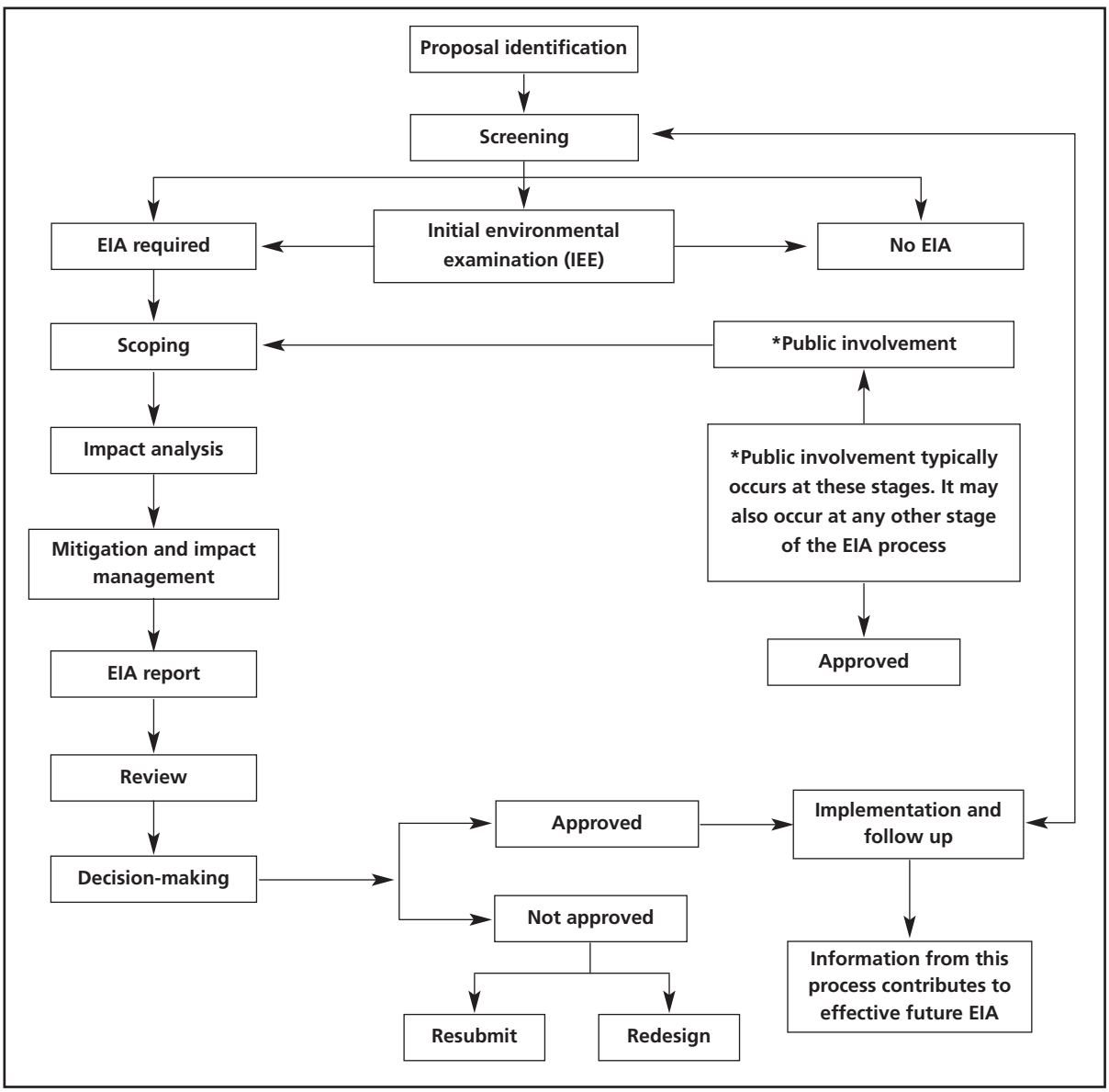
An EIA should not be used just as a tool for obtaining an environmental clearance; rather, the project implementer should see it as a management tool for sound planning of the project. On the other hand, it should be the responsibility of competent authorities to ensure that the project causes minimal environmental impacts and generates maximum social and economic benefits.

The effectiveness of the EIA process depends on many guiding factors which are as follows:

- The extent and nature of legal support it receives
- How the EIA is being conducted
- The stakeholders involvement at different stages
- The quality of the EIA report
- Quality of consultants who prepare the EIA report
- Composition and skills of the review committee

As a good practice, it is always recommended to conduct

Figure 3.1: **Best EIA practices**



Source: http://www.unep.ch/etb/publications/EIAman/SecETopic1.pdf, as viewed on November 21, 2012

an Initial Environmental Examination (IEE) of the project to determine if it requires an EIA or not. It is also advisable to involve the public from the very beginning — from the scoping process to the review of the EIA report (see Figure 3.1: *Best practices in EIA*). It is also recommended to consider the size, scale and site sensitivity while deciding the study area, duration and scope of the EIA study.

Best practices in the EIA process include preparing a report which is comprehensive and focused, and contains only the significant parameters instead of data and information which are irrelevant to the overall assessment of the project. The extent of the assessment required should be decided after careful examination of likely impacts on the environmental and existing socio-economic settings at the project site.

3.3 The environmental clearance process in India

The wind power sector is one of India's fastest growing RE sectors. As wind power projects are not land intensive and have little environmental impacts, the sector is not much regulated from an environmental perspective in India at present. Even in the current regulatory EIA framework, EIA is not applicable for wind power projects (see Box: *Renewable Energy projects exempted from EIA*).

In India, EIA became mandatory for development projects on January 27, 1994 under the Environment (Protection) Act, 1986 (EPA Act). The said act made environmental clearance mandatory for new projects and for expansion or modernisation projects. As per the new notification issued in 2006 by the MoEF, the projects mandating EIA

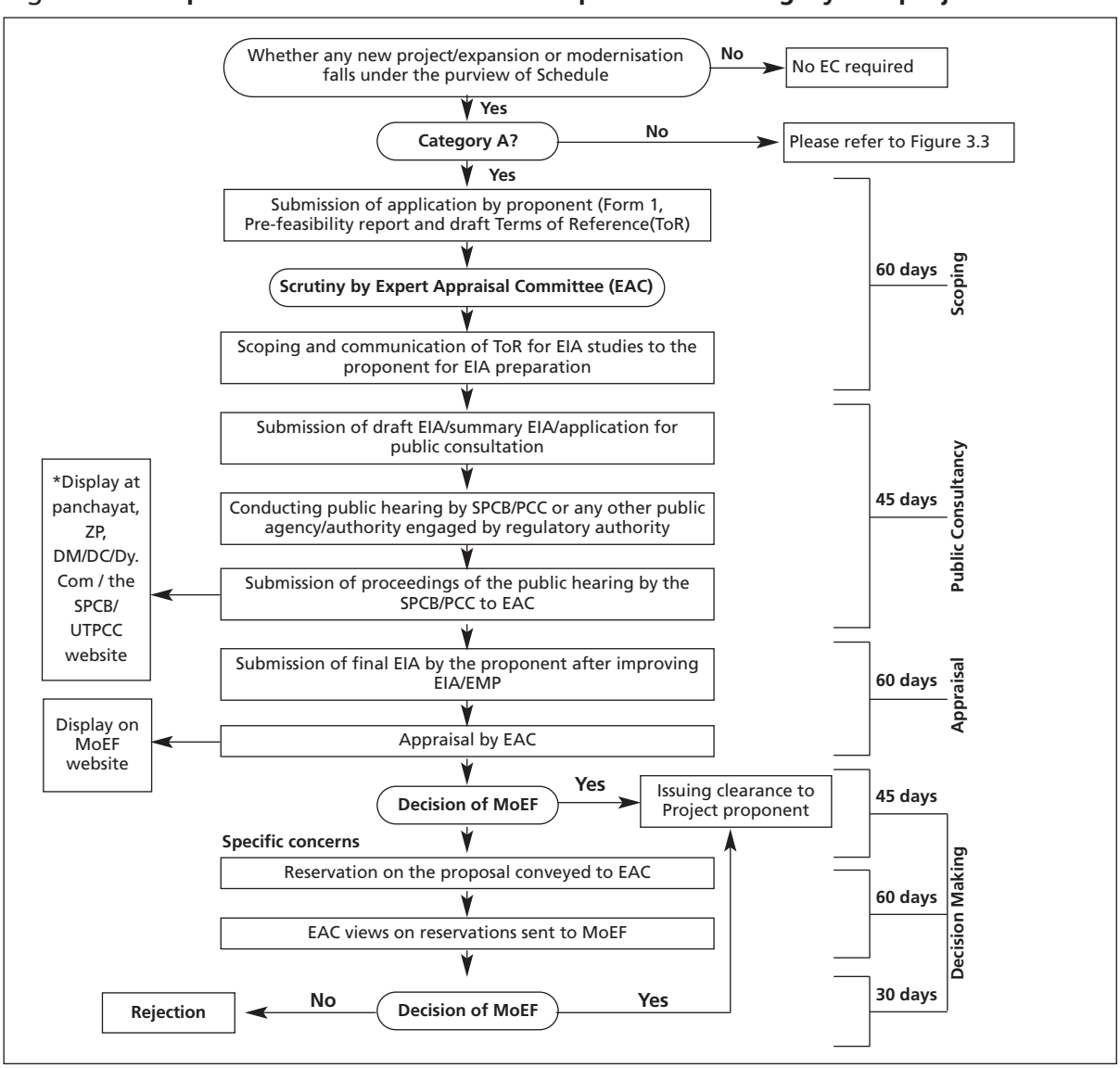
Renewable energy projects exempted from EIA

- Biomass projects up to 15 MW
- Municipal solid waste projects up to 15 MW
- No EIA is required for waste heat recovery for any capacity
- No EIA is required for solar photovoltaic (PV) power plants
- Small hydropower plants of capacity less than 25 MW are exempted.
- No EIA is required for a wind power project

fall into two categories, Category "A" projects which need clearance from the Central government and Category "B" projects which need clearance from the respective State Level Environment Impact Assessment Authority (SEIAA) appointed by the Central government (see Figure 3.2: *Steps of Environmental Clearance process for Category "A" Projects* and Figure 3.3: *Steps of Environmental Clearance process for Category "B" Projects*).

This categorisation is made with respect to the magnitude and sensitivity of the area. Category "B" is further subdivided into "B1" and "B2"; an EIA is applicable only for "B1" projects. Besides categorisation, the EIA procedure comprises of four stages: screening, scoping, public consultation and appraisal.

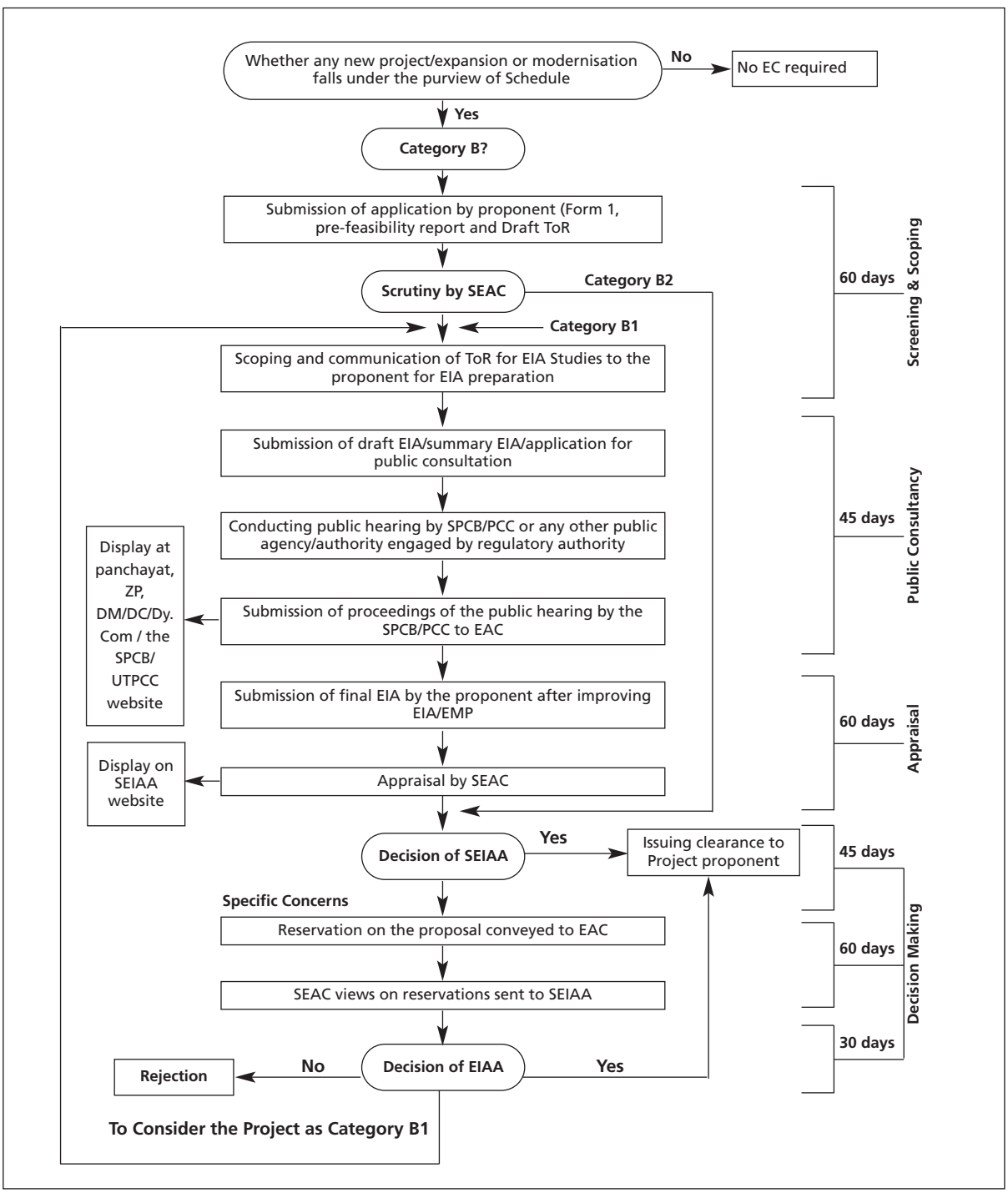
Figure 3.2: **Steps of environmental clearance process for category "A" projects**



Notes: *ZP – Zila Parishad, DM – District Magistrate, DC – District Collector, Dy. Com – Deputy Commissioner, SPCB – State Pollution Control Board, UTPCC – Union Teritory Pollution Control Committee

Source: Technical EIA Guidance Manual for Cement Industry, 2010, http://envfor.nic.in/sites/default/files/TGM_Cement_010910_NK.pdf as viewed on July 20, 2013

Figure 3.3: **Steps of environmental clearance process for category "B" projects**



Notes: *ZP – Zila Parishad, DM – District Magistrate, DC – District Collector, Dy. Com – Deputy Commissioner, SPCB – State Pollution Control Board, UTPCC – Union Teritory Pollution Control Committee

Source: Technical EIA Guidance Manual for Cement Industry, 2010, http://envfor.nic.in/sites/default/files/TGM_Cement_010910_NK.pdf as viewed on July 20, 2013

3.4 Need for EIA

As per the EIA notification of 2006[1], EIA is not mandatory for a wind power project irrespective of the size of the wind farm, its installed capacity, number of turbines or the sensitivity of the project location. However, in other countries, EIA is a pre-requisite for setting up of a wind power project (see Chapter 4, Table 4.1: *EIA requirement for wind power projects in different countries*). Many wind power projects in India currently do EIA because they are funded by an international development finance institution like the Asian

Development Bank (ADB) or The World Bank. For example, the 50.4 MW wind farm of Tata Power in Dhule, Maharashtra got an EIA/EMP report done because the project was funded by ADB.[2]

The fact is, the additional cost of conducting an EIA study is minimal when compared with the total capital cost of the project. As assessed by the Central Electricity Regulatory Commission (CERC) in its "Terms and Conditions for Tariff Determination from Renewable Energy Sources Regulations, 2012," the total capital cost of wind project is Rs 5.75 crore per MW.[3] The cost of conducting an EIA study would be less than 1.0 per cent of the project cost.

If just the official estimate on wind power potential is taken into account — 1,02,788 MW at an 80 m height[4] — India has merely exploited 17 per cent of its potential. There is, thus, significant scope for exploitation of wind power potential; this, however, may result in targeting of more forestland, farmland and ecologically sensitive areas for setting up of new wind farms.

To restrict large scale environmental damage, there is an urgent need to consider EIA in the current regulatory framework, in which all potential impacts of a wind power project can be addressed early on in the project planning stage by conducting an EIA study and implementing an appropriate mitigation measures.

3.5 Scope of the EIA guidelines

The guidelines are specific to wind power projects, and are aimed at improving the efficacy of the EIA process in India. These guidelines can be used by project developers for environmental management even if there is no formal EIA in place. The scope of these guidelines is as follows:

- Assist the regulatory agency and EIA practitioners in understanding the main areas of concern and employ that understanding to enhance the quality of the EIA study and report.
- Inform the regulatory agency and EIA practitioners about the best environmental management practices related to the wind power project.
- Assist the authorities to assess the EIA report in an efficient manner and arrive at a sound judgment.

The guidelines are not fixed, and might need to be updated and altered based on periodic reviews. Hence, feedback or suggestions from users for improvement of the guidelines are welcome and should be directed to the Centre for Science and Environment (*see CSE Website: www.cseindia.org*).

CHAPTER 4

Policy, guidelines and legal provisions for the wind power sector

4.0 Comparison of the EIA process in different countries

The wind power projects in most countries require an EIA or an Initial Environment Examination (IEE) study before they receive environmental clearance (see Table 4.1: *EIA requirement for wind power projects in different countries*). It is important to highlight that although India has elaborate EIA procedures for other power sectors, wind power sector does not feature in the list.

In Europe, EU Directives particularly Directive *85/337/EEC* (EIA Directive) and Directive *2001/42/EC* (Strategic Environmental Assessment Directive, SEA) stipulate undertaking EIA/SEA of any plans, programmes and projects which may cause a significant impact on the environment.

The installations for the harnessing of wind power for energy production like wind farms are listed in Annexure II of the EU EIA Directive, hence EIA is obligatory for the wind power sector.

Table 4.1: **EIA requirement for wind power projects in different countries**

Countries	Impact Assessment requirements and threshold value
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.[1] In addition to EA/EIS, the construction of wind turbines also requires to comply with other federal, state and local laws; policies and guidelines; and seek other permits, wherever applicable.[2] EIA is required for all power plants with capacities over 50,000 kW *1
China	Threshold limit is 50,000 kW[3] and over *1
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, EIA is more likely to be required for commercial establishments — with five or more turbines or a generation capacity of more than 5 MW.[4]
Denmark	EIA is required if the height of a turbine is greater than 80 m or the number of turbines is more than three. *2
Ireland	EIA is mandatory for wind farms if there are more than five turbines, or if the total generation output is greater than 5 MW[5]. In these conditions, an EIS must be submitted with relevant planning.Furthermore, if the 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.
Netherlands	An EIA is required if the total capacity is equal to or above 10 MW or if the number of turbines is 10 or more.
Spain	The threshold limit is 50 turbines and/or more except for Ramsar Convention wetland areas where the limit is 10 turbines and/or more. *2
Germany	In Germany, the mandatory threshold limit is 35 m height or 10 MW and with 20 turbines or more.[6]
France	A tower height over 50 m. *1, 3
India	No EIA is required for a wind power project irrespective of size and location. An EIA is not mandatory even if forest land is being diverted for setting-up a wind farm; only guidelines as issued by MoEF need to be followed.
Sri Lanka	EIA required for all RE electricity generating stations with a capacity exceeding 50 MW.[7]

Notes: *1 Facilities smaller than the thresholds of EIA requirement undergo simplified EIAs

*2 Facilities smaller than the thresholds of EIA requirement undergo screening

*3 For a rated plant output of 2,000 kW, the tower height is approx. 60-80 m, and the overall height is approx. 90-120 m

The Directive also states:

"Member States may set thresholds or criteria for the purpose of determining which such projects should be subject to assessment on the basis of the significance of their environmental effects".[1]

The Directive also empowers the Member States to determine the requirement of EIA for the projects listed in Annexure II. The Member States determine requirement of assessment based on a case-by-case examination and thresholds or criteria set by the Member State. It implies that for a wind power project, the national authority can employ screening criteria to determine the requirement of EIA.

In the EU, the conservation and protection of biodiversity is given high priority even while setting-up a wind power project.[2]

Some of the key Directives which regulate the on-shore wind power sector in EU are:

- "Habitats" and "Birds" Directives whose objectives are to protect and ensure survival of endangered and vulnerable species
- Creation of Natura 2000 network.

The Natura 2000 network is significant from the biodiversity perspective. At present, under this network nearly 26,000 sites have been included and it covers 18 per cent of the total EU land area. If any wind farm is proposed in and around Natura 2000 protected sites, then it is required to undergo detailed assessment. Also, appropriate safeguards for the protection of species and habitat need to be applied.

The Noise Directive (2002/49/EC)[3] stipulates conditions for the assessment and management of environmental noise. The noise generated from wind turbines is the main barrier for wind development projects in EU. As such, there is no specific EU regulation on noise generated by wind turbines. However, Member States set their own limits for regulating noise generated from wind turbines, which need to be met prior to the clearance of the wind farm project (for more details refer Chapter 10: *Global best practices*).

4.1 Applicable Act, Rules and Guidelines for wind power projects in India

4.1.1 Forest clearance

In case of wind power projects, the role of MoEF is very limited. The ministry exercises its power only when diversion of forestland is involved under the Forest (Conservation) Act, 1980, regardless whether the project is included under EIA notification or not.[4]

As per Rule 6 of the Forest (Conservation) Rules, 2003, any project, which requires use of a forest land for non-forest purposes needs to create a proposal in the appropriate Form (appended to the rules). Form 'A' pertains to proposals seeking first time approval under the Act and Form 'B' is for proposals seeking renewal of leases where approval of the Central Government under the Act has already been obtained.

The process for forest clearance includes an application by the project proponent 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 are then sent back through the forest department to the Principal Secretary of Forests. Depending upon the forest land required to be diverted for the project, the proposal can either be approved by Regional Office of MoEF or by Secretary, either at a regional or the central level (see Table 4.2: *Forest clearance procedure*).

In case of projects requiring 5-40 hectares, a State Advisory Group provides its recommendation to the regional office of MoEF, while for projects requiring above 40 hectares, a Forest Advisory Committee at the central

Table 4.2: **Forest clearance procedure**

	Advising/ Recommending body	Route	Final clearance authority
< 1 hectare	–	–	State government (Principal Secretary of Forests)
1–5 hectare	State forest department	State government to regional office of MoEF	Regional office MoEF
5–40 hectare	State Advisory Group	State government to regional office of the MoEF; then to the MoEF with State Advisory Group recommendations	MoEF
> 40 hectare	Forest Advisory Committee	State government to MoEF	MoEF

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

Compensatory Afforestation Fund Management and Planning Authority (CAMPA)

In May 2002, following the rising alarm in India over forest cover decline, the Supreme Court (SC) issued a Directive to formulate a scheme for compensatory afforestation and the MoEF set up a Central Empowered Committee (CEC).

The committee submitted its recommendations in 2002, elaborating on the procedure for the use of funds for compensatory afforestation, activities permissible under compensatory afforestation and compensation for loss of forestland through recovery of net present value (NPV).

The major recommendation of the CEC was that a firm involved in diverting forest for non-forestry purposes, should pay the NPV for the area diverted. The committee was convinced that planting saplings under the Compensatory Afforestation Scheme (CAS) could never adequately compensate for the loss of virgin forests, as they require a lot of time to mature and even then, are no substitute to virgin forests. Depending on the quality of forest, NPV value ranges from 6.9-10.43 lakhs per hectare. It was ordered by the Supreme Court that the amount recovered as NPV would be revised every 5 years keeping in mind inflationary pressures. Further, if the forest land sought to be diverted is situated within a national park then 10 times NPV is payable and in case of a sanctuary it is 5 times the NPV.

According to a ruling by the SC of India in 2008, wind power projects have been granted 50 per cent exemption on NPV, at a minimum rate, provided there is minimal felling of trees. The NPV and compensatory afforestation funds for both wind power projects and transmission lines are to be paid by the user agency to the Government as per the norms.

level gives its recommendations to the central office of MoEF.[5]

The act also requires the developers to pay for purchase of an equivalent area of non-forest land as near as possible to the site of diversion, or twice the degraded forest area, for transfer to the state forest department with sufficient funds for compensatory afforestation, which is then declared as reserved forest. Also, the developer should pay the Net Present Value (NPV) for the land diverted which should be in addition to the funds for compensatory afforestation (see Box: *Compensatory Afforestation Fund Management and Planning Authority (CAMPA)*.

Also, the wind power project would be subject to the provisions of the Scheduled Tribes and other Forest Dwellers (Recognition of Forest Rights) Act, 2006 if the project is over "forest land" where "forest rights" of scheduled tribe forest dwellers or "other traditional forest dwellers" exist (see Box: *Key provisions of Tribal Right on Forest land*)**.**

If a wind farm is being established on land which is part of protected areas (national park and/or sanctuary) then clearance from National Board for Wildlife (NBWL) is required in addition to getting clearance from Supreme Court (SC).[6]

Further, the forest guidelines also specify certain criteria for the setting-up of a development project, which states that no projects should be in the vicinity of the following:

- National Parks, Wildlife Sanctuaries and Core areas of the Biosphere Reserves.
- Scenic landscapes, areas of geo-morphological significance, unique and representative biomes and eco-systems, heritage sites/structures and areas of cultural heritage and importance.

Key provisions of Tribal Rights to Forest land

Scheduled Tribes and Other Forest Dwellers (Recognition Of Forest Rights) Act, 2006 recognises and vests with "forest rights" in the forest dwelling Scheduled Tribes and "other traditional forest dweller" who depend upon "forest land" for their livelihood. The act defines "other traditional forest dweller" as members of community who dwell or are dependent on forest for their occupation and livelihood since three generations prior to December 13, 2005 or 75 years prior (since 1930). The act recognises both individual and community forest rights. The forest rights committee formed by the Gram Sabha of the village is empowered to accept claims for grant of forest rights. Procedures in Forest Conservation Act, 1980 does not apply to for carrying out certain prescribed developmental works of the government if forest land being used for the purpose does not involve felling of trees exceeding 75 trees per hectare and forest land is not more than one hectare and the use is approved by the Gram Sabha. The Forest Right act beneficiaries as per law cannot be evicted or removed from forest land in which they occupy until the recognition and verification procedure is complete. Any person aggrieved by the resolution passed is also given an opportunity to petition their grievance to the higher authorities.

- Fragile eco-systems such as mountains; areas rich in coral formations as well as marine, coastal, desert, wetland, riverine and island eco-systems. Areas rich in biological diversity, gene pool and other natural resources.

Till date, the only guidelines issued by the MoEF for wind

power projects is *Guidelines for diversion of forestland for non-forest purposes under the Forest (Conservation) Act, 1980* (see Annexure 1: *Key provisions for diversion of forestland for non-forest purposes under the Forest (Conservation) Act, 1980*). Further, these guidelines are applicable only in the case of forestland diversion. Besides forests and wildlife, they cover few environmental aspects. If forestland is not involved then the guidelines issued by MoEF are hardly consulted. These guidelines mainly discuss prohibited zones, afforestation, collection of money, etc.

4.1.2 Eco-sensitive zones

In 2002, the MoEF decreed that an area of 10 km around national parks and sanctuaries should be assigned as an eco-sensitive zone, with restrictions on development. This was later changed to let the states decide the range of the zone and pass 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 as a default and any project including wind power projects that fall inside the zone have to seek approval from the National Board for Wildlife (NBWL). The NBWL may conduct a study if it believes the project may have large-scale impacts.[7]

This guideline has been violated in at least one case — that of the wind power project in Bhimashankar in the Western Ghats. The reason for such a violation could be that these guidelines actively promote RE projects and there are no previous records where a study has been mandated for a wind power project[8] .

4.1.3 Coastal Regulation Zone

India has not yet begun exploiting the wind resources available 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. Transmission also becomes more complicated, with a need for underwater cables. Maintenance crews need to be shipped or flown by helicopter to the turbines at every breakage.

Preliminary assessments have shown that the coasts of Gujarat, Tamil Nadu and Maharashtra may be ideal for wind power projects. A steering committee was set up in the MNRE in March 2013 to look at India's potential in offshore wind power.

The CRZ Notification[9] in effect since 2011, limits industrial and developmental projects along 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

Table 4.3: **Status of regulation under various acts and rules with respect to used oil**

Name of State Board	Installed capacity (as on 31.03.2012)*	Used oil regulated or not regulated**
Madhya Pradesh Pollution Control Board	376.40 MW	Regulated
Rajasthan Pollution Control Board	2070.70 MW	Not regulated
Andhra Pradesh Pollution Control Board	245.50 MW	Not regulated
Maharashtra Pollution Control Board	2733.30 MW	Regulated
Tamil Nadu Pollution Control Board	6987.60 MW	Regulated
Karnataka Pollution Control Board	1933.50 MW	Regulated
Kerala Pollution Control Board	35.1 MW	Not regulated
Gujarat Pollution Control Board	2966.30 MW	Not regulated

Note: * http://mnre.gov.in/file-manager/UserFiles/wp_installed.htm;
** Information collected from different boards through phone

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 RE project in the CRZ an impact assessment study is mandatory.

4.1.4 Role of State Pollution Control Board in wind power projects

There are provisions to regulate wind power project under Air (Prevention and Control) Act, Water (Prevention and Control) Act and Hazardous wastes (Management, Handling and Transboundary Movement) Rules, 2008. The status of regulation of these Act and Rules with respect to pollution control and/or environment protection in India has been summarised in Table 4.3: *Status of regulation under various acts and rules with respect to pollution control*. Closes examination of this table reveals that regulations with respect to wind power projects are not in practice.

However, it is mandatory to obtain Consent to Establish (CTE) and Consent to Operate (CTO) and authorisation from the concerned SPCB (see Table 4.4: *Applicable approval required for wind power project from SPCB*).

4.1.5 Wildlife Board's guidelines on linear intrusion

The 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 section 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 powerlines in natural areas. 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. According to the guidelines, roads should be no wider than 12.5 m for primary roads and 8.5 m 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 4.5: *Major elements of the guidelines for linear intrusion into natural areas*).

Table 4.4: **Applicable approval required for wind power project from SPCB**

Question	Answer
What type of wind power projects are required to apply for CTE?	If it involves activities such as quarry operation and/or crusher or both, hot mix plant for construction of access road or any other project related activities or discharge of sewage on land and waterbodies.
Whether the CTE is required under the provisions of Water Act & Air Act?	Required to obtain CTE under section 21(1) of the Air (prevention and control of pollution) Act, 1981. Also, CTE under section 25/26 of the Water Act is required in case of discharge of sewage or trade effluent in a stream or a well or a sewer or a lake.
Whether wind power development activity is required to apply for CTO?	Yes, prior to commercial generation, it is obligatory to apply for CTO under section 21 of the Air (P & CP) Act 1981, with respect to ambient air quality related to noise.
Whether a wind power project is required to apply for Hazardous Waste Authorisation?	Yes, wind power projects use different types of fluids for the smooth operation of the WTG. Primarily, three main types of fluid are used: (a) Generator cooling fluid is used as coolant (a mixture of glycol and water, similar to what is used in automobile radiators) (b) Lubricating oil is used in the gearbox (synthetic oil) (c) Hydraulic oil for operating the blade pitch system, yaw mechanism and rakes . To protect transformer from heating, mineral oil (transformer oil) is used as coolant. According to Section 3 (ze) of the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008: **"Used oil"** *means any oil derived from crude oil or mixture containing synthetic oil including used engine oil, gear oil , hydraulic oil, turbine oil, compressor oil, industrial gear oil, heat transfer oil, transformer oil, spent oil and their tank bottom sludge.* It clearly indicates that the used lubricating oil, hydraulic oil and transformer oil falls in hazardous waste category as per Section 3 (ze), Therefore, as per the said Rule, each and every wind power project operator has to take authorisation from the concerned SPCB under Section 5 (1) of the said Rule. The irony is that many SPCBs do not regulate wind power projects or grant authorisation.
Whether wind power projects are required to file Cess returns?	Yes, if they use more than 10 KLD of water including domestic water supplies. In such a case, the wind power project required to file Water Cess returns.
Inspection and monitoring	Under Section 24 of the Air (P & CP) Act 1981, the right to enter for the purpose of determining whether provisions of this Act or the rules made there under or any notice, order, direction or authorisation served, made, given or granted under this Act are being or have been complied with. Empowered to check record, register, document or any other material or for conducting a search of any place in which the SPCB official has reason to believe that there has been an offence under the said Act or the rules.

Source: Centre for Science and Environment, 2013

Table 4.5: **Major elements of the guidelines for linear intrusion into natural areas**

EIA and Social 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 the area/landscape
Workers	Provide housing outside natural area and transportation to and fro
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.)
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 of 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 and not felled.
Removal and restoration of unused roads and defunct power lines	MoEF 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 amphibians, 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 m above ground on level terrain and a minimum of 9.1 m above ground on steeper terrain
Avoiding bird deaths from powerlines	Maintaining 1.5 m spacing between energized components, cover and insulate energised 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 m in general in all natural areas (except tourism areas) and 0 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 a vegetated buffer zone of width not less than 10 m in level terrain and 30 m in steep terrain along streams and other water bodies with native species as appropriate to the specific natural vegetation type to prevent soil erosion or drift of debris and pollution into the waterbody.
Avoid 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 m width incorporated at regular intervals (every 8 m) and in the case of retention walls/side walls have a height not exceeding 45 cm. Fences should not be installed as a matter of policy, unless specifically evaluated and advised. The fence height, placement, should be done after field assessment by a competent wildlife scientist.
	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.
Reduce width of road	For existing roads reduce and maintain width of primary roads to less than 7.5 m (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

5
CHAPTER

Scoping

5.0 Introduction

The primary function of scoping, also referred to as setting the Terms of Reference (ToR) for an EIA, is to establish the environmental and social priorities and to set the boundaries for the study. The objective of the ToR is to keep the assessment process brief and focused, and to avoid creating a voluminous or a data-deficient report. The ToR provides the benchmark for data collection and limit the possibility of inefficiency in the EIA process. It also helps the competent authority to decide whether the EIA report has been compiled after meeting all the requirements or not.

There are various tools that can be used for scoping, such as questionnaire checklists, network method, comparison with other similar projects, matrix and ad-hoc methods. The selection of scoping tools largely depends on the size of the project and the existing environmental and social settings of the project area.

The ToR given below is a generic one and can be framed as per the project requirements. While framing the ToR, ground realities, background information of the study area (such as population in and around the project site), project-specific peculiarities, applicable laws, rules, guidelines and policies need to be taken into account to make the ToR relevant and precise.

As the given ToR is a generic one, it is applicable to most of the on-shore wind power projects, there is also a possibility that some of them are not applicable to a specific project. A site visit is also recommended before framing the ToR; this enhances the scope of the EIA process and makes it more efficient.

5.1 Generic ToR for on-shore wind power projects

The ToR should include the following conditions, details and components:

5.1.1 General information

- Executive summary of the project in English and the local/vernacular language, which summarises the project characteristics, environmental and social issues, and the proposed mitigation measures.
- Information about the project proponent and his/her experience in the wind energy sector with the following details (a) Name of the project (b) Name of the applicant (c) Present mailing address including telephone number, fax, and email (if any) (d) Name of the authorised contact person and his/her contact number.
- Site justification with clear description for choosing the site.
- Project financial statement including names of funders, project benefits and the project activity schedule in detail.
- Name of organisation/consultant preparing the EIA report, qualifications and experience of experts involved in the EIA assessment and report preparation.
- List of all regulatory approvals and No Objection Certificates (NOC) required for the project, wherever applicable and the status of these approvals.
- A self declaration certificate from the consultant stating that the information disclosed in the EIA report is correct.

5.1.2 Essential maps

- A map specifying the location coordinates of the project.
- A map specifying the land use patterns of the project site and study area.
- A map marking the sensitive zones in the study area, such as national parks and sanctuaries, forests, defence installations, international border, protected areas, and airports (if applicable).
- A study area map indicating features such as locations of human settlements, locations of other wind farm and its distances, other neighbourhood industries with details, if any.
- A contour map of the project site and the study area.
- A map indicating number of villages getting affected due to land acquisition, if applicable.
- Schematic layout of the wind park showing the position of wind turbine including spacing between the row and perpendicular distance between two turbines.
- A layout map showing access road, internal access roads, underground cable, substation and switchyard and additional structures including all utilities.
- A map indicating the flood ability or high tide and low tide, if applicable in case project is coming in along river or in coastal belt.
- A map clearly delineating the locations of various monitoring stations (ambient air and noise).

Note: *Depending upon the type, size and location sensitivity, a competent authority can decide the study area and recommend an appropriate scale for EIA*

5.1.3 Description of the project area

a. Information on existing land use pattern of the study area:

- Describe the total land required for the wind power project including land use pattern of acquired land and the study area.
- Identification of areas vulnerable to erosion or areas prone to landslides.
- If forest land or agricultural lands are likely to be diverted, then provide the information listed in Table 5.1. If grazing land is used for setting up a wind farm, information on the cattle pressure on the land needs to be provided. The report should also discuss the provision for grazing during the operational stage.
- If land acquisition is involved, the report should give the extent of land to be acquired for the project along with name of affected people village-wise with following information:

a. Village-wise list of the affected persons
b. The extent and nature of land and immovable property to be acquired including list of common and government properties which are affected or likely to be affected
c. A list of persons likely to lose their employment or livelihood or likely to be alienated wholly or substantially from their main sources of trade, business or occupation due to land acquisition, if applicable.

- Seismic characteristic of project area. If the site is falling in seismic zone, as per the seismic zoning map of India, the design foundation of wind turbine generators must consider the seismic factor.

b. Information on sensitive areas at project site and in the study area, if any:

- Distance of the project from key installations such as airports, defence installations, highways, wetlands, national parks and sanctuaries, ecologically-sensitive biological corridors, archaeological sites, critical watershed areas or any other important installations.
- Discuss if the project site or study area supports any unique habitats or any endemic, threatened or declining species or species of high economic and/ or ecological value.
- List of flora and fauna in the project area, duly authenticated by a government approved organisation or by an independent body such as a university. The findings should be annexed with the report.
- Discuss the prey/predator density at the proposed site and in the surrounding study area.
- Presence of nesting, breeding, foraging site for resident and transient bird species or bat or locations favoured by migratory birds either in project area or in immediate neighbourhood, if any.
- If the site preparation requires cutting trees, then provide the following information:

a. How many trees are proposed to be cut down.
b. Plant species and age of trees.
c. Are they protected/endangered/endemic species? If yes, provide details

For more details information refer *Annexure 2: Biodiversity assessment.*

5.1.4 Technical details

- Total installed capacity of the wind farm in MW[1]
- Total number of wind turbine generators (WTG)
- Unit capacity of each WTG
- WTG rotor diameter (in metres)
- Hub height (in metres)
- Number of blades per WTG
- Total power generation capacity
- Cut-in wind velocity (m/sec)
- Cut-out wind velocity (m/sec)
- Rated wind velocity
- Safety wind velocity
- WTG rotor speed
- Average plant load factor (per cent)[2]
- Average wind velocity at 50 or 80 m hub height
- Wind energy density (w/m^2)
- Describe the foundation details with a clear description on size, depth of foundation, quantity of earth to be extracted and mode of disposal.
- Describe how the power cable will be laid down including clear description on electrical safety hazards.
- Of total required area, specify:

a. Area for permanent uses
b. Area for temporary uses

Table 5.1: **Information required if forest or agricultural land is being diverted**

Agricultural land	Total area (ha)	Types of crops grown in a year	Number of crops grown in a year	Crop productivity (Rs./ha)
Forest land	Total area required (ha)	Type of forest	Actual area to be diverted (ha)	Types of activities on diverted forest land

5.1.5 Resource requirements

- Details of workforce to be employed — skilled, semi-skilled and unskilled labour both during construction and operational phases of the project with specific attention to employment potential of local population.
- Provide a schedule for each phase of construction and operation for the entire project and ancillary facilities. Include the environmental issues associated with each ancillary activity, wherever possible:

a. Mobilisation
b. Land clearing
c. Blasting, if applicable.
d. Borrow and spoil disposal
e. Excavation and sub-grade preparation
f. Foundation preparation
g. Concrete work
h. Construction and installation of each project facility,
i. Stabilisation of disturbed areas[3]

- Construction camps (if applicable)

a. Location of the camp
b. Water supply and distribution
c. Waste generation, handling and disposal
d. Fuel supply

- If applicable, provide detailed descriptions of batch plants, hot mix and rock crushers; their capacity, fuel requirement and storage including the environmental measures for pollution abatement and control.
- Describe the expected quantity of raw materials to be used during construction of the tower, roads, buildings and substation (see Table 5.2: *Raw material requirement)*.
- If the project requires quarries for supply of construction materials, then, describe the number of quarries to be opened, their capacity, the location of the quarries and sensitivity of surroundings, including the restoration and reclamation plan of the quarry site.
- Describe the types of equipment required for the proposed wind farm during construction stage (as mentioned in Table 5.3: *Equipment type and anticipated quantity)*.
- Water balance, detailing the sourcing and water usage during construction and operation stage.
- An estimate of permanent and temporaroy disturbance area (see Table 5.4: *Estimated permanent and temporary disturbance area)*.

5.2 Baseline data generation

- Data on surface water characteristics including inventory of the natural drains, streams, springs, water crossings and other water bodies, and their distances from the project.

Table 5.2: **Raw material requirement**

List of construction materials	Quantity (tonnes /month)		Source of material	Mode of transportation and storage site
	Peak	Average		
Cement				
Stone				
Steel				
Sand				
Bitumen				
Fuel				
Others (Please specify)				

Table 5.3: **Equipment type and anticipated quantity**

Construction Equipment	Equipment Type	Equipment Number

Table 5.4: **Estimated permanent and temporary disturbance area**

Temporary facilities	**Unit area**	**Number of units**	**Total area (acres)**
Roads			
Materials storage areas			
Area needed for layout of wind turbines			
Access for overhead gen-tie line			
Underground cable collector			
Others (specify)			
Permanent Facilities	**Unit Area (acres)**	**Number of Units**	**Total Area (acres)**
Wind turbine pads			
Area for substations and switchyards			
Meteorological tower			
Access roads and internal access roads			
Operation and maintenance facility area			
Others (specify)			

Source: Draft Environmental Impact Statement, Hermosa West Wind Energy Project, 2012, http://yosemite.epa.gov/oeca/webeis.nsf/(EISDocs)/20120314/$file/Hermosa%20West%20Wind%20Energy%20Project%20DEIS%20Vol%20I.pdf?OpenElement as viewed on October 15, 2012

- List of potential activities which can cause siltation of water resources.
- Detailed information on catchment area characteristics of the study area, such as terrain characteristics and existing natural drainage/run-off patterns.
- Describe the quantity and quality of top soil to be generated during the construction of access roads, internal roads, towers, substations and other areas, including its utilisation and conservation.
- If there will be any change in the drainage pattern after the proposed activity, details of changes need to be furnished including the identification of areas vulnerable to erosion
- Baseline data on ambient air quality should include parameters such as Particulate Matter$_{10}$ (PM_{10}) and $PM_{2.5}$, and information on existing meteorological conditions such as temperature, humidity, rainfall, wind speed and direction, wherever applicable.
- Details about the potential sources of fugitive emissions and list of activities that may generate fugitive dust.
- Details of the quantity and characteristic of solid/hazardous waste likely to be generated including from the utilities, if applicable.
- Details about the potential sources of noise generating equipment and activities that may cause noise pollution. For instance, in Ireland to obtain an accurate noise data, it is recommended to monitor continuous noise for two weeks when wind blows at a speed 3-12 m/sec.

5.3 Impact assessment

- Impact due to land acquisition, *if applicable*.
- Impact of a project on birds, bats and local biodiversity of the area.
- Impact due to modification, diversion and civil works on existing natural drainage or water courses flowing through the project area such as rivers, streams, springs and drains, if applicable.
- Impact of project and allied activities such as construction of access roads, erection of towers, construction of sub-station,crushing, transportation, etc. on ambient air quality including workers and nearest human settlements.
- Impact of movement of heavy vehicles on local infrastructure.
- Impact of noise and flickering on the nearest human settlement, *if applicable*.
- Impact on local landscape and scenic beauty of an area.
- Impact of a project on the hilly terrain due to slope destabilisation caused due to site preparation, civil works, construction of access roads and other activities, *if applicable.*
- Socio-economic impacts of a project.
- Impact of a project on radio communication, radar and navigation.
- Risks and hazards associated with WTG, sub-station and other allied activities including potential occupational health and safety issues that may arise out of:

(a) live power lines causing electrical hazards (b) working at a height (c) Fire/explosions from transformers (d) exposure to chemicals (transformer oil) (e) structure or blade failure.

5.4 Mitigation and Environmental Management Plan (EMP)

The EMP should discuss the mitigation measures to be taken against each impact**,** the timeline for completion, departments responsible for implementation, allocated budget for the EMP, post-monitoring provisions and reporting to the concerned regulatory authority.

- Preparation of a Resettlement and Rehabilitation plan (R&R) if displacement is involved. The plan should include details of the compensation provided, including land-for-land compensation, employment or money, provisions at the resettlement colony — basic amenities including housing, educational facilities, infrastructure and alternate livelihood potential; a clear timeline for implementation; responsibility; budgets; and grievance mechanisms.
- Detailed plan to avoid birds and bats strikes including detailed biodiversity conservation plan if endemic/threatened/endangered/vulnerable species are present in the project site or surrounding areas (see Box: *Definitions by International Union for Conservation of Nature*).
- Detailed plan to reduce landslides and ensure slope stabilisation during construction of access road and tower on a hilly terrain, *wherever applicable*.
- Prepare a detailed EMP for fugitive emission control during land-clearing, civil works, handling/transporting of construction material, construction of access roads, quarry operations, hot mix and batch plants, *if applicable*.
- Mitigation measures for erosion control and run-off from the area where construction is to take place, especially if there is a water body or agricultural land adjoining to the project site.
- Detailed management plan to reduce the impact on natural landscape.
- Mitigation measures for noise abatement and control, including nuisance due to flickering, *wherever applicable*.
- Plan for topsoil utilisation and conservation
- Mitigation plan to reduce, avoid or minimise spills and leaks from transformers, substations, etc.
- Plan for reclamation of debris and spoil, *if applicable.*
- Mitigation plan for quarry related activities including its restoration, *if applicable.*
- Management plan to avoid or minimise collision and electrocution of raptors, other large birds and wild animals.
- Mitigation plan to avoid or minimise electromagnetic interference, *if applicable.*
- Mitigation measures against extreme weather events and natural catastrophes such as landslides, earthquakes and avalanches, *wherever applicable.*
- Afforestation plan.
- A detailed plan for beneficial utilisation of non-utilised land.
- A management plan for occupational health and safety of the workers and local community, *wherever applicable*.
- A detailed mitigation plan and EMP for improving and enhancing socio-economic condition of people displaced, *wherever applicable.*

Definitions by International Union for Conservation of Nature

a. Endemic – Native to, and restricted to, a particular geographical region. Highly endemic species, those with very restricted natural ranges, are especially vulnerable to extinction if their natural habitat is eliminated or significantly disturbed.
b. Threatened – A threatened species is a native species that is at risk of becoming endangered in the near future.
c. Endangered – When used in the context of the IUCN Red List, a taxon is classified as 'Endangered' when there is very high risk of extinction in the wild in the immediate future (IUCN, 2001).
d. Vulnerable – When used in the context of the IUCN Red List, a taxon is classified as 'Vulnerable' when facing a high risk of extinction in the wild in the immediate future (IUCN, 2001).

CHAPTER 6

Prediction, evaluation and assessment of impacts

6.0 Introduction

The scientific and technical accuracy of an EIA study depends on the skills of the EIA practitioners or reviewers, who estimate and review the nature, magnitude and significance of the environmental impacts that the proposed project may entail.

Impacts assessment is a vital exercise for deciding alternatives, planning mitigation measures and developing an EMP. Predicting the magnitude of impacts and evaluating their significance is a cornerstone of the assessment process.

This process is also known as impacts analysis and can be broadly broken down into three overlapping phases:

- *Identification*: To specify the impacts associated with each phase of the project and the activities undertaken
- *Prediction:* To forecast the nature, magnitude, extent and duration of the main impacts
- *Evaluation:* To determine the significance of residual impacts after taking into account how mitigation will reduce a predicted impact

Normally, in an impact assessment, potential impacts can be categorised into various parameters ranging from its type and nature to magnitude and reversibility, each signifying its importance in impact prediction and decision making (see Table 6.1: *Parameters which determine impact characteristics*)

6.1 Impacts identification

The potential impacts of a wind power project are not as severe as other development projects. Only 1-3 per cent of the land is utilised during such projects hence the scope of impacts is very limited. For more details on the type of impacts refer Chapter 2: *Environmental and socio-economic impacts of wind power projects.*

To ensure effective impact identification, the practitioner/reviewer should always opt for a simple, logical and systematic approach. As a good practice in EIA, it is always recommended to consider all potential impacts and their interactions. At the same time, it is important to ensure that indirect and cumulative effects which may be potentially significant are not unintentionally omitted, for instance the impact of the placement of two wind farms close to each other.

All the identified impacts may not require a detailed analysis and evaluation — the level of detailing should match the scale, sensitivity and complexity of impacts. The choice of the chosen methodologies should reflect these criteria.

Table 6.1: **Parameters which determine impact characteristics**

Parameters	Description
Type	Positive or negative
Nature	Direct, indirect or cumulative
Magnitude or severity	Low, moderate or high
Timing	Short term, long term, intermittent or continuous
Duration	Temporary or permanent
Reversibility	Reversible or irreversible
Significance	Local, regional or global

Source: EA Training Resource Manual, Second Edition 2002, United Nations Environment Programme (UNEP), p 263

6.2 Impacts prediction

Predictions of impacts are normally based on commonly used qualitative and quantitative methods and models. Expert judgments and comparison with similar projects can also be used for impacts prediction.

There are a number of models for predicting impacts on the physical environment; modelling socio-economic and cultural impacts is difficult and is generally done through qualitative assessment or economic analysis. A model can be effective only if the input data is correctly entered. The use of models, therefore, should be done with care and prudence.

The sophistication of the prediction methods to be used should be in proportion to the "scope" of the EIA. All prediction techniques involve assumptions and uncertainties. While quantifying and stating an impact, these assumptions should be clearly described. Also, uncertainty of prediction in terms of probability and the margin of error should be mentioned (see Table 6.2: *General models and methods used for impact prediction*)

6.3 Impacts evaluation

In impacts evaluation, the predicted adverse impacts are analysed on the basis of their significance. Therefore, the criteria for evaluating the significance of impacts and

Table 6.2: **General models and methods used for impact prediction**

Impacts	Assessment method/model
Noise	**CONCAWE model**[1] An accurate predictive noise model, it is based on the accepted CONCAWE algorithm for noise transmission in different meteorological conditions. It predicts noise levels at a distance based on the weather conditions and knowledge of the source spectrum in octave bands.
Landscape and Visual effects assessment[2]	Different countries are using different models and matrices for assessing the landscape and visual impacts. Some of them are listed below. **AUSTRALIA** ***a. GrimKe Matrix*** Assesses various aspects of landscape character and visual effects like topographic relief, vegetative cover, cultural and landscape value, horizontal and vertical visual effect. ***b. Photomontages*** A software to depict the visual character of the wind farm in the landscape **The US** ***a. Zone of Visual Influence (ZVI) maps***[3] A map showing the parts of the landscape from which the wind turbine structures are visible. ***b. Digital Elevation Model (DEM)*** A 3D representation of a terrain's surface for the purpose of visualising the proposed wind project. DEM data combined with simulation software (designed for illustrating wind energy projects) helps in inserting turbines and other project infrastructures onto a photograph from an identified viewpoint. ***c. 3-D visualization models*** It is a photographic simulation method, preferably used by architects to create an entirely digital scene of the site-visits. These photographs can be modified to represent a range of different lighting conditions like dusk or bright sunlight. They help in understanding the size of the turbines in relation to surrounding landscape features, and also the visibility of the project from particular viewpoints. **The UK** ***a) Zone of Visual Influence (ZVI) surveys***[4] Area depicting the object visibility in the surrounding landscape. Usually represented as maps. ***b) Wind Farmer*** A commercial software package that combines Geographic Information System (GIS) to calculate ZVI and create a simulation of wind farm project site. It helps in designing and analysing wind farms.[5] ***c) The Thomas and Sinclair-Thomas Matrices***[6] It estimates the potential visual impacts of different sizes of wind turbines.
Biodiversity	• Bird species assessment by fixed point count surveying, opportunistic observations, call recognition and nest counting. For detailed information refer Annexure 2: *Biodiversity assessment* and Annexure 3: *List of threatened bird species in India* • For bat assessment AnaBat detectors are widely used; they are ultrasonic detectors for identifying bat presence. It records calls which are beyond the range of human hearing.[7] For detailed information, refer Annexure 2. • Comparative evaluation of conservation value. • Expert opinions.

Continued…

Table 6.2: **...continued**

<table>
<tr><th>Impacts</th><th>Assessment method/model</th></tr>
<tr><td>Biodiversity</td><td>
Qualitative measure of likelihood and consequences
<table>
<tr><th colspan="2">Likelihood (how likely is mortality from collision to occur)</th><th colspan="2">Consequence (significance of associated impact on species viability)</th></tr>
<tr><th>Rating</th><th>Definition</th><th>Rating</th><th>Definition</th></tr>
<tr><td colspan="2">A Chronic: The event is expected to occur in most circumstances</td><td colspan="2">5 Catastrophic Disaster: Will potentially lead to the collapse of the species.</td></tr>
<tr><td colspan="2">B Frequent: The event probably will occur in most circumstances, i.e. a weekly or monthly basis.</td><td colspan="2">4 Major: Critical event, very likely to have significant impact on species.</td></tr>
<tr><td colspan="2">C Likely: The event will occur at some time, i.e. once in a while.</td><td colspan="2">3 Moderate: Likely to have an impact on population with the potential to impact long-term viability under some scenarios.</td></tr>
<tr><td colspan="2">D Unlikely: The event could occur at some time.</td><td colspan="2">2 Minor: May have an impact on population, no impact on species.</td></tr>
<tr><td colspan="2">E Rarely: The event will occur only in exceptional circumstances.</td><td colspan="2">1 Insignificant: Individuals may be affected, but viability of local population will not be impacted.</td></tr>
</table>
</td></tr>
<tr><td>Potential risks and accidents</td><td>• Risk assessment</td></tr>
</table>

their effects should be set in advance (see Box: *Impacts evaluation criteria*) and should be based on local standards wherever possible. Where local standards are not available, acceptable international standards should be used for instance International Finance Corporation (IFC), World Health Organisation (WHO) or United States Environmental Protection Agency (USEPA), or standards and guidelines of others countries which incorporate best practices.

In all cases, the choice of the appropriate guidelines must be robust, defensible and relevant to the local situation. If there are no appropriate existing standards available, then the criteria should be developed and their use must be clearly explained in the EIA.

As a good practice in impacts evaluation, it is better to use established procedures or guidelines, or relevant criteria which are comparable (see Table 6.3: *Some criteria and standards for impact evaluation*) . While doing impacts evaluation, it is equally important to understand the nature and characteristics of impacts on potential target areas, such as air, water, land, avian fauna and human beings to understand the significance, importance and intensity (see Box: *Possible Evaluation Criteria for determining impact significance*).

Impacts evaluation criteria

- Comparison with laws, regulations or accepted national or international standards. *Refer Chapter 4 on Policy, Guideline and Legal Provisions for the Wind Power Sector* and Table 6.4: *Some criteria and standards for impacts evaluation*
- Consistency with international conventions or protocol
- Reference to pre-set criteria such as conservation or protected status of a site, features or species
- Consistency with local, regional and national policy with reference to
  a. Landscape value
  b. Proximity to dwellings
  c. Cultural heritage
  d. Electromagnetic interference
  e. Aircraft safety and radar communication
  f. Restricted areas
  f. Others
- Comparison with best practices
- Existing environmental and social stress in the area
- Extent of impacts on biodiversity
- Acceptability to local community or general public
- Severity of the impacts (reversible or irreversible)

Table 6.3: **Some criteria and standards for impact evaluation**

Impacts	Criteria and standards
Air quality	• The Air (Prevention and Control of Pollution) Act,1981 • National Ambient Air Quality Standards (NAAQS) by Central Pollution Control Board
Waste water discharge from residential colonies, if applicable	• Water (Prevention and control of pollution) Act, 1974 • Water (Prevention and Control of Pollution) Cess Act, 1977
Noise	• Noise Pollution (Regulation and Control) Rules, 2000
Forest and biodiversity	• The Forest Conservation Act 1980 • The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 • The Biological Diversity Act 2002 • Wild Life (Protection) Act 1972 • Guidelines issued by MoEF: *Guidelines for diversion of forest land for non-forest purposes under the Forest (Conservation) Act, 1980*
Hazardous waste generation	• The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008
Cultural/archaeological sites	• The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010
Linear intrusion in natural areas	• Guidelines issued by the National Board for Wildlife (NBWL)
Others	• State policy/guidelines including sector specific guidelines published by different departments

Source: EA Training Resource Manual, Second Edition 2002, United Nations Environment Programme (UNEP), p 263

At the same time, it is also essential to find out the answers to the following three questions:

- Are there residual environmental impacts?
- If yes, are these likely to be significant?
- If yes, are these significant effects likely to occur? Is their probability high, moderate or low?

Also, the following questions must be asked while evaluating biodiversity:

- Is their presence of any species of plants which hold high economic value?
- Does the project site or adjoining area support high species diversity i.e. Western Ghats or fragile ecosystems, if any, like mountain ecosystem?
- Is there impact on forest produce or does the area provide any important biodiversity services? If yes, then, was any attempt made to evaluate the loss of forest-based economy.

Possible evaluation criteria for determining impact significance

- No impacts
- No significant impacts without or with available and practical mitigating measures
- Impacts, but significance not quantifiable
- Significant impacts even with available and practicable mitigating measures
- Impacts cannot be mitigated

7
CHAPTER

Environmental Management Plan and best practices for wind power project

7.0 Introduction

Mitigation is the process of providing solutions to avoid severity of impacts or reduce them to acceptable levels.

The key objectives of mitigation are:

- To enhance the environmental and social benefits of a proposal.
- To avoid, minimise or remediate the adverse impacts.
- To ensure that the residual adverse impacts remain within acceptable levels.

A good wind power project should incorporate environmental and social alternatives at the initial stages of project development. However, there are some impacts which can be managed only after being identified and predicted.

Mitigation measures can be classified into structural and non-structural measures.

- **Structural measures** include site alternatives, changes in the design, engineering modifications, substitution and change in construction, automation and mechanisation.
- **Non-structural measures** includes incentives, legal, institutional and policy instruments, corporate social responsibility (CSR), benefit-sharing, training and capacity building. For long term sustainability and to avoid long-term conflicts between local people and the project proponent, non-structural measures are very vital and are gradually being adopted.[1]

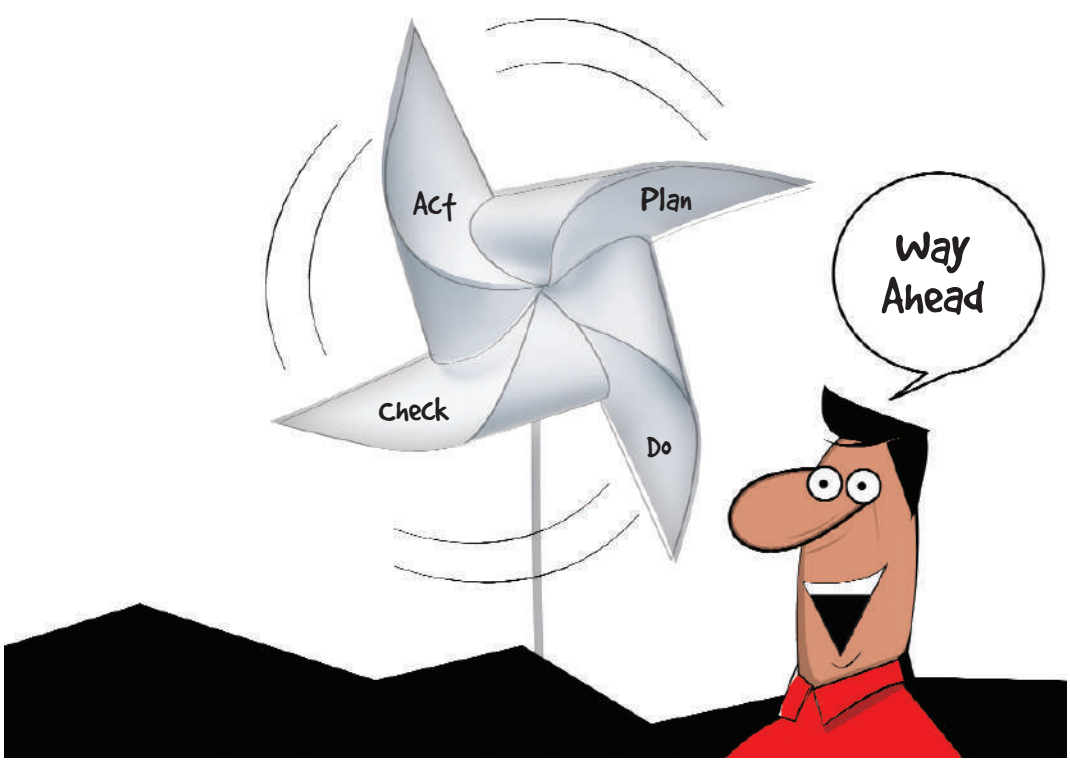
An EMP is a framework for the implementation and execution of mitigation measures and alternatives.

The objectives of an EMP[2] are:

- To ensure that mitigation measures are properly implemented.
- To establish a scheme and procedures for this purpose.
- To monitor how effective are the mitigation measures.
- To ensure that proposed mitigation measures comply with environmental laws and regulations.
- An adequate action when unexpected impacts occur.

The EMP outlines:

- A plan for operation or execution of the recommended mitigation plan, including assigning responsibility and schedules.
- The detailed estimated costs to execute the mitigation plan.



- The EMP should also address the formation of a monitoring committee, with the objective of finding out whether different pollution-related issues and social development commitments related to health, education, infrastructure, employment, etc., are adhering to the time schedule or not. In case of delays, the reasons for the delays need to be identified and suggestions to be made for rectifying them.

A good EMP[3] should contain the following:
- An outline of all likely impacts.
- A detailed description of proposed mitigation measures.
- A time-line for completion of mitigation measures.
- Resource distribution and responsible department.
- A programme for surveillance, monitoring and auditing.
- Compliance with relevant standards.
- An emergency plan when the impacts are greater than expected.

A monitoring plan related to the predictions made in EIA for key environmental indicators for monitoring all significant impacts,.

The EMP should also outline the need for monitoring, its duration and reporting procedures. The programme for surveillance, monitoring and auditing should clearly identify the following:
- Monitoring locations, including sample surveys — to assess the environmental and socio-economic impacts.
- Frequency of monitoring.
- Reporting frequency to competent authority.
- Provision for annual budget for environmental and social audit.

7.1 Best practices for wind power project

The wind speed throughout the year is the main criterion for site selection and to ensure reliability and economic sustainability of a wind farm project. Apart from wind speed, many environmental and social impacts can be averted or resolved at the project planning stage by adequate site selection (see Table 7.1: *Development chart and good practices for setting up wind power project*).

7.1.1 Wind monitoring

The first and foremost step for planning a wind power project is adequate site-specific data about the wind resource. This is required for long-term reliability and performance of wind farm. Some of the recommendations[4] for monitoring the wind resource are as follows:
- **Representative measurements:** Location of the meteorological masts must consider elevation and terrain while collecting data on the site.
- **Number of meteorological masts:** It is determined on the basis of size and terrain characteristics of the site. In case of a forest area, it is recommended to set up masts in such a way that no turbine is situated more than 1 km from a representative mast, whereas for simple terrain, it is suggested that no turbine is located more than 2 km from a representative mast.
- **Mast height:** It is advised that data collection should take place at hub height or at least three quarters of this height. Therefore, if hub height is 50 m, mast should be erected up to that height.
- **Measurement duration:** It is advised to study a site for 24 months; however, a minimum of 12 months monitoring is a prerequisite. It is also recommended to check data on a regular basis to ensure uniformity and incase any errors or sensor failure is detected, it can be resolved on time.
- **Documentation:** A detailed report of every meteorological mast with clear indications. Any change in equipment or malfunction of equipment at a certain time must be recorded and documented for better assessment.
- **New equipment for wind data monitoring:** Although cup anemometry is still widely used for wind data collection, use of remote sensing is also increasing. It is advised to take technical views into account while considering remote sensing for wind monitoring. The use of *Sonic Detection and Ranging* (SODAR) and *Light Detection and Ranging* (LIDAR) for wind monitoring is also increasing and highly recommended.

7.1.2 Site selection criteria

Few of the recommendations for site selection criteria for India are as follows:

Areas to be avoided
- Within or close to national parks, sanctuaries, notified eco-sensitive zones or an area with outstanding natural beauty or an area close to archeological and historical site of importance or any area as deemed fit by regulatory agencies.
- Site falling in wildlife corridors or nesting, breeding, foraging site for bird or bat or locations favoured by migratory birds either in project area or in immediate neighbourhood.
- Site close to natural lakes or wetland or wetland notified under Ramsar convention.
- Site close to residential areas, if unavoidable, then minimum setback distance should be followed.
- Defence training and other defence installations, as per siting guidelines for the industry this

Table 7.1: **Development chart and good practices for setting up wind power project**

Steps	Phase	Technical and Commercial Considerations	Environmental Considerations	Consultation
1.	Site selection	Desk based studies on wind resource, grid connectivity, available infrastructure to access the site, size of project and land ownership pattern	Collecting information and adequately considering factors like distance from national parks, sanctuaries, important landscapes, archaeologically, historically and ecologically sensitive areas, applicable laws, policies and guidelines to get site clearance.	Preliminary consultation with local, state, and central authorities.
2.	Project feasibility	Site survey, preliminary cost estimation to ensure technical and commercial feasibility. Actual monitoring of wind resource by installing meteorological masts, studying existing land use pattern, land costs, ground conditions, planning of access roads and estimation of cost for grid connectivity.	Assessment of the project feasibility from the environmental and social aspect and determining the scope of assessment.	Commence consultation with local community and other interested groups
3.	Assessment	Continue assessment of wind resource and economic viability of project (see Chapter 10: Global Best Practices)	Preparation of EIA report	Continue consultation with competent authority at local, state and national levels, including local community and other interested groups.
4.	Consent and approval from stakeholders	Obtain legal clearance from various departments, submit EIA report for environmental clearance, engage in general consensus building with local community and other interested groups.		
If projects is approved then 5th stage is construction of project				
5.	Construction	Begin construction as per outlined management policy and the project activity schedule.	Implementation of agreed environmental clearance measures and Environmental Management	Establish a public grievance redressal system.
6.	Operation	Implementation of operation and maintainence, and safety plan.	Continue with agreed post-monitoring plan and submit performance report.	Develop plan for peripheral development and execution of CSR activities

Note: Concept has been customised to suit the Indian context.

Source: Best Practice Guidelines for Wind Energy Development, 1999, http://www.bwea.com/pdf/bpg.pdf as viewed on December 1, 2012

distance is 25 km[5].

- Close to civil airport. As per siting guidelines for industry, this distance is 25 km.
- Important radar system.
- Site of scientific interest, historical, archaeological and major parks.
- Unavailability of grid connection.

7.1.3 Mitigation measures to reduce land footprint

Many best practices have been adopted in different parts of the world to optimise land use and reduce the impacts of wind power projects on land and communities. In the US, farmers can grow their crops or graze cattle in the project lands.

In the corn belt states such as Iowa, Illinois, eastern Kansas, southern Minnesota and parts of Missouri[6], crop cultivation is allowed in the project area[7] (see Figure 7.1: *Use of project land for agriculture in the US*). At the Iowa Wind Farm, project developers have worked closely with local landowners to determine the most appropriate access road in order to minimise intervention or interference with farming operations. In the Clear Lake region of Iowa, many wind farms have adopted the practice of sharing lands with local farmers who can use the project land for growing crops.[8] Also, see Box: *Good practices for landscape and visual impact in Scotland*.

In Australia, apart from the area occupied by the turbines and the access roads, almost all the land is still available for its original purpose which is normally either grazing or cropping.[9]

Wind farms only take away approximately 1 per cent of the total land area; this figure will decrease even further as the average size of wind turbines increases. For instance, a site that uses 2-MW turbines might take away 0.67 per cent of the land.

In case of the Challicum Hills Wind Farm[10], Australia's largest wind farm set up in August 2003 with a capacity of 52.5 MW, each of the seven farming families who leased land to Pacific Hydro for the wind generators and connecting roads, received revenue payments for the life of the wind farm. Since the 35 turbines (1.5 MW capacity each) and the wind farm took up less than 1 per cent of the available land, grazing and farming continued without any interruption.[11] Table 7.2 gives some examples of wind farms in Australia where the land footprint has been reduced by optimisation of the project land for agriculture and grazing, thereby preserving the local flora and fauna and satisfying community needs.

The approaches adopted to optimise land use include:

- Attempts should be made to limit land footprint to less than or equal to 1 per cent of the total wind farm area which includes the erection of turbines, construction of access roads and setting up other infrastructure.
- Encourage setting-up of large capacity turbines rather than small turbines. The large capacity turbines not only reduce land footprint but also cause less visual distraction.
- The land in the project area should be made available for alternative uses like agriculture, grazing and other activities.
- It has been observed that around 80 per cent of the land is required for construction of access roads[12]. Thus, it is recommended that the project site should be set-up near the existing approach roads so that land footprint for access road construction is minimised.
- Use of wastelands and/or barren lands should be encouraged rather than agricultural land or forest areas for setting up of wind farms.
- Inclusion of forest areas with thick canopy covers in project site should be avoided to prevent habitat fragmentation.
- Restoration of land that has been impacted during the project construction phase.

7.1.4 Mitigation measures to avoid bird and bat collision

- Use various types of anti-perching plans such as covering of nacelles, more use of monopole tubular towers[13] than lattice towers and avoiding use of wires to hold the turbines. It is also recommended to seal the junction between tower and nacelle as it creates a nesting place for bats.

- Assessment of site to understand prey-predator density. Avoid area, if prey density is high. It is recommended to stick to areas with low prey density.

- Risk of bird collision with large capacity turbines (≥500 kW) is low (reduce raptor collision rates at wind facilities) in contrast to older and smaller capacity turbines (40 to 330 kW).

- It has been observed that weather patterns have some influence on bat collision with turbines. Studies indicate that collisions of bats are very high during the night when wind speed is low. This is time when bats are very active. Furthermore, studies also demonstrate that fatalities can be reduced by 50 – 87 per cent by compromising a little on power

Figure 7.1: **Use of project land for agriculture in the US**

Source: Mason Inman, 2011, 'Planting Wind Energy on Farms May Help Crops, Say Researchers', National Geographic, December 16, http://news.nationalgeographic.co.in/news/energy/2011/12/111219-wind-turbines-help-crops-on-farms/, as viewed on September 7, 2012

Good practices for landscape and visual impact in Scotland

Site specific assessment as well as design and layout are necessary for each wind farm project.

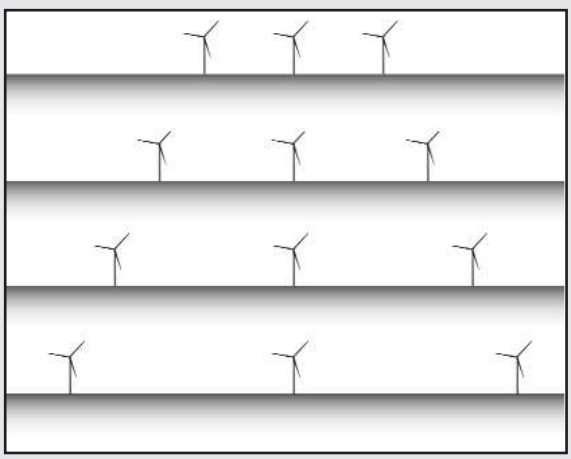
For instance in Scotland, every wind farm proposal has to undertake a Landscape and Visual Impact Assessment (LVIA). The project developer has to submit either as a separate report or submit it as a chapter in the EIA report[1]. Even if, EIA is not required for projects i.e. below the threshold limit, the project developer needs to submit LVIA report. This clearly shows that LVIA is a prerequisite for every project irrespective of size and capacity. The design and layout of wind farm play a dominant role on landscape and visual impact. Some of main components usually addressed in LVIA include:

- Proposed layout and total number of turbines
- Wind turbines size, design and model
- Planning and construction of access roads including their connectivity to the public roads
- Locations of borrow pits and their restoration
- Location, design and restoration of temporary construction compounds
- Location and size of the meteorological mast
- If visitors are allowed in a wind farm, the developer must provide proper signage, parking provision and a visitor centre for reporting

In Scotland, the wind farms in rural areas also follow some general rules, which include the following:

- Preference of single color for turbine
- Any type of colours or graded colour at the turbine are usually avoided
- Most preferred colour is light grey, it is considered as a good colour that minimises visibility
- Attempt is made to reduce paint reflection
- Disclosure of degree of paint reflectivity and colour tone in the application is made
- More preference if transformer is installed in nacelle in order to reduce number of elements

Spacing between the turbines



Note: Top figure depicts the spacing in between two turbines , which is two times the rotor diameter followed by three times the rotor diameter, four times the rotor diameter, and five times the rotor diameter (bottom) respectively

Source: Wind Turbines in Denmark, 2009, Danish Energy Agency, http://www.ens.dk/en-US/supply/Renewable-energy/WindPower/Documents/Vindturbines%20in%20DK%20eng.pdf as viewed on December 21, 2012

Spacing between the wind turbines

This is another factor, which influences aesthetics as well as the overall impact on landscape. It is recommended that in between two turbines, the spacing should be three to four times the diameter of the rotor[2] (see Figure: *Spacing between the turbines*).

Some of general mitigation measures recommended to reduce landscape and visual impact are summarised below.

General mitigation measures for landscape and visual impact

Landscape	Visual
• Use same size and type of turbines on a wind farm or adjoining wind farms • Use light grey, beige and white colours on turbines • Use three blades rather than two blades • Layout or adjustment should be such that turbines blades rotate in the same direction • Preference should be for large turbines rather than too many small turbines. Flat landscapes fit well with turbine distribution in rows	• Design of wind farm should be in accordance to the site characteristics and its sensitivity to the surrounding landscape • Maintain a buffer between wind farm and human settlements • Neutral colour and anti-reflective paint for towers and blades should be selected • Use only underground cables

Source: Wind Energy: The Facts, http://www.wind-energy-the-facts.org/en/environment/chapter-2-environmental-impacts/onshore-impacts.html as viewed on December 19, 2012

production. This can be achieved by increasing the minimum wind speed, which is referred as "cut in" speed, at which wind turbine starts to generate electricity.

- Increasing rotor visibility is another way to avoid bird collisions; however, scientists have mixed opinions regarding its success. Usually to improve rotor visibility, it is recommended to use high-contrast colour like black and white bands or to use UV-painted rotor blades.
- Avoid sites close to natural wetland ponds or lakes because they might attract birds. It is also recommended to ensure good storm water management to avoid accumulation of water.[14]
- Avoid migratory pathway area or keep tower height less than the migratory height.
- More use of underground cables rather than overhead lines.
- Restrict the height of wind turbine to limit the barrier effect.

7.2 Mitigation measures

Some of the mitigation measures related to wind power projects including transmission lines are illustrated in Table 7.3: *Mitigation measures for wind power projects*.

Table 7.2: **Reducing land footprint in wind farms in Australia**

Name of the wind farm	Capacity	Reduction in land footprint
Projects under operation		
Codrington wind farm, southwest Victoria	Began operations in July 2001, 18.2MW	• 14 turbines and roads take up less than 1 per cent of the land and thus the sheep and cattle grazing activities are continued unaffected.
Challicum Hills wind farm, western Victoria	Completed in August 2003, 52.5 MW	• Only 1 per cent of the total land is occupied by 35 turbines and roads. Thus, farming is continued uninterrupted. • Revegetation programs have lead to an increase in the native flora and protected local biodiversity and improved the habitat of indigenous wildlife.[2]
Cape Bridgewater wind farm, southwest Victoria	Completed in 2008, 58 MW	• Revegetation programmes around the wind farm site to help promote native flora. • Over 74,500 m^2 of land has already been direct seeded with pasture grasses and 3,000 m^2 with native grasses. This in return is helping to protect local biodiversity while improving the habitat for native fauna.[1]
Clements Gap wind farm, South Australia	Began operations in February 2010, 56.7 MW	• Optimisation of land use, by using it for cropping and grazing[3]
Proposed projects		
Keyneton Wind Farm Project, Keyneton in South Australia[4]	105 MW capacity project	• The project ensures continued farming activities and use only 1 per cent of the total land.
Nilgen wind farm project, Western Australia[5]	53 turbines with installed capacity of 100 MW	• The project work take up less than 1 per cent of the total land. • The project has ensured that the current farming practices can continue.

Table 7.3: **Mitigation measures for wind power projects**

<table>
<tr><td>Land</td><td>

Preventive measure — Avoid the site if it is located in a sensitive area like a forest, national park, sanctuary or a foraging, nesting, breeding and migratory area of birds or an area with a significant presence of bats.
Avoid site, if tree density is high.
Minimising the ground clearance area through proper planning.
Sensitive alignments must be avoided like steep hillsides for construction of access roads.
While constructing roads/transmission lines in general or in hilly terrain, an attempt should be made to balance the fill and cut requirements through route choice.
Remove topsoil from the area, which is being used by the project permanently and scraped topsoil should be used immediately for plantations or agriculture or landscaping.
Immediately replant trees in disturbed or cleared areas and slopes to reduce erosion and ensure stability of soil. This should be undertaken as early as possible in the construction process, before erosion becomes too advanced.
Slope Protection: Some of the well-established engineering measures for slope protection in hilly terrain include retaining structures, such as gabions (rectangular wire baskets of rocks), cribs (interlocking grid of wood or concrete beams, filled with earth or rock), or other types of wooden barricades and grid work, usually battered back against the slope.
Prohibit or restrict following activities in case the project is proposed in ecologically sensitive areas:
<ol type="a">
Cutting of old trees such as banyan and native species of girth at breast height (GBH) >30 cm[1]
Avoid planting of tree species such as eucalyptus and acacia wattles
Prohibit cutting of trees for firewood in natural areas
Prohibit cutting of vegetation which can lead to complete breakage of canopy cover in closed-canopy forests
Applicable to transmission lines - the vegetation clearing along the transmission corridor should be minimised by increasing tower height to reduce vertical clearance over natural vegetation or provision of underground power cables along sensitive stretch to avoid disruption of vegetation or forest continuity
All types of construction waste must be removed from natural ecologically sensitive areas for safe disposal

</td></tr>
<tr><td>Water resources</td><td>

Avoid construction during the rainy season and maintain a safe distance from water bodies for the building of access roads. Route survey should be conducted to determine alternative alignments.
Avoid alignments areas, which are susceptible to erosion, such as those crossing steep slopes. If unavoidable, then consider construction of check dams and gabion structures.
Minimise the number of water crossings wherever possible.
Use only "clean" fill materials around watercourses, such as quarried rocks containing no fine soil.
Cut/fill generated during construction should be kept in an earmarked area to prevent water pollution.
Prohibit or restrict activities such as dumping of solids and liquid waste including oils into rivers, streams, or any other water bodies.
Transformer and substation areas should be properly lined to avoid groundwater and soil contamination.
A spill prevention and containment plan.

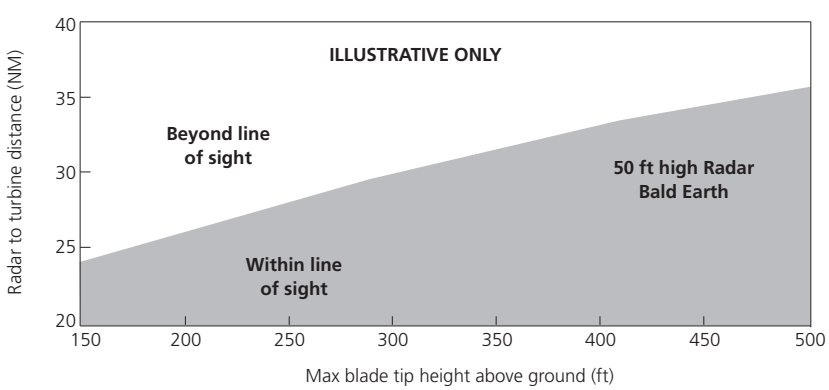
</td></tr>
<tr><td>Air quality</td><td>
Good practices for fugitive dust control are mentioned below:
<table>
<tr><th>Activities</th><th>Best Practices</th></tr>
<tr><td>Land-clearing/ civil works/ construction of access roads</td><td>• Water spray
• Use of personnel protective equipment (PPE)</td></tr>
<tr><td>Transportation of construction materials</td><td>• Covering the trucks/ dumpers to avoid spillage of construction material
• Speed control
• Water spray</td></tr>
</table>

Keep stockpiles and exposed soils compacted and revegetate as soon as possible.
Provision for air pollution control device in case of crusher or hot mix plant
Maintenance and inspection of equipment and vehicles

</td></tr>
</table>

Continued…

Table 7.3: **...continued**

Electromagnetic interference (EMI) and Aircraft Navigation	• Preventive measures should be taken, for instance avoid selecting a site close to an airport, an important radar system, a defence site and human settlements to avoid EMI issues. In case of unavoidable circumstances, then obtain No Objection Permission (NOP) from the Civil Aviation Authority and Ministry of Defence. • In order to avoid long-term impacts, a buffer distance of 9.2 km from Air Traffic Control (ATC) should be maintained.[2] Installation of wind turbines is permitted in Europe and the UK outside 5 nautical miles. However, some aviation authorities demand wind farm proponents/ to undertake a study (propagation study) for turbines that are located 10-15 nautical miles (NM) away from ATC radars.[3] • Avoid setting up wind turbines within defence air radar lines. To avoid EMI interference with defence radar, there is a restriction on height. For instance, if the wind farm site is proposed say 30 NM from the defence air radar, the Maximum Wind Turbine Height can be be 300 feet. The height of wind turbine is calculated by the equation given below. Also see figure below to understand the relationship between height of turbine and distance from radar. **Maximum wind turbine height = $(R_{NM}/1.23 - (\text{Radar antenna height})^{1}/_{2})^{2}$**  **Source:** www.masscec.com/index.cfm/pk/download/pid/11163/id/11645 as viewed on September 4, 2012.
TV interference	• A monitoring framework is required to investigate and rectify any interference to television reception. • Complaints from neighbours regarding interference with TV or other electromagnetic signals must be addressed immediately. • Modifications or replacement of antennas and if it not works, switch over to digital TV reception.[4] If both methods are ineffective then provide installation of satellite or cable TV. • Some other mitigation measures include: a. Installation of higher quality or directional antenna b. Direct antenna towards an alternative broadcast transmitter c. Installation of an amplifier[5]
Noise	• Avoid site location in close proximity to sensitive receptors.[6] • Provision of protective devices like earmuffs/ earplugs to workers, who are continuously exposed to high levels of noise during construction activities. • Provide silencers or enclosures for noise generating machines such as Diesel Generator (DG) sets, compressors, etc. during the construction stage. • Construction techniques and machinery selection should take in to account the need to minimise noise and vibration.
Biodiversity	• Preventive approach: While planning a new wind farm project or alignment of access roads, the sensitive natural environments should be identified early in the planning process so that alternative designs may be considered.

Continued...

Table 7.3: **...continued**

	• Setting of wind farms should be done in such a way so as to avoid removal of any burrowing species residing in the project area. • Undertake site selection to account for known migration pathways or areas where birds and bats are highly concentrated.[7] • Modify facility, activity locations and timing to avoid critical ecosystems, migratory routes and breeding areas. • Restoration and Rehabilitation (R&R) plan should be created for disturbed areas. • Appropriate spacing between turbines in order to allow for safe bird passage. • Provision to minimise or avoid electrocution of raptors and other large birds. • Use of reflectors or other items that can prevent bird collisions and deaths. In case of transmission lines, avoid critical habitats like nesting grounds, heronries, rookeries, bat foraging corridors and migration corridors by aligning the corridor at the planning stage.[8] • Maintain 1.5 m spacing between energised components and grounded hardware or, where spacing is not feasible, cover or insulate energised parts and hardware. • Existing transmission or distribution systems may be retro-fitted by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g. insulated "V's"), changing the location of conductors, and / or using raptor hoods. • Marking of powerline wires with reflectors or other items that will prevent bird collisions and deaths. • Preference should be given to underground cables instead of overhead cables, particularly along sensitive stretches.
Culture and heritage sites	• Preventive measure: Avoid areas close to archaeological, historical and cultural sites. • If avoidance is not possible, prepare a management plan to ensure the least damage to cultural, archaeological sites or maintain a safe distance as prescribed by the competent authority. • Prohibit or restrict cutting tree species valued by local communities such as banyan, peepul, neem, and tamarind trees.
Socio-economic environment	• Avoid sites close to existing settlements. If unavoidable, then create a R&R plan which addresses all the concerns of local people. • Best practices in land acquisition and R&R are as follows: a. The land should not be acquired without the consent of the majority of the project-affected population. The project proponent should receive "free, prior and informed consent" from the affected population. b. The affected population should include not only landholders but also people dependent on the land for livelihood like share-croppers and landless labourers, if agricultural land is being diverted for wind farm project. c. Compensation for land should be based on the current market price. d. Provision for land-for-land compensation for indigenous communities. e. The R&R plan should be framed in consultation with the project affected people (PAP). f. The affected population should have a say in the selection of the resettlement site and design of the housing and other infrastructure facilities, if applicable. g. The R&R plan should recognise not only landholders, but also those dependent on land for livelihood like share-croppers and landless labourers, etc. h. Basic amenities should be provided at the new resettlement site for relocated families. This should include roads, safe drinking water, sanitation facilities, educational and health facilities, markets, community centres and playgrounds. i. Financial assistance and training for self-employment should be provided to the affected population • Benefit sharing (see Chapter 10, section 10.2: *Benefit Sharing*) • Access roads for the project should be open for local people.
Waste management	• Appropriate disposal of domestic waste from colonies and labour camps, wherever applicable. • Provision of mobile toilets and movable accommodation for construction workers. • Hazardous waste such as spent lubricating, hydraulic and transformer oils should be collected and disposed through an authorised dealer.

Continued...

Table 7.3: **...continued**

	• Left over construction or repair materials including stones, sand, cement, packaging material, papers, cartons, oils, cans, bags, wires, metal objects, housing sheds and should be removed and safely disposed of or reused elsewhere.
Quarry, if applicable	• Waste rock/ spoil materials should be placed at designated areas with proper biological reclamation. • Compaction and revegetation of exposed areas should take place as soon as possible. • Water spray to reduce dust during quarry operations. • In case, the quarry gets exhausted, appropriate plan should be made for its restoration and reclamation.
Risks and Hazards	• Wind power project, sub-station and transmission lines design must comply with the national and international standards. • Work permit for working at height of 50-80 m. • As a good practice, risk assessment should be undertaken, if wind turbines are located within 50–200 m of a public road.[9] • Protection from fire/ explosions/ lightening a. Adequate provisions should be made to avoid fire hazards due to short-circuiting in substation and switchyard. b. Fire safety design and fire-fighting equipment consistent with national standards to avoid fire hazards from transformers/ sub-stations should be made available. c. Preparation of fire emergency action plan and relevant staff training should take place. d. The rotor blade should be equipped with lightening protection system. The lightening receptor should be connected to the hub and nacelle and proper earthing should be made. • Electric shock Hazards a. Restrict entry to substation area. b. Appropriate colour coding and warning signs on facilities. c. Prepare emergency plan to avoid unforeseeable events and / or natural calamities.
	Ice Throw and Ice Shed Impact of ice throw is mainly confined in cold countries or wind farms located at high altitudes where snowfall occurs. The preventative measure is to maintain a safe distance between wind turbines and human settlements or public roads. A European study recommends a safe distance of 200–250 m from the wind turbine, whereas in the US, the recommended safe distance is 230–350 m. In addition, other measures include stopping turbine operation in icing conditions.

8
CHAPTER

Public Consultation

8.0 Introduction

Public consultation is an essential part of the EIA process. It provides an opportunity to those who are directly affected by the project to express their views on environmental and social issues and on the R&R plan. In many countries, the process of public consultation is legally enforced and detailed steps are provided for conducting the consultation process smoothly.

According to UNEP, *"Timely, well-planned and appropriately implemented public consultation process contributes to the successful implementation, operation and management of the project".*[1]

Some advantages of undertaking public consultation are as follows**:**

- Public consultation makes the project more acceptable to the people as well as to the government and the concerned authorities. When locals are kept informed about the impacts including the benefits of a project, their anxiety and concerns related to the project tend to get reduced. It also gives a chance to persuade them about the project in a positive manner, in terms of creating a sense of ownership.

- Local communities have an in-depth understanding of local conditions prevailing in the project area such as local biodiversity. The information, if shared, with the EIA practitioner, can be of great value in project planning. Local people can come up with very good suggestions on how to avoid or minimise adverse impacts. For example, their involvement can be of great assistance in resettling displaced families in a humane manner.

- Public involvement since the beginning of a project also contributes to spreading awareness about various alternatives and mitigation measures. The project proponent becomes answerable to the people on why a particular technology has been chosen.

- It helps in preventing and reducing conflict through early identification of controversial issues.[2] In any society, local people expect to be consulted about development activities or projects which will have a direct or indirect impact on their lives, their livelihoods, their health, their social structures or historical, cultural and recreational sites. If the project proponent fails to consult them, it can lead to conflicts, thereby delaying the project unnecessarily.

- A good public consultation can certainly benefit all the stakeholders involved, including developer, affected communities and decision-makers.

Good practices while conducting a public hearing

A public hearing should be conducted at the initial stages of the project.

- It must be open to all stakeholders affected by the project — local NGOs, government departments; regulatory authorities, experts and other interested individuals should be invited to the meeting.
- Information about the public hearing should be made available to the public well in advance, at least a month before the hearing. The notice of the public hearing must be published in the local newspapers, preferably in the vernacular language
- The notice must include the time and place of the meeting and a brief statement of purpose of the meeting.
- The notice must also include the address and telephone numbers of the venue, including contact numbers of where the EIA report/ executive summary would be available.
- The EIA report/ executive summary should be made available in the local language/s.
- The EIA report should be easily available for any kind of reference along with the summary of the EIA report to be made available on the website of the concerned regulatory agency.
- Feedback on the project can also be invited through the Website of the regulatory agency.
- The regulatory agency should be responsible for conducting the public hearing and a senior level official should chair it.
- Everyone who wishes to raise a question should be allowed to do so.
- The proceedings should be recorded in minutes as well as videotaped.
- The decisions of the public meeting should be made public and posted on the website of the regulatory agency.
- The issues raised in the public hearing should be reflected in the EIA report.

8.1 The stakeholders involved in public consultation

The different stakeholders who ought to be involved in the public consultation process include the following:

- *Local people*: Project-affected communities are the most important stakeholders who must be consulted. They have the right to ask and know the details of the project, its likely impacts and measures to be taken to minimise the impacts.
- *Local leaders*: The views of local leaders and representatives also need to be taken into account.
- *Related government agencies*: It is important to involve relevant government agencies which are directly or indirectly associated with the project.
- *NGOs and interest groups*: Comments from NGOs and civil society groups, which may not necessarily be based in the area, can also provide a useful and insightful perspective on the impacts of the project.
- *Experts and academics*: Experts in related fields and from academia can make significant contributions to the EIA study.

8.2 Procedure for conducting public consultation in India

Public consultation is mandatory as per EIA notification 2006. As per said notification, public consultation is a must for all development activities listed under the Schedule with few exceptions such as defence projects. Public consultation is applicable for projects falling under Category "A" and Category "B1" projects or activities.[3]

The Public Consultation involves two components:

- Public hearing at the project site or in close proximity.
- Any person can file a written response to the competent authority about the project.

As of now, EIA is not applicable to wind power projects; therefore, public consultation is not mandatory. For more information on EIA and the public consultation process in India, please contact MoEF or refer to the notification at the URL: *http://envfor.nic.in/legis/eia/so1533.pdf*

8.3 Approaches to conduct public consultation

There are numerous approaches and techniques to involve stakeholders during the public consultation process.

Some of the common approaches are discussed below:

- *Public hearing or meeting*: Organising a meeting so the views and concerns of the people interested in the project can be expressed. To ensure that the meeting is conducted in a fair and an unbiased manner and the views of all stakeholders are recorded, this meeting should be conducted by the concerned regulatory authority. Also, it should be held at the site, where the project is coming up, to enable a broad representation of the affected communities (see Box 7.1: *Good practices in conducting public hearings*). The public meeting should be open for all to attend.
- *Advisory panels*: These panels consist of selected

individuals, who have been chosen to represent the wide spectrum of stakeholders. The selection of the stakeholders and their representatives is crucial, and particular care is needed to involve the poor and vulnerable groups, women and indigenous people. The panel can meet periodically to discuss the impacts and mitigation measures and to provide their recommendations on future activities. The panel can be particularly useful in shaping the socio-economic development programme of the region.

- *Surveys*: A structured questionnaire is prepared to determine the views of the local people. This is a crucial exercise, as it may reflect the mood of the locals toward the project and the kind of apprehensions they have about it.

- *Interviews*: The purpose of interviews is to take into account the opinion of the members of a selected community. Interviews can be conducted with the poor, the farmers, landholders, landless people or women; they enable the project proponents to know the views of different categories of stakeholders.

- *Open house*: An open house refers to an accessible location from where the information on a proposed project can be easily retrieved. An EIA team member is required to be present at this open house; s/ he can discuss the issues and record the views/ opinions/ concerns of the visitors. An open house should be accessible to all, and its location and time of opening should be well publicised to ensure an effective consultation process.

8.4 Stages of the EIA where public consultation is important

Ideally, public involvement should start right from the project planning stage and continue throughout the EIA process[4] to ensure long term sustainability of the project. However, every country has its own legal mandate for public engagement. For instance, public consultation in India takes place once the draft of EIA report has been prepared.

In South Asia, there is still a debate as to at what stage should the public consultation begin, and how many stages of consultation should take place. This is particularly important for major projects that affect local people's livelihoods.

The five key stages when public involvement can take place in the EIA process are as follows:

- *Screening*: For projects that are being planned in ecologically sensitive areas, or those that could affect large number of people, the regulatory authority should encourage public consultation during the screening stage. This will help the authority gain a better understanding of the nature and significance of likely impacts at the early stage. It will also make it easier to incorporate the detailed management plan into the EIA scoping.[5]

- *Scoping*: This stage is very crucial and mandates a public consultation because the TOR are formulated for undertaking a detailed EIA study. A properly conducted consultation at this stage can be of assistance in resolving a lot of issues. At this stage, various significant environmental and socio-economic issues are identified, information specific to the site and surrounding areas is collected and various options for meeting the project objectives are considered. This stage also entails requirement of public consultation at the latter stage of EIA and to what extent.

- *Impact analysis and mitigation*: Involvement at this stage further helps improve the assessment process, especially issues related to social and biodiversity. It also assists with the identification of places of historical or cultural importance, finding alternatives and the consideration of various options while drafting the R&R plan. Public participation at this stage will helps in the following ways:
  a. avoid biases in the analysis and make assessment more accurate
  b. consideration of the preferences to people's needs c. avoid long-term conflict.

- *Review of quality of EIA*: This stage becomes controversial, if the local people are not consulted in the stages mentioned above. This is the stage when the EIA report is presented for public comment. In India , this stage is a formal process and is referred as *'Public Hearing',* in which people are asked to express their opinion about the project based on the EIA report or Executive Summary. It is crucial that irrespective of whether the meeting is formal or informal, it should be structured such that the affected people must be able to express their valid concerns and their concerns must be reflected in the final report.

- *Implementation and follow-up*: This stage is mainly intended to determine the EMP compliance or clearance conditions as given by competent authority at the time of environment clearance. The local public including other stakeholders should scrutinise and participate in the follow-up process. This arrangement can help the developer and the competent authority respond to problems related to pollution or R&R issues or other commitments made by a developer at various stages of public consultation.

CHAPTER 9

Reviewing an EIA report

9.0 Introduction

The purpose of reviewing an EIA report is to take the following decisions:

- Should the project be cleared in the same state as proposed by the project proponent?
- Should the project plan be modified to reduce the impacts and then cleared?
- Is the "no project" option justified, considering the social and environmental costs vis-à-vis the benefits of the project?
- If the project is cleared, then what conditions may be prescribed for compliance during design stage, construction and operation of the project?

9.1 Composition of the EIA review team

The monitoring committee or appraisal committee should include experts from diverse fields with a good understanding of the wind power project and the potential impact areas. The reviewers should possess technical expertise in their respective domain and be competent enough to review the report. They should be able to provide valuable suggestions/ recommendations to the project proponent for taking corrective action. The team should include the following experts:

- *Wind energy experts/electrical engineer* who are well versed with the process, technology and potential impacts of a project.
- *An environmental scientist/engineer* to provide an overview of the adequacy of mitigation options suggested for air, noise and water pollution and waste management.
- *A civil engineer* who can review the issues associated with road construction, erection of towers, slope stabilisation, etc..
- *A social science expert/anthropologist* to review the social issues and the R&R plan.
- *A biodiversity expert/botanist/ornithologist* who can review the biodiversity issues, biodiversity conservation and afforestation plans.
- *A meteorological expert* who can review the meteorological parameters and their adequacy and compatibility.
- *A safety engineer and occupational health expert* who can review the levels of safety, mechanisation, occupational hazards and mitigation strategies to minimise risks and hazards at the planning and operational stages.
- *Landscape engineer/planner* who can assess and review the impacts of a project on local landscape and visual effect.

9.2 Reviewing an EIA report for a wind power project

While reviewing the EIA report, the following key aspects need to be carefully examined:

- Has the EIA report evaluated the beneficial and adverse impacts of the project clearly?
- Which are the unavoidable adverse impacts? Are they acceptable?
- Is the proposed mitigation plan sufficient to manage and control all adverse impacts?
- What kinds of safeguards need to be incorporated to ensure that the mitigation plan is implemented effectively?
- What are the parameters that need to be monitored during the construction phase and during operation so that the state of the environment can be studied throughout the project life?
- Is the project acceptable to local communities?
- Are the concerns of the local communities genuine and has the EIA report adequately addressed these concerns?
- Will the project improve the socio-economic status of the local communities?

For more details, see Table 9.1: *Checklist for reviewing the EIA report of wind power project*.

Table 9.1: **Checklist for reviewing the EIA report of wind power project**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
1. General information		
a. Executive summary (It incorporates different aspects of the project including the foreseeable environmental and social impacts, mitigation measures and benefits).	Has the executive summary of an EIA report described in detail the nature and scope of project, its characteristics and the environmental and social impacts arising from the project? **Note:** Scrutinise the report and check whether all the concerned issues have been addressed in the executive summary. **Significance:** The executive summary of an EIA report should be prepared in the local language so that it can be understood by a larger group of people. The locals should know details about the project and its environmental and social implications, so that they can raise valid questions during the public consultation.	
b. Terms of Reference (ToR)	The reviewer must establish whether the EIA report has complied with prescribed ToR.	
c. Statutory clearances	Has the project developer taken the approvals or No Objection Certificate (NOC) from various concerned departments or organisations? **Significance:** This will help the reviewer to understand applicable regulatory approvals required and the status therewith.	
d. Project proponent	Experience in wind power projects and track record on social and environmental fronts in other projects.	
e. Information about the EIA consultant	Disclosure of name and contacts of organisation/consultant preparing the EIA report, qualifications and experience of experts involved in the EIA assessment and report preparation	
f. Cost of the project and donors	Has the report described the financial cost of the project including donors or banks involved in the funding?	
h. Declaration	Does the report include a declaration stating that the information disclosed in the EIA report is correct?	
2. Project description		
Location	Has the report provided sufficient reason for site selection including environment and social issues associated with each site? Is given justification adequate and reasonable?	
Maps (cartographic) representations of the following	While reviewing the questions below, the reviewer should check the adequacy of information, quality of maps, the appropriate scale, ground verification (wherever possible), source and date of the map. Some of the common review questions are: • Has the report provided a map specifying the location of the project? Does it clearly mentions the state, district and village with latitude and longitude? • Has the report provided a study area map indicating features such as locations of human settlements, radar station, defence	

Continued...

Table 9.1: **...continued**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
	site, TV tower station, locations of other industries or other wind farms? • Has the report provided a map indicating the detailed land use pattern of the project site and study area? • Has the report provided a map marking the sensitive zones in the study area — such as forests, protected areas, migratory areas, tourist resorts, important landscapes, historical sites, National parks and sanctuaries, international borders, etc.? • Has the report provided a contour map of the plant site and study area? (Applicable where water bodies are located nearby) • Has the report provided a layout map displaying access roads, internal access roads, underground cables, substations, switchyards and additional structures including all utilities? • Has the report provided a map indicating the floodability of the area, if applicable?	
Activities during project construction stage	• Has the report provide a schedule for each phase of construction and operation for project and ancillary facilities? Does it include the environmental issues associated with each ancillary activity, wherever possible such as mobilisation, land clearing, tree cover removal, shifting of utilities, transportation of material, establishment of construction camps, stockyards, installation of plants and equipments, blasting (if applicable), borrow and spoil disposal, excavation, foundation, concrete work, stabilisation of disturbed areas? **Note:** Check whether all environmental and social concerns have been addressed. • If applicable, check whether the description of batch plants, hot mix and rock crushers, their capacity, fuel requirement including the environmental measures for pollution abatement and control have been provided in the report? Are given information and listed mitigation measures adequate? • Has the report provided details on types of equipments required for proposed wind farm during the construction stage, the environmental implications associated and pollution control measures? Are pollution control measures adequate? • Has the report provided details of the expected quantity of raw materials to be used during construction of the tower, roads, building and substations and environmental implications associated with each activity? Has the report discussed the pollution controls measures recommended for reducing air, noise and water pollution? Are proposed measures adequate? • Has the report provided the water balance, detailing the water usage during the construction and operation stage and the source of water? Reviewers can check whether Water Cess is applicable or not. • Does the report contains the details of the workforce to be employed during project construction and operation? Also is there information on employment potential during the construction and commissioning of the plant? Check the provisions or amenities provided by the developer to reduce pressure on local resources during construction stage of the project.	

Continued...

Table 9.1: **...continued**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
Technology and technical details	• Has the report provided detailed information on the technology being used and technical details on following? a. Total installed capacity of wind farm (MW) b. Total number of wind turbine generators (WTG) and Unit capacity of WTG c. Type of wind tower d. WTG Rotor Diameter (in m) e. Hub Height (in m) f. Number of blades per WTG g. Total Power Generation Capacity h. Cut-in wind velocity (m/sec) and Cut-out wind velocity (m/sec) i. Rated wind velocity and Safety wind velocity j. WTG Rotor Speed and Average plant load factor k. Wind Velocity at 50 m or 80 m hub height and average wind velocity at 50 m or 80 m hub height l. Wind Energy Density (w/m^2) Is the given information adequate? • Has the report provided details on the foundation of wind turbines with a clear description on the size, depth of foundation, quantity of earth to be extracted and mode of disposal? The reviewer should check the pollution control measures and safety aspects at the time of foundation and erection of tower. Are proposed measures adequate? **Note:** If the site is falling in a seismic zone, then check whether the design foundation of the wind turbine generator has taken into consideration the seismic factor or not. • Has the report described the laying of cables with a clear description of electrical safety hazards? Are safety measures adequate?	
Site characteristics	• Has the report mentioned the total land requirement for the project, land use pattern of the acquired land and study area separately? If private land is being acquired, then check information on land ownership and the compensation being offered to land owner. For best practices refer to Chapter 10, section 10.2: *Benefit Sharing*. **Note:** Reviewer should check measures for effective utilisation of unused land within the project area. The actual land diverted for permanent uses is less in relation to the total acquired land. If farmland or grazing land is taken over by a project, the same activities can resume on the remaining 97 to 99 per cent of the wind farm area. • Has the report provided details on characteristics of the catchment area? Does the details include terrain characteristics and drainage pattern? Is given information adequate? Check the areas vulnerable to erosion or areas	

Continued...

Table 9.1: **...continued**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
	prone to landslides. • Check the distance of the project from ecologically sensitive areas and key installations such as airports, defence installations, highways, wetlands, National Parks and Sanctuaries, biological corridors, archaeological sites, critical water-shed areas or any other important installations. In addition to the areas/zones/installations mentioned above, the reviewer should also check distance from following sites a. Distance from nearest habitation and how many houses fall within 300 m b. Distance between two wind farms c. Distance from roads, railway lines and waterways d. Distance from high voltage lines e. Nearest radio communication, radar and navigation towers. f. Distance from water bodies Internationally, many countries follow a setback distance from the key installations to avoid environmental and social risks (see Chapter 10: *Global Best Practices*). **Check the following information wherever applicable** • If forest land is diverted, then check whether the project site or study area supports any unique habitat, endemic, threatened or declining species or species of high economic/ecological value, wildlife corridors or nesting, breeding, foraging sites for birds or bats or locations favored by migratory birds either in project area or in immediate neighborhood. For details refer Annexure 2. Is information provided in the report adequate? If yes, then will the project cause significant impacts? If yes, then, are impacts manageable?(Yes/No). If yes, then, review the quality and applicability of the management plans. If not, then reject the proposal. **Note:** Check the quality of data, duration and season of data generation • If applicable, has the report provided information on prey density at the proposed site and in the surrounding study area? Check the quality of data generated and also check whether forest and local people were consulted. • If the site preparation requires felling of trees, then, check the followings information in report: a. Number of trees to be cut down b. Plant species and age of trees c. Are they protected/endangered species? If yes, was information given on their characteristics.	

Continued...

Table 9.1: **...continued**

Item	REVIEW QUESTION	Comments (If question is not adequately addressed, what further information is needed?)
	Note: While reviewing the biodiversity section, the reviewer should check following: a. Quality of data b. Extent of field surveys and use of scientific techniques c. Stakeholder consultation like with the forest department and local people d. Interpretation of data	
Baseline data collection	**Note:** While reviewing the baseline data, the reviewer should check the following basic information in an EIA report: a. Whether the report has clearly, concisely and adequately depicted the existing environmental and socio-economic status of the study area with appropriate data, maps and diagrams? b. Is the secondary data given in the report relevant? Check the source of data and the year in which it was generated. c. Is the primary data generated using appropriate monitoring plans and methodologies by an appropriate agency? Is there a basis for questioning the quality and authenticity of the data? **Reviewer should review the following details should:** • Has the report provided data on surface water characteristics including an inventory of natural drains, streams, springs, water crossings and other water bodies in the project and adjoining area. Is the given information verified and authenticated by the local or regional water resource department? • Has the report provided information on potential project activities which may cause contamination of water resources. Is the given information adequate? • Information on quality and characteristics of top soil to be generated during the construction of access roads, internal roads, erection of towers, substations and other areas. Also are measures for conservation and use included? Is the given conservation plan adequate? **Air and Noise quality** • Has the report provided information on ambient air quality such as PM_{10}, $PM_{2.5}$? Is there information on existing meteorological conditions such as temperature, humidity, rainfall and wind speed and direction, wherever applicable? While reviewing the above data, reviewer should check the following information: a. Have all the parameters been covered? b. Has the location of the monitoring station been appropriately fixed, considering the sensitive receptors and existing meteorological conditions? c. Was the air quality data generated using appropriate sampling methods and testing methodologies? d. Were the results — meteorological and ambient air data — interpreted correctly or not?	

Continued...

Table 9.1: **...continued**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
	• Has the report listed down the potential sources of fugitive emissions and list of activities that may generate fugitive dust? Is the given information adequate? • **Noise:** Has the report provided details on potential equipments and activities that may cause noise pollution? Check whether mechanical and aerodynamic noise was mentioned in the report (Yes/No). If yes, then check the reported data on maximum and minimum aerodynamic noise anticipated at maximum and minimum wind speeds. Also check the setback distance and influence zone with respect to human settlement. • Has the report discussed on shadow flicker including influence zone with respect to human settlement (Yes/No)? If yes, then, was any estimate made or threshold limit determined that it should not be more than certain number of days in a year. If no, then, reviewer should demand information on shadow flicker (see Chapter 10: Global Best Practices) • Has the report provided information on potential risks and accidents anticipated during various stages of development? Is given information adequate? • Is the socio-economic and cultural information/data generated as per approved ToR? The reviewer should check the following data/information in EIA. a. Has the report provided information on the number of household or families to be displaced, if land acquisition is involved? b. Check data/ information on movable and immovable properties to be affected c. Public and community properties and infrastructure likely to be affected d. People who are likely to lose their employment or livelihood or likely to be alienated wholly or substantially from their main sources of trade, business or occupation due to acquisition of land. **Note:** Check whether the socio-economic data is generated by using an appropriate field survey and public consultation? Has the data been interpreted correctly or not? **Others** • Check information on quantity and characteristics of solid and/ or hazardous wastes likely to be generated including from utilities, if applicable.	

Continued...

Table 9.1: **...continued**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
Impact Assessment	While reviewing the impacts assessment, the reviewer should check the following: a. Whether the impacts are clearly characterised, wherever relevant, in terms of magnitude, extent, duration, frequency, probability and importance? b. Does the report clearly mention the basis on which the impact predictions were made, for example, case studies, models, literature, expert analysis, etc.? Are the assumptions made for impact prediction clearly indicated and justified? Is there a basis for questioning the method used for impact prediction? **Check in detail the following aspects in the impacts assessment section:** • Has the report clearly described the impacts due to land acquisition? *If applicable*. • Has the report assessed the impact of a project on birds, bats and local biodiversity of the area? If yes, was the quality of assessment adequate? • Has the report discussed the impact of project activities on local water bodies? Check if the impact is assessed in terms of magnitude, extent, duration, frequency, probability and importance. • Has the report assessed the impact of noise and flickering on the nearest human settlement? If yes, was the quality of assessment adequate? • Has th report assessed the impacts of the project and allied activities such as land clearing, civil works, construction of access roads, erection of tower, construction of sub-station transportation, crushing and loading on ambient air quality including workers and nearest human settlements? • Has the report assessed the impact of movement of heavy vehicles on local infrastructure? Is the given information adequate? • Has the report assessed the impact of the project on local landscape and scenic beauty of an area? See Chapter 6, Table 6.3: *General models and methods used for impact prediction* • If applicable, the impact of a project on the hilly terrain due to slope destabilisation caused by site preparation, civil works, construction of access roads and other activities. • Socio-economic impacts of a project. • Impact of project on radio communication, radar and navigation. • Risk and hazard associated with WTG, sub-station and other allied activities including potential occupational health and safety issues that may arise out of a. Electrical hazards b. Working at a height c. Fire/explosions from transformers d. Exposure to chemicals like transformer oil e. Ice throw, applicable only in cold areas f. Consequences of blade or tower failure	

Continued...

Table 9.1: **...continued**

Item	Review Question	Comments (If question is not adequately addressed, what further information is needed?)
Environment management plan (EMP) and post-monitoring	While reviewing the mitigation measures and EMP, the reviewer should check for the following general information: a. Whether EMP has discussed the mitigation measures for each individual impact to be examined while reviewing the EIA. b. The timeline for completion c. The departments responsible for implementation d. Allocated budget for the EMP e. Post-monitoring provisions and reporting to the concerned regulatory authority. • R&R plan, if displacement is involved. Check whether the plan has included details of the compensation and basic amenities at the resettlement colony, (such as housing, educational facilities, infrastructure and alternate livelihood potential), a clear timeline for implementation, responsibility, budgets and grievance redressal mechanism. • What measures and initiatives have been proposed to avoid bird and bat strikes? Are proposed measures adequate? • What measures and initiatives have been proposed to reduce landslides and to ensure slope stabilisation during construction of access roads and towers on a hilly terrain, wherever applicable? Is the given management plan adequate? • What measures and initiatives have been proposed to reduce fugitive emissions during land-clearing, civil works, handling/transporting of construction material, construction of access roads, quarry operations, hot mix and batch plant, wherever applicable? Are given management plans adequate? • What measures and initiatives have been proposed for the control of erosion and run-off from the area where construction is to take place? (especially if there is a water body or agricultural land adjoining the project site). Are given management plans adequate? • Management plan for noise abatement and control, including nuisance caused by flickering, wherever applicable. Are given management plans adequate? • What measures have been proposed to reduce the landscape and visual impacts? • What measures have been proposed to use the un-utilized area? • Plan for topsoil utilisation and conservation. Are management plans adequate? • Mitigation plan to reduce, avoid or minimise spills and leaks from transformers, sub-stations, etc. Are management plans adequate? • Plan for reclamation of debris and spoil, if applicable. Are given management plan adequate? • Plan for quarry related activities including its restoration, if applicable. Are given management plan adequate? • Plan to avoid or minimise collision and electrocution of raptors and other large birds. Are management plans adequate? • Plan to avoid or minimise electromagnetic interference, if applicable. • Measures against potential risk and hazards • Afforestation plan and beneficial utilisation of un-utilised land. Are given measures for use of un-utilised land adequate? • Check the surveillance and monitoring programme including fund requirement, manpower , monitoring schedule, frequency, parameters to be monitored and equipments required for surveillance and monitoring programme . • **Key components:** Does the report include the following?: a. Year-wise capital and revenue budgets for environmental protection b. Year-wise budget allocated for training and awareness raising programmes c. Year-wise budget allocated for socio-economic development of the community	

10
CHAPTER

Global best practices

10.0 Introduction

In India, regulations are lax for wind power projects. There are no fixed environmental standards which are being followed because these projects are considered "green". However, globally, wind power projects are well regulated. In order to minimise the impacts of wind power projects on the environment and people, different countries have developed their own standards and guidelines, details of which are summarised below.

10.1 Standards and guidelines across the world

10.1.1 On noise

In India, there are no specific standards for noise generated due to wind power projects. However, in the Noise Pollution norms issued by MoEF, it is mentioned that in residential areas, the noise level should be 55 dB during day time and 45 dB during night time. For any construction activity the following recommendations should be followed:

- Acoustic barriers should be placed near construction sites.
- The maximum noise levels near the construction site should be limited to 75 dB(A) Leq (5 min) in industrial areas and to 65 dB(A) Leq(5 min) in other areas.
- There should be fencing around the construction site to prevent people coming near the site.

Some of the noise standards and guidelines for wind power projects followed across the world are:

In order to avoid impact of noise, different nations have set a setback distance from the nearest settlement. For instance, in Denmark, to minimize noise nuisance, the prescribed distance limit from a neighboring home is four times the turbine's total height. In the US some states followed setback distance of more 4,500 feet from any place of residence (see Table 10.1: *Setback distance from habitation*).

Figure 10.1: *Comparison of noise limit for wind turbines in different countries* shows the setback distance criteria adopted in different states of Australia and other countries. It also clearly indicates that there are two factors for determining the criteria – the distance and the ambient noise level standards.

Europe has set the criteria taking in consideration a short distance and higher noise level, whereas, New South Wales (NSW), Australia, has used a longer distance with lower noise level standard.

For instance, in NSW, the noise setback distances vary between 1-1.5 km and the noise level standard set for that distance is 35dB. Whereas, in UK, for 500 m distance the noise level standard is 43 dB and for Europe it is 55 dB for a 100 m (approximately) distance from the wind farm. These levels are indicative only and do not consider site-specific conditions which may increase or decrease the noise level.

According to a recommendation[11] by the World Health Organisation (WHO), the outdoor sound levels should not exceed Leq = 45 dBA at night to protect from sleep disturbance, and 50 dBA during the day to protect from moderate annoyance, and for protection from serious annoyance, the recommended limit is 55 dBA during the day.

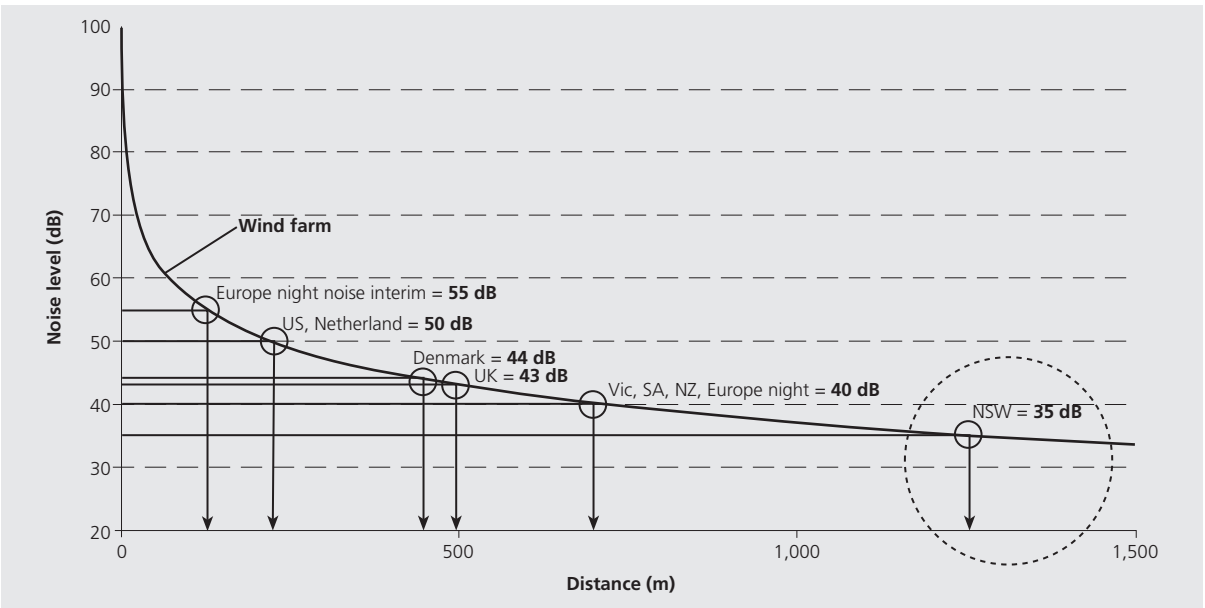
Noise limits followed in different countries are:

- *The Netherlands:* Limit is 40 dB from the nearest

Table 10.1: **Setback Distance from habitation**

Country/State	Setback distance
Rural Oregon (US)	3.2 km (minimum)
Victoria and New South Wales, NZ	2 km (minimum)
As per UK Noise Association (UKNA)	1.6 to 2.4 km
Beech Ridge Wind Farm (West Virginia)	1.6 to 6.4 km
Michigan (US) Audible Noise Standard	From 6:00 am - 10:00 pm - Within 1.6 km, the noise limit shall not exceed 35 dBA or shall not add 5 more decibels to the background noise. Background noise +-5 dB From 10:00 pm-6am - Within 1.6 km, the noise limit shall not exceed 3 dBA to the background noise. Background noise +-3 dB

Figure 10.1: **Comparison of noise limit for wind turbines in different countries**



Source: NSW Planning Guidelines, Wind Farms, 2011, http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=5yeY6yw_wRE%3d&tabid=205&mid=1081&language=en-AU as viewed on November 1, 2012

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.

- *France:* Noise measured at the neighbourhood. Based on the difference of noise measurement before and after turbines are commissioned, the authorised emergence is fixed up to 3 dBA at night and 5dBA 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 dBA in Wallonie region. A wind turbine produces noise when it operates above a wind speed of 5 m/s; the Dutch noise curve is used to find out the real impact of noise.
- *India:* No sector-specific standard.

10.1.2 On shadow flicker

- *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
- *Ireland*: The recommended limit for flickering is 30 hours per year or 30 minutes per day for receptors from a distance of 500 m. In case, there is another wind farm within 2 km, the developer must undertake a cumulative noise and shadow flickering assessment.
- *India:* No standard or guidelines

10.1.3 On the distance between two wind farms

- *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.

10.1.4 On the distance from housing

- *The Netherlands:* 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.

10.1.5 On the distance from roads, railways and waterways

- *The Netherlands:* It is 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 is a defined distance for every type of road (communal, main roads, motor-way) where no construction is allowed. Rules are laid down in local town planning documents.
- *Denmark:* Decided at a country level. In case of major roads, it is 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, the recommended distance is equal to the height of the turbine for national roads and railways. For waterways, no distance is pre-defined. In the Flemish region, a risk assessment is recommended for projects close to highways and railways.
- *Ireland:* As a good practice, it is recommended to maintain buffer space of 50 m from the existing watercourse. It is also recommended to install a silt arrestor to avoid direct discharge of silt in the water body.
- *India:* No specified distance as such.

10.1.6 On the distance from high voltage line

- *The Netherlands:* Distance is equal to diameter of rotor to the nearest line, otherwise at least 30 m.
- *France:* No clear rules, least distance equal to the total height of the turbine to the nearest lines. Sometimes, mention of 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, the recommended distance is equal to the height of the turbine from the power lines.
- *India:* No specified distance as such.

10.1.7 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 site and building.
- *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.

10.1.8 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. The project is allowed only if EIA study illustrates that there is no significant impact. However, the competent authorities or expert advice is a prerequisite. In the Flanders region, if 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; broad buffer areas of 200 to 700 m are considered.
- *India:* No specified distance, the MoEF guidelines - 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 does not specify the safe distance from said sensitive receptors.

10.1.9 On the distance from water bodies

- *The Netherlands:* A distance of 50 m is considered from waterways; however, no limit is specified from 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 are guided by the local documents of town planning.
- *Denmark:* Following distance is allowed (a) 150 m from lake and river (area above 4 ha) (b) Special planning and landscape consideration from 3 km from sea, however, wind turbines are permitted at 100 m 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.

PHOTOGRAPH: LEENA GUPTA

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

10.1.10 On the distance from forests

- *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 allow or not allow a site in relation to location of wind turbine in forests and silent areas.
- *India:* Forest land is used for siting of wind farm. As of now, wind power has diverted 3,349 ha of forest land from 2006 to 2012.

10.1.11 On the protection of flora and fauna

- *The Netherlands:* Project developer need to undertake a fauna study before developing wind energy.
- *France:* In every case, the location of project site is preliminary verified by DIREN (Environmental Regional Direction) and also evaluated considering the environmental limitations. The wildlife impact study is an integral part of EIA. A flora and fauna (especially birds) impact analysis is required every 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, in such case authorisation from the competent authority is prerequisite. The proposal may be rejected based on location sensitivity and kind of species in the area. In Wallonie's Region, EIA study needs to evaluate the impact on wildlife particularly birds including the impact on breeding area, identification of 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 on birds. If the project has potential to impact the birds resting, feeding or reproduction area or migratory corridor, then a detailed study need to be conducted.
- *India:* EIA or biodiversity assessment is not applicable thus protection of flora and fauna is hardly considered.

10.2 Benefit Sharing

Many long-term conflicts between the local community members and project developers can be resolved at the project planning stage by involving the landowner or affected people in a project benefit scheme such as offering some sort of mutually consensual financial benefits (see Table 10.2: *Wind farm and benefit sharing*).

Unutilised area can be used for agriculture and grazing

Table 10.2: **Wind farm and benefit sharing**

Countries	Benefit Sharing
India	No benefit sharing as such if private land is used for setting-up the wind farm. In India, the land is purchased at a certain rate and then there are no further transactions in terms of lease payments or royalty as such.
Denmark	• According to a new Danish legislation, there must be an option to purchase shares in wind development projects. • In order to support the idea of local ownership, residents who live within 4.5 km of the site must be offered 20 per cent 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 improving landscape, recreational value or local, cultural and informative activities aimed at increasing acceptance of RE.[1]
UK	• Depending on the size of turbine and the wind speed, farmers can earn £2000-£4000 per annum from each turbine, which typically take up 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: a. Income for upto 30 years b. Rental income in excess of £2000 per turbine per year[2]
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 per cent of gross revenues. The amount that a developer offers to compensate the landowner is dependent upon a number of factors, including: • Annual energy output • Power purchase agreement • How valuable the property is to the project *Compensation for impacts*: 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 A 90 m diameter turbine generates around 14,000 CAD per year revenues to landowners, whereas a turbine located at 100 m away generates 4,000 CAD per year; and 2,000 CAD per year for those within 300 m.
Belgium	In Belgium, Enervest Wind Energy Company (EnerVest AG) offers financial allowance to directly and indirectly affected people. The company offers 200 - 250 €/ha/year to affected people who are living close to the wind farm, whereas financial allowance in between 5,000-12,000 €/turbine/year is offered to the landowner whose land has been used by the company for wind turbines. Similar types of financial grants are offered by a Belgian and Dutch established energy company called WindVision.[3]
US	Usually four types of compensation packages are offered: • One time lump sum payment • Fixed payment at scheduled intervals i.e. a set amount per turbine per year, for instance, in High Winds Farms in Solano County, California, the project developer paid $25.5 million as a lease payment which was distributed among eight landowners over the 25 year life of the project.[4] • Royalty payments based on gross revenues — revenue generated by selling wind generated electricity determines the total royalty payments • A combination of the above three payment methods Apart from these methods, in some cases, the landowner also receives a signing bonus. The compensation also varies depending upon factors such as the type and value of land, wind power density, location and access to a transmission line — site close to transmission lines pay better returns to the landowner, price of energy, land value, electricity demand, etc.
France	• In Le Haut des Ailes, landowners with wind turbines on their land receive only 70 per cent of the royalties paid for land leases. The remaining 30 per cent is paid to adjoining landowners who reside close to the wind turbines.[5]

Annexure 1: Key provisions for forest land diversion

Table 1: **Key provisions for diversion of forestland for non-forest purposes under the Forest (Conservation) Act, 1980**

Keys 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 the threat posed 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[1] wind farm.
The tips of wind turbines should be painted orange to avoid bird hits. The state government should take sufficient precautions in siting the wind mills so that they do not stand in the migratory paths of birds and are not located near breeding sites.	Painting of windmills 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 m 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 should 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 can 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 clarifying the numbers. Wind farms may create between 0.4 and 1.4 jobs per MW during the construction phase. However, during operation and maintenance (O&M), it creates around 0.06 to 0.2 jobs per MW. For instance, a 50-MW wind farm may create 20 to 70 jobs during construction and three to 10 jobs during O&M.[2]
The lease period initially should 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 should 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 the developer to the 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.

Continued...

Table 1: **...continued**

Keys provisions of guidelines	Remarks
Land area (circle) of 100 m in diameter should be provided for installation of a wind mast for every 500 ha. A one-time payment of Rs 1 lakh per wind mast should be charged. The wind mast should be removed within a maximum period of two years.	The guideline fails to describe the environmental precautions to be considered for mast installation. Too much focus on money collection.
A lease rent of Rs 30,000/MW should 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, NPV 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.	There is no provision for a report to show that the lease rent has been used for providing gas connections
65 to 70 per cent of the leased out area should be utilised for developing medicinal plant gardens where feasible.	Good intiatives, but no implementation
Soil and moisture conservation measures like contour trenching should be taken up on the hills supporting windmills.	Good initiatives, but no implementation.
Since the output of a windmill is only 25 per cent of its capacity, a cost-benefit analysis of the project is 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.	Good initiative but it should be used as a screening criterion to check the project feasibility in the forest area.
The alignment of roads should 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.

Annexure 2: Biodiversity assessment

Introduction

In case, a wind power project or transmission lines involves forestland diversion or is coming up in an ecologically sensitive area, biodiversity assessment is a pre-requisite.

In most cases, in the name of biodiversity assessment, merely a list of flora and fauna is provided. The final conclusion drawn in such reports is that the project will have "no impact on biodiversity" despite the fact that the project is coming up in an ecologically sensitive area.

As a good practice, it is recommended that if a project is likely to cause impacts on local biodiversity, then it is always advisable to conduct an independent assessment (see Box: *Do all wind power projects require biodiversity assessment*), rather than including it in the EIA. However, if anticipated impacts are limited, then a biodiversity management plan may be integrated with common EMP.

While conducting the biodiversity assessment, the first and foremost step is to note the season and the duration of the assessment. If the site is very sensitive, for instance, it falls in migratory birds route or if any specific bird/bat sites such as nesting, breeding or foraging sites, then one season's data is not sufficient and a comprehensive assessment is required.

Do all wind power projects require biodiversity assessment?

To determine whether a project requires biodiversity assessment or not, the process of screening is an influential step and plays a crucial role in establishing the requirement for and the extent of biodiversity assessment.

If the screening process determines the necessity and extent of an assessment, then the process of scoping lays out the key issues that can be included in the biodiversity assessment. In order to ensure effective scoping, the following activities are a prerequisite — site visit, local stakeholder participation and use of a checklist to identify potential areas of concern.

At the scoping stage, there is also a need to develop consensus on a baseline survey requirement, prediction method and evaluation criteria with the involvement of appropriate bodies.

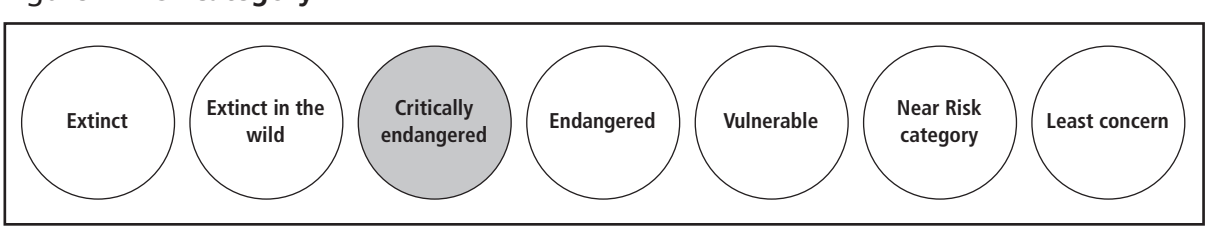
It is also important to review the cost and benefits of development project vis-à-vis the richness, sensitivity and importance of biodiversity. If the site is very sensitive and will cause irreversible impacts on biodiversity, which cannot be compensated in any way possible then a site alternative is the best option.

Risk category assessment

One of the essential components of biodiversity assessment is the identification of the presence of vulnerable, endangered and critically endangered plant and animals species including avian species. The assessment takes place at the project site or in adjoining areas, if either or both are categorised as highest risk category (see Figure 1: *Risk category*) under the Indian Wildlife (Protection) Act 1972, or as assigned by the International Union for Conservation of Nature (IUCN).
There are five quantitative criteria normally used to determine whether a taxon is threatened. They are:

- Populations have declined or will decrease, by greater than 80 per cent over the last 10 years or three generations.
- A restricted geographical range.
- Small population size of less than 250 individuals and continue to decline at 25 per cent in 3 years or one generation.
- Very small or restricted population of less than 50 mature individuals.
- High probability of extinction in the wild.

Figure 1: **Risk category**



Source: http://moef.nic.in/downloads/public-information/critically_endangered_booklet.pdf

Table 1: **Approach to assess the potential impact at the initial stage**

Issues	Significance and method of preliminarily assessment
Proximity of national park/ wildlife sanctuary/ reserve forest/ old caves (habitat for bats)	• Closeness to the project site and high abundance of avian fauna means high impact is anticipated and thus project proponent must do preliminary site investigation to ensure significance of impact.
Encroachment of forest land	• Decision can be either "Yes" or "No" based on species richness, species-specific impact, threat to inhabitants and economic value offered by the forest
Location of the project affects the foraging/ breeding/ nesting/migration routes of birds/bats and other animals	• Anticipated impact of bird/bat strike would be high and preliminary avian fauna assessment is a prerequisite for site feasibility and thus decision can be taken either "YES" or "NO" Method – Interaction with forest department, local villagers and reconaissance survey.
Presence of vulnerable, endangered and critically endangered plant and animals species including avian species at the project site or in adjoining areas	• Anticipated impact would be high and preliminarily assessment is prerequisite for site feasibility and thus decision can be either "Yes" or "No" **Note:** *Local stakeholders and the forest department can provide valuable information on species' inventory and provide sound information on environmental and economic importance of species.*
Proposed project is close to waterholes or to wetlands or/ and fish breeding grounds	• Presence of water holes/wetlands and fish breeding grounds would attract large number of birds and thus risk of bird strike would be high. Preliminary assessment is a prerequisite for site feasibility and thus decision will be either "Yes" or "No". • Method — Interaction with forest department, survey of site and input from the local stakeholders.
Proposed project activities would increase siltation that would affect surrounding biodiversity	• Method — By studying the rainfall, site elevation and flow pattern • If runoff originates from the site following the direction of biodiversity area, then the impact would be high
Does the project likely effect the fauna of an area, which has economic/medicinal value	• Detailed assessment of flora by a taxonomist is the best method. Moreover, local stakeholder input is vital in identifying the medicinal value of plant species

Source: Centre for Science and Environment, 2013

Quick way to assess the potential impact on Biodiversity

While doing biodiversity assessment – the option for "site alternative" and "Preventive Approach" is the best method to reduce the impact on biodiversity. There are some methods, which can be very useful to assess the likely impact of project at the conceptualization stage (see Table 1: *Approach to assess the potential impact*).

Guiding parameters for effective assessment

There are some key guiding parameters, which need to be carefully examined while dealing with a sensitive project or when forestland diversion is required.
These parameters are as follows:

- In case of very sensitive area, biodiversity assessment must be comprehensive.
- Option for a "site alternative" in case of areas which have a unique habitat or are populated with endemic, threatened or declining species, or species of high economic and cultural value to society or an ecosystem, for instance areas with mangrove trees.
- Type of forest and area of forestland diverted for non-forest use and status of forest cover.
- Biodiversity should be assessed on the basis of parameters mentioned below:

a. *Composition:* What biological units are present and how abundant are they?
b. *Structure (or pattern):* How biological units are organised in time and space?
c. *Function:* The role different biological units play in maintaining natural processes and dynamics.

- Number of trees to be cut down with age and name (both scientific and local)
- Details of flora, fauna and avian fauna present in the area, their abundance and the season in which abundance is high. Also, for avian fauna assessment the following details should be furnished:

a. Types of birds and bird activities across the wind farm project

b. Identify birds species listed as threatened or migratory or any specific species coming in a specific season
c. Record the location and extent of bird habitat with reference to significance to conservation
d. Record the flight behaviour of raptor
e. Identification of resident and transient bird species
f. Birds utilisation status — determine all the species present across different seasons and how they utilise the site
g. Identification of flight height to determine species at risk (for potential collisions)

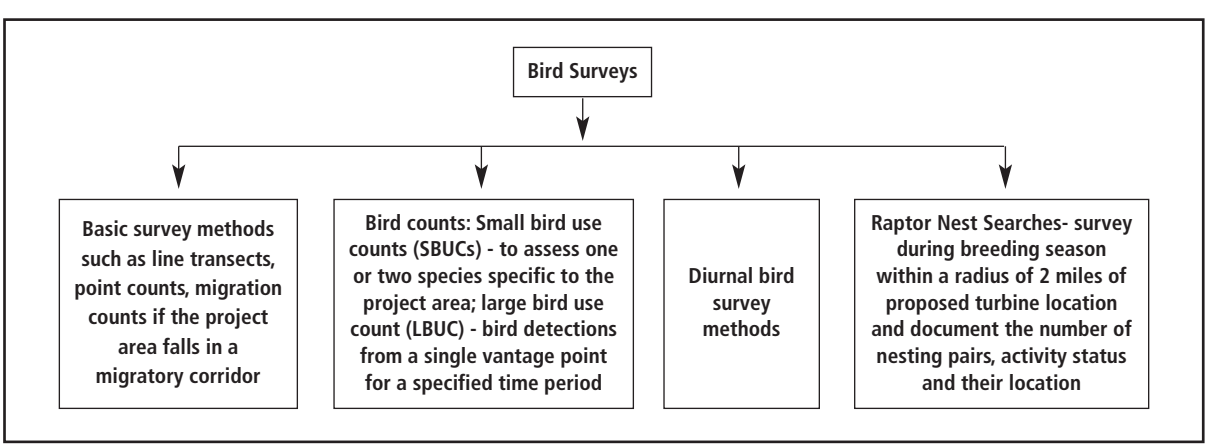
Also, refer to Figure 2 and Figure 3 for *sampling methods of birds and bats for before and during construction of wind turbines and* see Box: *Survey method used in Australia for assessment of avian fauna and Bat Assessment*.

- Project site or adjoining area support high species diversity i.e. Western Ghats or fragile ecosystems, if any like mountain ecosystem
- How fauna and avian fauna assessment was conducted — whether nocturnal and diurnal behaviour has been considered.
- Impact on forest produce or areas provide important biodiversity services. If yes, then, was any attempt has been made to evaluate the loss of forest-based economy.
- Whether state forest department had authenticated and verified the wildlife or migratory corridor.
- Whether local people have been consulted in flora and fauna identification.
- Report must provide procedure for impact evaluation and how the impact are evaluated.

Review of mitigation plan for biodiversity

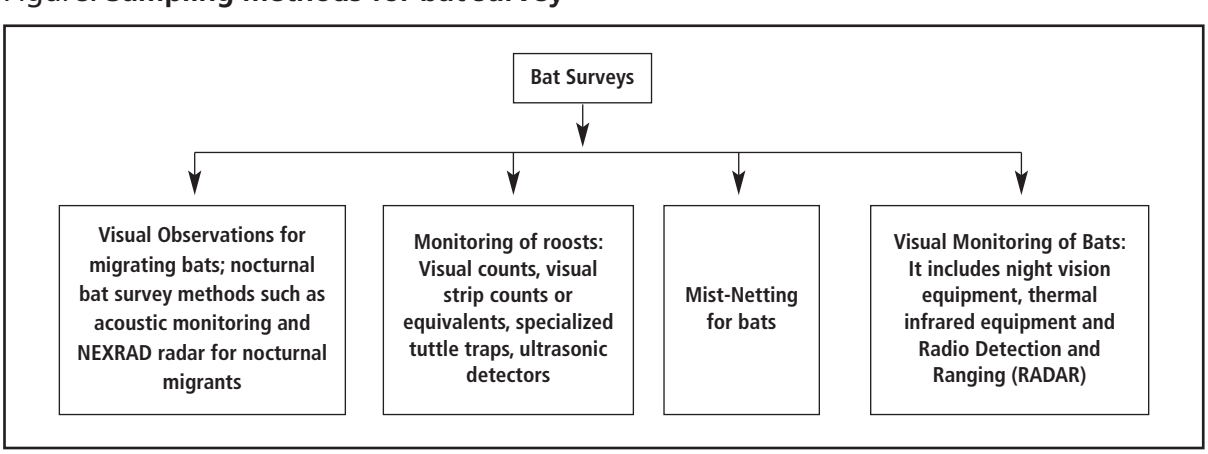
While preparing a biodiversity conservation plan, the focus should be on safeguarding biodiversity and the ecosystem as far as practicable. As a general rule, if impacts are irreversible and cannot be compensated by any means, it is better to avoid the site. If impacts are manageable, then

Figure 2: **Sampling methods for bird survey**



Source: Compiled by CSE team with inputs from Bombay Natural History Society

Figure: **Sampling methods for bat survey**



Source: Compiled by CSE team with inputs from Bombay Natural History Society

Survey method used in Australia for assessment of avian fauna

In Australia, following methods are used for avian fauna assessment:

Fixed count method in which the activities include: (a) Identification of bird survey site (b) Fixing time duration for point counting (c) Recording details – species type, number of individual, number of movement, height above ground (d), Distance from observer (e) Behaviour.

Under behaviour of avian fauna following details are recorded: (a) Flying in single direction (b) Flying (hovering or circling) over or above a single path (c) Forging on ground (d) Perching/resting/walking on ground (e) Direction of flight, if possible

In Opportunistic observation, the birds are observed while travelling between the sites, while in **nest survey method**, identification and counting of nest of various birds are performed in different seasons, this method assist in understanding the species used for nesting, it may be resident or transient bird species or both.

Bat Assessment

The method used for bat survey in Australia includes:

- Preliminary assessment through literature review followed by actual field survey.
- Under field survey following activities are conducted:

a. Identification of bat species utilising the site or present in the study area
b. Presence of habitats within the site
c. Recording of bat behaviour such as flight patterns and flight heights
d. Identification of roosting and foraging habitats of bat species present in the project site
e. Identification of bat species recognised as threatened or rare or national and state significant

After procuring all information, GIS map is prepared to locate bat survey locations and bat activity. For conducting field surveys usually AnaBat detectors are used. The passive surveys identifies bat species utilising the project site and record bat call activity across the project site. In the passive surveys, different habitats are surveyed with the help of AnaBat detectors. The assessment also includes additional methods to support passive surveys, which are listed as follows:

a. *Trapping*: This method involves use of instruments that capture bats for species identification and bats are released after taking identification and reference calls.
b *Active surveys*: Undertaken to record better bat call sequences. It is also combined with a light tagging technique where small glow sticks are attached to bat fur with medical glue and these glow sticks fall off within few days. It helps in following bat's flight path for a short time.

minimise the impacts by creating a Biodiversity Action Plan (BAP). Similarly, Conservation Plans incorporate Species Action Plans (SAPs) where the mitigation is targeted for the protection of a specific species and Habitat Action Plans (HAPs) which aim at protection of habitats of rare, critically endangered, endangered and vulnerable species. Some key components that must be provided for reviewing the conservation plan include financial requirements for conservation, responsible authorities and monitoring schedule.

Annexure 3: List of threatened bird species in India

According to the Bird Life International and IUCN list of 2011, 153 species of birds found in India are globally threatened. This includes 15 Critically Endangered, 15 Endangered, 52 Vulnerable, 66 Near Threatened, 2 Data Deficient, and 3 Taxonomic upgrades. The list given below includes all the endemic threatened species that occur only in India and semi-endemic species such as Sarus Crane, Lesser Florican, Great Indian Bustard, Long-billed Vulture; bulk of the world's population of the semi-endemics is found in India. This list also includes bird species which are found in many other countries, however, the major conservation action of these birds is taking place in India; if they disappear from India, their global population will decline. Some of these bird species are Spot-billed Pelican, Indian Skimmer, Greater Adjutant, Painted Stork, Black-necked Stork, etc.

Out of 153 globally threatened bird species found in India, for 110 species, India is extremely important for their survival. Care should be taken if the wind mills are coming in areas having high population of threatened species. Table 1 enlists the 110 species of birds which are categorized as critically endangered, endangered, vulnerable, near threatened and data deficient.

Table 1: **Simple approach to assess the potential impact**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
1	Himalayan Quail *Ophrysia superciliosa*	CR	100% population found in India. Last reported in 1878. Sustained scientific searches are requied to locate it.
2	Pink-headed Duck *Rhodonessa caryophyllacea*	CR	Possibly extinct in India as no probable wetland habitab remains, but maybe it survives in Myanmar. No population estimate available.
3	White-bellied Heron *Ardea insignis*	CR	Almost 50% of global population found in India. Top priority for research. Protection of rivers against disturbance and overfishing.
4	White-rumped Vulture *Gyps bengalensis*	CR	80-90% of global population found in India. Conservation breeding and complete ban on veterinary use of diclofenac. Extremely high chances of extinction.
5	Indian Vulture *Gyps indicus*	CR	95-99% of global breeding population found in India. Conservation breeding and complete ban on veterinary use of diclofenac. Extremely high chances of extinction.
6	Slender-billed Vulture *Gyps tenuirostris*	CR	Almost 80% of global population found in India. Conservation breeding and total ban on veterinary use of diclofenac. Extremely high chances of extinction.
7	Red-headed Vulture *Sarcogyps calvus*	CR	50-70% of global population may be found in India. Extensive surveys needed.
8	Bengal Florican *Houbaropsis bengalensis*	CR	Almost 50% population found in India. Protection of terai grasslands. Research on its movements required urgently. Project Bustards required.
9	Great Indian Bustard *Ardeotis nigriceps*	CR	Upto 90% population in India. Extreme chances of extinction in 10-15 years. Project Bustartds, and maybe conservation breeding required urgently.
10	Jerdon's Courser *Rhinoptilus bitorquatus*	CR	Single known population (100%) in India. Ecological research and habitat protection are top priorities.
11	Forest Owlet *Heteroglaux blewitti*	CR	Single known population (100%) in India. Habitat protection urgently required, particularly in Yawal, Shahada, Toranmal.

Continued…

Table 2: **...continued**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
12	White-winged Duck *Cairina scutulata*	EN	Population estimate not available. India has a major role in protecting its wetland habitat. Research on ecology and habitat requirement needed.
13	Greater Adjutant *Leptopilos dubius*	EN	Over 50% population found in India. Special conservation initiatives needed to protect its breeding and feeding areas.
14	Egyptian Vulture *Neophron percnopterus*	EN	Impact of diclofenac and other factors to be assessed to study its decline.
15	Lesser Florican *Sypheotides indicus*	EN	Almost 100% breeding population found in India. Grassland protection and control on hunting top priorities. Study movement through ringing and satellite tracking.
16	Masked Finfoot *Heliopais personatus*	EN	Survey Sundarbans to locate its population. After that, detailed study on its biology. Strict control on poaching.
17	Narcondam Hornbill *Aceros narcondami*	EN	100% population in India. Total protection of its small island habitat required. No more infrastructure development or increase in human population in Narcondam island.
18	Black-chinned Laughingthrush *Strophocinchala cachinnans*	EN	100% breeding in India. Small habitat remains in Nilgiris. Total protection of habitat required. Research on impact of pesticides on its breeding.
19	White-bellied Blue Robin *Myiomela albiventris*	EN	100% population in India. Total protection to its 'sky islands' in Western Ghats. Genetic studies required.
20	Nilgiri Blue Robin *Myiomela major*	EN	100% population in India. Total protection to its 'sky islands' in Western Ghats. Genetic studies required.
21	Nicobar Megapode *Megapodius nicobariensis*	VU	100% population in India. Total protection to its 'sky islands' in Western Ghats. Genetic studies required.
22	Swamp Florican *Francolinus gularis*	VU	Almost 80% of world population in India. Total protection to its grassland habitat; strict ban on hunting/trapping.
23	Manipur Bush-quail *Perdicula manipurensis*	VU	100% population in India. Very few recent records. Survey urgently required.
24	Chestnut-brested Partridge *Arborophila mandelli*	VU	Almost 80% of world population found in India. Total protection to its forest/grassland habitat, and strict control on hunting/trapping.
25	Western Tragopan *Tragopan melanocephalus*	VU	Maybe 50% of world population found in India. Total protection to its grassland/forest habitat, and strict ban on hunting/trapping.
26	Blyth's Tragopan *Tragopan blythii*	VU	India has a major role to play to protect its forest habitat.
27	Sclater's Monal *Lophophorus sclateri*	VU	India has a major role to play to protect its forest habitat.
28	Cheer Pheasant *Catreus wallichi*	VU	India has a major role to play to protect its forest habitat.
29	Lesser Adjutant *Leptoptilos javanicus*	VU	Major part of the world population found in India. Research and protection of nesting sites required.
30	Pallas's Fish-eagle *Haliaeetus leucoryphus*	VU	Major part of global population found in India. Research and protection of nesting sites required.

...continued

Table 2: **...continued**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
31	Nicobar Sparrow-hawk *Accipiter butleri*	VU	100% population in India. Full-fledged research programme, including genetic studies required.
32	Indian Spotted Eagle *Aquila hastata*	VU	Almost 50% of world population in India. Surveys, monitoring and research on ecology required.
33	Sarus Crane *Grus antigone*	VU	Almost 95% of breeding population in India. India's iconic wetland bird. Long term research and monitoring programme.
34	Black-necked Crane *Grus nigricollis*	VU	Iconic bird of high altitude wetlands of Ladakh, though only 1% of world population in India. Culturally important. Strict control of tourism and army near breeding sites. Eradication of feral dogs.
35	Indian Skimmer *Rynchops albicollis*	VU	Indian rivers very important as breeding sites. Monitoring and long term study on ecology. Protection of river islands urgently required.
36	Pale-backed Pigeon *Columba eversmanni*	VU	India is a very important wintering habitat. Ban on hunting and trapping.
37	Nilgiri Wood-pigeon *Columba elphinstonii*	VU	100% population in India. Totally dependent on intact forests in Western Ghats. Study on movement and ecology.
38	Pale-capped Pigeon *Columba punicea*	VU	India may have significant global population. Surveys in northeast India and Orissa-Chhattisgarh-Jharkhand required.
39	Dark-rumped Swift *Apus acuticauda*	VU	India may have significant global population. Surveys in northeast India and Orissa-Chhattisgarh-Jharkhand required.
40	Rufous-necked Hornbill *Acerous nipalensis*	VU	Strict control on poaching through involvement of local people. Surveys, monitoring and studies on its ecological behaviour.
41	Great Slaty Woodpecker *Mulleripicus pulverulentus*	VU	Important indicator species of intact forests. Revival of natural forests, e.g., in Dudhwa, by removal of Teak plantation, required.
42	White-naped Tit *Parus nuchalis*	VU	100% population in India. Protection of old-growth thorn forest in Gujarat, Rajasthan, Karnataka, Tamil Nadu. Provision of nest boxes. Urgently requires studies on breeding biology.
43	Grey-crowned Prinia *Prinia cinereocapilla*	VU	Detailed survey and based on survey results, special protection to its grassland habitats.
44	Yellow-throated Bulbul *Pycnonotus xantholaemus*	VU	100% population in India. Protection of forest/scrub. Detailed surveys all over its range, particularly to find whether it exists in Orissa or not.
45	Bristed Grassbird *Chaetornis striata*	VU	Detailed surveys to determine its numbers and protection of grasslands to forest plantation.
46	Broad-tailed Grassbird *Schoenicola platyrus*	VU	100% population in India. Detailed surveys to determine its numbers and protection of grassland habitat. Prevent conversion of grasslands to forest plantations.
47	Marsh Babbler *Pellorneum palustre*	VU	Upto 80% of world population may be in India. Surveys to determine its numbers and protection to its terai grassland habitat. Strict control on livestock grazing and conversion of grasslands to forest plantation.
48	Rusty-throated Wren-babbler *Spelaeornis badeigularis*	VU	100% population in India. Surveys and detailed studies on its ecology, habitat requirements and behaviour required.

...continued

Table 2: **...continued**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
49	Tawny-breasted Wren-babbler *Spelaeornis longicaudatus*	VU	100% population in India. Surveys and detailed studies on its ecology, habitat requirements and behaviour required.
50	Snowy-throated Babbler *Stachyris oglei*	VU	Almost 90% of world population in India. Surveys and detailed studies on its ecology, habitat requirements and behaviour required.
51	Jerdon's Babbler *Turdoides longirostris*	VU	May be 50% of population in India. Protection of its grassland habitat. Surveys and detailed studies on its ecology, habitat requirements and behaviour required.
52	Slender-billed Babbler *Turdoides longirostris*	VU	Upto 80% population in India. Protection of its grassland required. Surveys and detailed studies on its ecology, habitat requirements and behaviour required.
53	Bugun Liocichla *Liocichla bugunorum*	VU	100% population in India. Detailed surveys to find its total range of occupancy, detailed studies on its ecology and behaviour required.
54	Black-breasted Parrotbill *Paradoxornis flavirostris*	VU	Upto 90% of population in India. May be extreme habitat specialist. Detailed ecological studies on marked birds. Strict protection of its grassland habitat and surveys to find new areas in the Brahmaputra floodplains. Creation of suitable grasslands in new extension of Kaziranga. Inclusion of Amarpur grasslands in Dibru-Saikhowa NP.
55	Beautiful Nuthatch *Sitta farmosa*	VU	Studies on its habitat requirement and ecology. Impact of dams in Northeast on its habitat.
56	White-browed Bushchat *Saxicola macrorhynchus*	VU	Have major populations in India. Detailed studies on its distribution, ecology and behaviour, with marked birds required.
57	Browned-chested Jungle-flycatcher *Rhinomyias brunneatus*	VU	Genetic studies of the birds found in Andaman and Nicobar to settle taxonomic dispute. If Nicobar Jungle-flycatcher is a valid species, detailed ecological research.
58	Kashmir Flycatcher *Ficedula subrubra*	VU	Up to 95% of population in India. Protection of its wintering habitat in Western Ghats. Studies on breeding ecology in Kashmir. Extensive banding with numbered and colou-coded rings to trace its movements.
59	Yellow Weaver *Ploceus megarhynchus*	VU	Up to 80% population in India. Major rehabilitation programme required to revive/restore its terai habitat, conservation breeding and release, and strict ban on trapping. Control of crow population near its major breeding areas.
60	Green Munia *Amandava formosa*	VU	100% population in India. Strict control on trapping. Surveys to determine its exact distributional range.
61	Nilgiri Pipit *Anthus nilghiriensis*	VU	100% population in India. Total ban on conversion of high altitude grasslands of Western Ghats to forest plantation and complete ban on overgrazing. Practical method for control invasive Scotch Bloom.
62	Satyr Tragopan *Tragopan satyra*	NT	Upt to 50% of population in India. Control of poaching and trapping.
63	Lesser Flamingo *Phoeniconaias minor*	NT	Control of poaching and trapping. Protection of nesting sites in Kutch, and wintering sits in rest India, particularly in Sewri mudflats near Mumbai.

...continued

Table 2: **...continued**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
64	Painted Stork *Mycteria leucocephala*	NT	India has major population. Continue protection of nesting sites through involvement of people. Studies on movement through marked birds and satellite tracking. Protection and revival of wetlands to benefit people and birds. Total prohibition of zero-net fishing.
65	Black-necked Stork *Ephippiorhynchus asiaticus*	NT	Almost 50% of world population in India. Protection and revival of wetlands to benefit people and birds. Total prohibition of zero-net fishing. Studies on movement through marked birds and satellite tracking.
66	Black-headed Ibis *Threskiornis melanocephalus*	NT	Over 50% population in India. Continue protection of nesting sites through involvement of people. Protection and revival of wetlands to benefit people and birds. Total prohibition of zero-net fishing.
67	Spot-billed Pelican *Pelecanus philippensis*	NT	May be upto 60-70% global population in India. Continue protection of nesting sites through involvement of people. Studies on movement through marked birds and satellite tracking. Protection and revival of wetlands to benefit people and birds. Total prohibition of zero-net fishing.
68	Oriental Darter *Anhinga melanogaster*	NT	Up to 50% population in India. Continue protection of nesting sites through involvement of people. Protection and revival of wetlands to benefit people and birds. Total prohibition of zero-net fishing.
69	Laggar Falcon *Falco jugger*	NT	Up to 50% of population in India. Strict control on trapping. Surveys and regular population monitoring, and studies on its ecology and impact of pesticides.
70	Lesser Fish-eagle	NT	Detailed surveys to determine its exact distribution range. Studies on impact of pesticides on its food chain.
71	Grey-headed Fish-eagle *Ichthyophaga humilis*	NT	Detailed surveys to determine its exact distribution range. Studies on impact of pesticides on its food chain.
72	South Nicobar Serpent-eagle *Ichthyophaga ichthyaetus*	NT	100% population in India. Detailed genetic studies of all serpent-eagles of Andaman and Nicobar to settle taxonomic dispute.
73	Andaman Serpent-eagle *Spilornis klossi*	NT	100% population in India. Detailed genetic studies of all serpent-eagles of Andaman and Nicobar to settle taxonomic dispute.
74	Andaman Crake *Rallina canningi*	NT	100% population in India. Strict control on hunting with involvement of people wherever possible, and protection to its wetland habitat.
75	Black-bellied Tern *Sterna acuticauda*	NT	Up to 50% population in India. India has a major role in protection of its nesting sites in main rivers. Detailed all-India survey and then regular population monitoring.
76	Andaman Wood-pigeon *Columba palumboides*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
77	Andaman Cuckoo-dove *Macropygia rufipennis*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
78	Nicobar Pigeon *Caloenas nicobarica*	NT	Control on hunting with guns, wherever possible, with involvement of local people.

...continued

Table 2: **...continued**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
79	Nicobar Parakeet *Psittacula caniceps*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
80	Long-tailed Parakeet *Psittacula longicauda*	NT	Control on hunting with guns, wherever possible, with involvement of local people.
81	Yellow-rumped Honeyguide *Indicator xanthonotus*	NT	Detailed surveys in Himalaya to find extant populations; encourage sustainable exploitation of honey by local people. Study colony collapse syndrome of honeybee.
82	Andaman Scops-owl *Otus balli*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
83	Andaman Hawk-owl *Ninox affini*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
84	Ward's Trogon *Harpactes wardi*	NT	India may have major population. Strict protection of forest streams against excessive fishing and disturbances. Ecological studies, impact of dams and development projects on its status.
85	Blyth's Kingfisher *Alcedo Hercules*	NT	India may have major population. Strict protection of forest streams against excessive fishing and disturbances. Ecological studies, impact of dams and development projects on its status.
86	Austen's Bron Hornbill *Anorrhinus austeni*	NT	India may have major population. Strict protection of forest streams against excessive fishing and disturbances. Ecological studies, impact of dams and development projects on its status.
87	Malabar Pied Hornbill *Anthracoceros coronatus*	NT	100% population in India. Restricted to Western Ghats. Prevention of hunting and destruction of old Ficus trees.
88	Andaman Woodpecker *Dryocopus hodgei*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
89	Andaman Treepie *Dendrocitta bayleyi*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
90	Andaman Drongo *Dicrurus andamanensis*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
91	Rufous-vented Prinia *Prinia burnesii*	NT	May be 50% of population in India. Protection of floodplain grasslands in northwest (Punjab) and northeast India (Assam, Arunachal etc.). Genetic studies of two disparate populations to know the variance, and whether they are full species.
92	Nicobar Bulbul *Hypsipetes nicobariensis*	NT	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people.
93	Grey-headed Bulbul *Pycnonotus priocephalus*	NT	100% population in India. Restricted to Western Ghats. Surveys and regular monitoring of its populations.
94	Rufous-rumped Grassbird *Graminicola bengalensis*	NT	Strict protection to its terai grasslands. Ecological studies to find out the best time to burn/harvest grass.
95	Long-billed Brush-warbler *Bradypterus major*	NT	Surveys to find out its main breeding areas in the Himalayas.
96	Tytler's Leaf warbler *Phylloscopus tytleri*	NT	Up to 80% population in India. Protection of forest, particularly in northern Western Ghats.

...continued

Table 2: **...continued**

S No.	Common Name / Scientific Name	Threat 2011	Important recommendations in brief
97	Rufous-throated Wren-babbler *Spelaeornis caudatus*	NT	Maybe 50% population in India. Strict protection of its forest habitat. Ecological studies, impact of dams and development projects on its status.
98	Long-tailed Wren babbler or Naga Wren-babbler *Spelaeornis chocolatinus*	NT	100% population in India. Strict protection of its forest habitats. Ecological studies, impact of dams and development projects on its status.
99	Blackish-breasted Babbler or Sikkim Wedge biller Babbler *Sphenocichla humei*	NT	Maybe 90% population in India. Strict protection of its forest habitat. Ecological studies, impact of dams and development projects on its status.
100	Chevron-breasted Babbler or Cachar Wedge-biller Babbler *Sphenocichla roberti*	NT	Maybe 50% population in India. Strict protection of its forest habitat. Ecological studies, impact of dams and development projects on its status.
101	Chestnut-backed Laughing thrush *Garrulax nuchalis*	NT	Maybe 50% population in India. Ecological studies, impact of dams and development projects on its status.
102	Kerala Laughing thrush *Garrulax fairbanki*	NT	100% population in India. Restricted to southern Western Ghats. Genetic studies to determine its taxonomic status.
103	Rusty-bellied Shortwing *Brachypterynx hyperythra*	NT	India may have major population. Strict protection to its forest habitat. Ecological studies, impact of dams and development projects on its status.
104	Black-and-orange Flycatcher *Ficedula nigrorufa*	NT	100% population in India. Restricted to Western Ghats. Surveys and monitoring of its populations, and study of connectivity between populations.
105	Nilgiri Flycatcher *Eumyias albicaudatus*	NT	100% population in India. Restricted to Western Ghats. Surveys and monitoring of its populations, and study of connectivity between populations.
106	Nicobar Acops-owl *Otus alius*	DD	100% population in India. Genetic and ecological studies required.
107	Large-billed Reed-warbler *Acrocephalus orinus*	DD	Collaboration with international teams in Afghanistan and Thailand. Detailed survey of breeding and wintering populations in India.
108	Andaman Teal *Anas albogularis*	New	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people. Protection of wetlands. Genetic studies to determine its taxonomic status.
109	Andaman Barn Owl *Tyto deroepstorffi*	New	Control on hunting with guns, wherever possible, through involvement of local people. Genetic studies to determine its taxonomic status.
110	Andaman Cuckoo-shrike *Coracina dobsoni*	New	100% population in India. Control on hunting with guns, wherever possible, with involvement of local people. Genetic studies to determine its taxonomic status.

Note: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Nearly Threatened; DD – Data Deficient; New – Taxonomic Upgades

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