

**Overseas Private Investment  
Corporation  
Environmental Guidance  
Renewable Energy – Wind Projects**

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## Acknowledgements

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# Overseas Private Investment Corporation Environmental Guidance Renewable Energy – Wind Projects

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# Overseas Private Investment Corporation

## Environmental Guidance

### Renewable Energy – Wind Projects

#### Section 1.0 - Introduction

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##### 1.1 Project Definition

These guidelines apply to projects that involve the development of energy harnessing power from wind through wind turbines, both at the utility scale level and also through stand-alone units (i.e. small individual turbines used to power a specific building). Wind generation projects can be located onshore or offshore. Wind turbines comprise a tower, two to three blades, a generator, a controller, a nacelle and an anemometer. Towers are made from tubular steel or steel lattice and stand typically 100 feet (ft.) or more above the ground. Blades are connected to a shaft, which is connected to an electrical generator, which converts the mechanical energy of the spinning blades into electricity. The controller starts up and shuts down the machine at specified wind speeds, which are measured and then transmitted to the controller by the anemometer. The nacelle contains most of the working parts of the turbine and sits atop the tower.

The scope of wind projects also includes any associated infrastructure or ancillary facilities associated with the Project, including those that are not funded as part of the Project (funding may be provided separately), but whose viability and existence depend exclusively on the Project, and whose goods and services are essential for the successful operation of the Project. These may include pipelines, power transmission lines, access roads, and temporary-worker housing.

##### 1.2 Summary of Significant Issues

These guidelines discuss the evaluation features most significant to wind development projects and reflect the information contained in the International Finance Corporation's Environmental, Health and Safety Guidelines for Wind Energy, International Finance Corporation's General Environmental, Health and Safety Guidelines, International Finance Corporation's Performance Standards and other relevant standards and guidelines.

These features include:

- Presence of critical or sensitive habitat on or adjacent to the site.
- Presence of bird or bat migration routes or areas of congregation.
- Land acquisition and land use.
- Socio-cultural issues.
- Community issues.
- The potential for infrastructure interference (navigation, radar, telecommunication).
- Impacts related to the construction of ancillary facilities including access roads and power transmission lines.
- Cumulative effects.

### 1.3 Scope of the Guidelines

These guidelines present potential environmental and social issues associated with wind energy projects, how OPIC may consider each of these issues when screening projects, applicable guidelines and standards, recommended measures to mitigate impacts, information needed to review a project, and monitoring recommendations.

These guidelines discuss the evaluation features that, in general, are most significant with respect to wind energy projects and therefore require more emphasis while conducting environmental and social due diligence. As each project is unique, these guidelines may not capture the complete set of environmental and social issues related to wind projects. Each project is distinct and therefore will have environmental and social issues associated exclusively with that particular project.

It should be noted that these guidelines do not discuss typical impacts from construction and civil works such as erosion, impacts to water quality, solid waste disposal, and occupational health and safety issues. For additional guidance on these matters, please refer to IFC's General Environmental, Health and Safety Guidelines (April 30, 2007) (Please refer to Section 2.0: Standards and Guidelines).

## Section 2.0 - Standards and Guidelines

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In addition to applicable host country requirements, wind projects are assessed against:

- **OPIC's Environmental and Social Policy Statement (2011).**  
[http://www.opic.gov/sites/default/files/consolidated\\_esps.pdf](http://www.opic.gov/sites/default/files/consolidated_esps.pdf)
- **International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability (2012).**  
<http://www.ifc.org/ifcext/policyreview.nsf/Content/2012-Edition-PerformanceStandards>
- **IFC's Environmental, Health and Safety Guidelines for Wind Energy.**  
[http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui\\_EHSGuidelines2007\\_WindEnergy/\\$FILE/Final+-+Wind+Energy.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_WindEnergy/$FILE/Final+-+Wind+Energy.pdf)
- Applicable provisions of **IFC's General Environmental Health and Safety Guidelines**, including the following:
  1. **Environment**
    - Section 1.1 Air Emissions and Ambient Air Quality
    - Section 1.2 Mobile Sources – Land-based
    - Section 1.3 Wastewater and Ambient Water Quality
    - Section 1.6 Waste Management
    - Section 1.7 Noise
  2. **Occupational Health and Safety**
    - Section 2.1 General Facility Design and Operation
    - Section 2.2 Communication and Training
    - Section 2.3 Physical Hazards
    - Section 2.7 Personal Protective Equipment
    - Section 2.9 Monitoring
  3. **Community Health and Safety**
    - Section 3.2 Structural Safety of Project Infrastructure
    - Section 3.4 Traffic Safety
    - Section 3.7 Emergency Preparedness and Response
  4. **Construction and Decommissioning**
    - Section 4.1 Environment
    - Section 4.2 Occupational Health and Safety
    - Section 4.3 Community Health and Safety

[http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui\\_EHSGuidelines2007\\_GeneralEHS/\\$FILE/Final+-+General+EHS+Guidelines.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/$FILE/Final+-+General+EHS+Guidelines.pdf)

Other guidelines relevant to ancillary infrastructure include applicable provisions of:

- **IFC's Environmental, Health and Safety Guidelines for Electrical Power and Distribution.**  
[http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui\\_EHSGuidelines2007\\_ElectricTransmission/\\$FILE/Final+-+Electric+Transmission+and+Distribution.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_ElectricTransmission/$FILE/Final+-+Electric+Transmission+and+Distribution.pdf)
- **IFC's Environmental Health and Safety Guidelines for Toll Roads.**  
[http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui\\_EHSGuidelines2007\\_TollRoads/\\$FILE/Final+-+Toll+Roads.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_TollRoads/$FILE/Final+-+Toll+Roads.pdf)
- **Workers' Accommodation: Processes and Standards: A Guidance Note by IFC and the EBRD.**  
[http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p\\_WorkersAccommodation/\\$FILE/workers\\_accomodation.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_WorkersAccommodation/$FILE/workers_accomodation.pdf)

Note: International organizations, the United States Government and Industry groups periodically revise guidelines and standards to reflect technological advances and improved understanding of environmental, health, safety, and social risks. Completed applications that are received before the effective date of a new guideline or standard will be assessed using the guideline or standard that is in effect on the date of application, provided OPIC commitment for support is achieved within one year of the effective date of the new guideline or standard. If commitment is not achieved within one year after the effective date of the new guideline, the Project will be subject to the new guideline.

## Section 3.0 - Screening

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Based on information received from the Project applicant for the purposes of environmental, social, health and safety review, OPIC screens projects into one of three categories: Categorically Prohibited, Category A, and Category B.

### 3.1 Categorically Prohibited

Wind projects can result in adverse impacts and land disturbances that may preclude OPIC support. Project location is the primary determinant of eligibility. OPIC will not support the following types of projects:

- Projects that involve conversion or degradation of Critical Forest Areas or forest-related Critical Natural Habitats.
- Projects that require resettlement of 5,000 or more persons.
- Projects in or impacting natural World Heritage Sites (<http://whc.unesco.org/en/list>) unless it can be demonstrated through an environmental assessment that the Project (i) will not result in the degradation of the protected area and (ii) will produce positive environmental and social benefits.
- Projects in or impacting areas on the United Nations List of National Parks and Protected Areas ([http://www.unep-wcmc.org/un-list-of-protected-areas\\_269.html](http://www.unep-wcmc.org/un-list-of-protected-areas_269.html)) unless it can be demonstrated through an environmental assessment that the Project (i) will not result in the degradation of the protected area and (ii) will produce positive environmental and social benefits.
- Extraction or infrastructure projects in or impacting: protected area Categories I, II, III, and IV (Strict Nature Reserve/Wilderness Areas and National Parks, Natural Monuments and Habitat/Species Management Areas), as defined by the International Union for the Conservation of Nature (IUCN). Projects in IUCN Categories V (Protected Landscape/Seascape) and VI (Managed Resource Protected Area) must be consistent with IUCN management objectives ([http://www.iucn.org/about/work/programmes/pa/pa\\_products/wcpa\\_categories/](http://www.iucn.org/about/work/programmes/pa/pa_products/wcpa_categories/)) ([http://www.iucn.org/about/work/programmes/species/red\\_list/](http://www.iucn.org/about/work/programmes/species/red_list/)) unless it can be demonstrated through an environmental assessment that the Project (i) will not result in the degradation of the protected area and (ii) will produce positive environmental and social benefits.

If not prohibited, then the wind project is further screened and categorized as either Category A or Category B.

### 3.2 Category A or Category B

Category A wind projects are likely to have significant adverse environmental and social impacts that are irreversible, sensitive, diverse, or unprecedented. Category A projects require submission of an Environmental and Social Impact Assessment (ESIA) developed in accordance with IFC P.S. 1, an on-site due-diligence visit by an OPIC environmental analyst or a third-party consultant approved by OPIC and development and implementation of an Environmental and Social Action Plan (ESAP). Within three years of the execution of the contract with OPIC, Category A projects are required to conduct a third party audit.

Issues that require careful consideration in determining whether a wind project is Category A or B include the following:

- Potential for significant habitat alteration.
- Potential for significant wildlife mortality, injury, or disturbance.
- Potential for significant socio-cultural impacts related to land acquisition, land use, indigenous peoples and cultural heritage.
- Potential for significant community impacts related to noise, visual or audio disturbance or illumination or electromagnetic effects.
- Potential for significant environmental and social impacts from ancillary features.
- Potential for significant cumulative impacts due to the siting of multiple wind facilities in one region.

If a project originally screened as a Category A is subsequently found to result in major or unreasonable adverse environmental, social, health or safety impacts, OPIC may decide to decline support.

Modifications of project design, advanced planning in siting, and operation mode may be used to avoid or significantly reduce adverse impacts of wind projects. A wind project may be screened as Category B if significant impacts are avoided, adequately mitigated and sufficient information is provided to assess such impacts, and there is no significant opposition to the Project by local stakeholders.

## Section 4.0 - Significant Issues and Applicable Guidelines and Standards

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This section describes environmental and social evaluation features associated with wind energy projects, how each of these features may affect screening determinations, and measures to mitigate impacts as provided in applicable guidelines and standards.

### 4.1 Presence of Critical or Sensitive Habitat on or Adjacent to the Site

*Description of Impact.* Impacts to habitat due to the siting of wind energy projects will vary greatly according to location, but wind projects represent the potential for significant impact to a wide array of wildlife and vegetation. Long-term displacement and fragmentation of habitat as a result of road and transmission line construction compounded by direct collision with the wind turbines by birds and bats are documented adverse impacts that result from wind power installations. The natural habitat where wind farms are to be sited could be adversely impacted in the short-term from sedimentation and erosion caused during construction of the Project, including construction of ancillary facilities such as transmission lines and roads. Indicators of the potential presence of critical habitats that can affect categorization include the presence of wetlands, known wildlife breeding areas, or known migratory routes. The presence of limited range endemic species may also be a strong indicator of critical habitat.

Habitat alteration associated with offshore wind farms may result from excavation of the sea bottom and the short-term increased turbidity due to the disturbed marine sediments during placement and construction of the turbine or their attachment points.

*Screening.* OPIC cannot support projects that involve conversion or degradation of Critical Forest Areas or forest-related Critical Natural Habitats or projects located in or adversely impacting internationally recognized protected areas unless it can be demonstrated through an environmental assessment that the Project (i) will not result in the degradation of the protected area, and (ii) will produce positive environmental and social benefits.

Projects that are not located in forest-related Critical Natural Habitats or Critical Forest Areas but that have the potential to result in significant habitat alteration or wildlife disturbance, including disruption of wildlife migration corridors, may be classified as Category A. The extent of impact and species located in or near the habitat or corridors are considered in determining the classification of the Project.

*Impact Mitigation.* Habitat alteration for terrestrial wind farms is limited to the small individual footprints of the turbines and land that must be cleared to support the construction of ancillary infrastructure. Avoidance and minimization of impacts to habitat are described in the IFC's Sector EHS Guidelines for Wind Energy, Toll Roads, and Electrical Power and Distribution. Examples of recommended mitigation measures include:

- Siting to avoid critical habitat.
- Designing and constructing wildlife access to avoid or minimize habitat fragmentation.
- Avoiding or modifying construction activities during breeding or other sensitive seasons.
- Minimizing removal of native plant species and replanting of native plant species in disturbed areas.

For offshore wind projects, potential negative impacts can be avoided or minimized by proper siting of the turbines outside of sensitive habitat areas (IFC EHS Guidelines for Wind Energy, 2007).

## 4.2 Presence of Bird or Bat Migration Routes or Areas of Congregation

*Description of Impact.* Collision mortality can result from direct collisions with the turbines or in the case of bats, barotrauma: an over-expansion of the bat's lungs due to extreme differences in air pressures surrounding the spinning turbines (Weiss, 2005). Adverse impacts to birds and bats may also result from habitat modifications and changes in the type and number of perching, breeding, and nesting sites.

With respect to birds, stakeholder concerns primarily focus around raptor mortality because raptors tend to concentrate in areas, such as, ridge tops and the upwind side of slopes where wind farms can sometimes be sited to take advantage of the wind patterns and speeds (NWCC 2010). Small prey and conditions that favor high-prey densities can also attract raptors and result in higher rates of mortality. Higher mortality rates for all species are found during migration periods when higher population densities are more likely to pass through wind farm sites.

Studies have observed two to three times as many bats being killed than the total losses of all bird species combined, with fatalities being seasonally and species dependent. Bats statistically have a higher mortality rate from collisions with turbines, the most vulnerable appearing to be tree-roosting migratory bat species. Specific review needs to occur if any rare or endangered species are present, especially because bats are long-lived with low reproductive rates (NWCC, 2010).

*Screening.* Impacts of a wind project on birds and bats typically are related to project siting. Project sites that are located in or near important bird areas (IBAs)<sup>1</sup>, special protected areas (SPAs)<sup>2</sup>, concentrated feeding, breeding and roosting areas, or other sensitive ecosystems or sites have the potential for significant adverse impacts and therefore may be screened as Category A. If impacts to birds or bats cannot be adequately mitigated, OPIC may decline to support a project.

*Impact Mitigation.* Recommended mitigation measures can be found in IFC's EHS Guidelines for Wind Energy and NWCC and includes the following:

- **Proper siting:** As a general rule, open habitats are less important for bat foraging and wind farms located on land previously cleared for agriculture may pose a lower risk. Projects should be sited so that project boundaries are located over 2,500 ft. away from IBAs.

In addition, sites should be located away from:

- Known migratory pathways or areas where birds and bats are highly concentrated.
- Narrow bat migration routes.
- Areas of known raptor concentration.
- Concentrated feeding, breeding, and roosting areas for bats or birds.

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<sup>1</sup> IBAs hold significant numbers of one or more globally-threatened species, are one of a set of sites that together hold a suite of restricted-range species, or biome-restricted species and have exceptionally large numbers of migratory or congregatory species [(Birdlife International) (<http://www.birdlife.org/action/science/sites/>)].

<sup>2</sup> SPAs consist of strictly protected sites classified for rare and vulnerable birds and for regularly occurring migratory species [(Joint Nature Conservation Committee) (<http://www.natura.org/>)].

- SPAs (<http://jncc.defra.gov.uk/page-162>) and statutorily designated or qualifying international sites (Natura 2000, <http://www.natura.org/>).
- Other sensitive sites, such as known habitat for endangered/protected species, Ramsar sites ([http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1\\_4000\\_0\\_\\_](http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__)), and other sites that could result in significant adverse impacts to a sensitive ecosystem.
- **Creating Buffer Zones:** Buffer zones should be created around nationally or regionally important roosts. In some cases it may be necessary to engage a species expert to determine whether sufficient buffer zones have been incorporated into project design.
- **Technology and Operational Considerations:** Turbine and tower design, controlled periods of operation and the wind speed at which the turbines “cut in” all appear to affect both bird and bat fatalities, especially bat fatalities which have been demonstrated to be reduced by 50-87 percent through operational modifications (NWCC 2010). Lighting also has been documented to reduce bird and bat collisions. These types of design and operational factors should be considered by project developers to mitigate impacts.
- **Turbine Layout:** Turbines should be orientated to minimize effects on any bird movement patterns, such as placing them in rows parallel to any known migration paths or other bird movement paths rather than perpendicular to such paths.
- **Tower Height:** Maintain tower heights below typical elevations of migratory bird pathways.
- **Rotor Blade Adjustments:** Maintain rotor blades at a suitable elevation and employ slower turning rotor blades to make them more visible.
- **Storm Water Management:** Implement appropriate storm water management measures to avoid creating bird attractors, such as small ponds.

## 4.3 Socio-Cultural Issues

### 4.3.1 Land Acquisition and Land Use

*Description of Impact.* Large wind farms require a large amount of land. Any project involving land acquisition can impact local communities and their livelihoods, current landowners and/or current land users. Land acquisition that results in involuntary resettlement can complicate the social impact of the Project. This is compounded when projects are located in countries where land tenure and ownership laws are tenuous and/or in situations where local communities or groups do not hold title to the land.

Areas fully developed for agriculture, especially row-crop farming, where minimal existing wildlife is found, are often viewed as complimentary to wind farm development, but the actual effect of a wind farm development on existing and adjacent land uses can vary significantly. In open areas with row-crops or pasture, the original land farming can continue even after the wind farm is in operation.

*Screening.* Land acquisition procedures, physical or economic displacement of people and/or impacts on their livelihood, and changes in land use are factors considered in screening projects as Category A or B. Information regarding actual land ownership, and in some countries, past ownership, as well as existing and adjacent land use, can assist in determining if effects in this area would result in a Category A or B classification. Projects involving significant resettlement or impacts on livelihoods due to changes in land use are likely to be screened as Category A.

*Impact Mitigation.* Land should be acquired on a voluntary basis with current owners and tenants and prices should be negotiated with current owners at market rates. For projects that involve involuntary physical or economic displacement, land must be acquired in accordance with IFC’s Performance Standard 5 (Land Acquisition and Involuntary Resettlement) and, where indigenous peoples are involved, IFC’s Performance Standard 7 (Indigenous Peoples). The resettlement, compensation and community consultation processes, and agreements must be clearly documented.

Land use patterns should be assessed to determine if there are current existing land uses, such as agriculture or tourism, which could be diminished as a result of the establishment of a wind farm.

#### 4.3.2 Indigenous Peoples and Cultural Heritage

*Description of Impact.* Indigenous People may be particularly vulnerable if their lands and resources are transformed, encroached upon or significantly degraded. Their languages, cultures, religions, spiritual beliefs and institutions may also come under threat.

Projects may be located in an area with the potential for containing tangible cultural resources. In addition, a wind project may impact the cultural heritage of the area by changing the landscape and possibly the type of economic activity in the area (IFC 2006).

*Screening.* Projects with the potential to adversely impact indigenous peoples are sensitive and as such are more likely to be screened as Category A. Projects with the potential to affect cultural heritage may be screened as Category A if impacts are determined to be significant.

*Impact Mitigation.* Projects should anticipate and avoid adverse impacts on communities of indigenous peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. For additional information on standards and requirements related to impacts on indigenous peoples, consult IFC's P.S. 7.

If a wind project has the potential to impact cultural resources, either tangible or intangible, mitigation measures found in IFC P.S. 8 should be implemented.

### 4.4 Community Issues

#### 4.4.1 Visual Impacts

*Description of Impact.* Visual impacts associated with wind energy projects are typically related to the turbines themselves (i.e. color, height, and number of turbines) and impacts relating to their alteration of the character of the surrounding landscape. Wind turbines may also be equipped with lighting if the towers pose an aviation hazard, which may cause additional negative visual impacts at night.

*Screening.* If opposition to a project develops, the level of opposition can affect a project's classification as Category A or Category B.

*Impact Mitigation.* The IFC guidelines recommend consideration of the landscape character during siting and evaluation of visual impacts from relevant viewing angles. Specific assessment from critical viewsheds with renderings is appropriate. Ancillary structures such as fencing and on-site access roads should be minimized, steep slopes avoided, erosion control measures, and revegetation procedures implemented, uniform size of turbines maintained, and turbines painted in a uniform color. Maritime and airspace navigational marking regulations should be met and company insignia and advertising on the turbines should be avoided. Visual effects can be reduced with the elimination of guy wires and the use of non-reflective paints and resins.

#### 4.4.2 Shadow Flicker and Blade Glint

*Description of Impact.* Shadow flicker and blade glint can become an issue when residences are located near, or have specific orientation to, the wind farm. Blade glint typically disappears when blades become tarnished after a few months of operation, but the current use of non-reflective resins and materials in blade design can prevent flicker and glint from the start of operations.

*Screening.* If opposition to a project develops, the level of opposition can affect a project's classification as Category A or Category B.

*Impact Mitigation.* Prevention and control measures include proper positioning of towers to avoid impacts on residences located within the narrow bands where flicker has a high frequency and the painting of the wind tower with non-reflective coating to avoid reflections. Mitigation such as hedgerow tree plantings and controlled operation times may also reduce the shadow flicker on any nearby sensitive receptors. Where shadow flicker cannot be avoided, it should occur no more than thirty minutes per day with a limit of thirty hours per year (Schattenwurf-Hinweise, 2002).

#### 4.4.3 Noise Impacts

*Description of Impact.* Noise generated from the turbines can be a nuisance to nearby communities or residences.

*Screening.* If opposition to a project develops, the level of opposition can affect a project's classification as Category A or Category B.

*Impact Mitigation.* Alternative locations that provide maximum distance between turbine structures and local communities are preferable. Measures to prevent and control noise are mainly related to engineering design. For example, noise may be controlled through the use of variable speed turbines or pitched blades to lower rotational speed. Additional measures include siting to avoid close proximity to sensitive noise receptors such as residences, hospitals and schools and adherence to national or international acoustic design standards for wind turbines, e.g. International Energy Agency, International Electrotechnical Commission and the American National Standards Institute (IEC, 1994).

The best practice standard (Weed, 2006) for wind energy systems is that noise should not exceed 55 dB(A) at the property line closest to the wind energy system. Exceptions for neighboring properties are allowed with the written consent of those property owners. This sound pressure level may be exceeded during short-term events such as utility outages and/or severe windstorms. If the ambient sound pressure level exceeds 55 dB(A), which can occur at times of higher wind speeds, noise levels should not exceed ambient dB(A) plus 3 dB(A) (IFC 2007).

#### 4.4.4 Blade/Ice Throw

*Description of Impact.* Ice throw is a public safety issue and is only relevant in cold climates. The overall risk of blade throw is extremely low if the distance from the turbine is sited over 1,700 ft. to the nearest receptor.

*Screening.* Impacts from blade/ice throw can be mitigated to acceptable levels by applying mitigation measures laid out in IFC's Environmental, Health and Safety Guidelines for Wind Energy. Implementation of appropriate mitigation measures with respect to blade/ice throw would assist in screening the Project as Category B.

*Impact Mitigation.* Mitigation planning for blade/ice throw includes:

- Distancing turbines away from buildings and populated areas within possible trajectory pathways. Setback distances vary with the size, shape, weight, and speed of the rotor and height of the turbine.
- Equipping turbines with vibration sensors that can react to imbalance in the rotor blades.
- Shutting down the turbine if necessary.
- Performing regular maintenance.
- Posting warning signs.

For ice throw, the IFC Guidelines for Wind Energy identify management strategies such as:

- Curtailing operations during periods of ice accretion.
- Posting of signs at least within 150 m in all directions.
- Equipping turbines with heaters and ice sensors.
- Using cold-resistant steel for the turbine tower.
- Using synthetic lubricants in cold weather.
- Using black fluoroethane-coated blades.
- Providing full-surface blade heating, if available, or otherwise use leading-edge heaters at least 0.3 m wide.

#### 4.5 Ancillary Facilities

*Description of Impact.* Ancillary features, including access roads and transmission lines to the main grid, can result in significant land use disturbances, visual intrusions, and wildlife impacts. In addition, because sites for wind park projects can sometimes be located in remote areas or the required skilled workers do not live near the Project site, workers' accommodations may be needed. Workers' accommodations require consideration of siting issues as discussed above, provision of potable water and availability of wastewater and solid waste disposal services.

*Screening.* The significance of the impacts that ancillary facilities may have and their potential cumulative effects need to be considered during the screening process as they could have an effect on a project's category classification. The length and route of a transmission line or access road, outside the Project boundary, and their impact on the siting criteria discussed above, will determine if effects related to ancillary facilities would result in a Category A or B classification.

Potential social impacts that may result from worker housing should be considered including impacts on community infrastructure, health, and safety. Depending on the size, duration and potential risks associated with workers' accommodations, impacts from workers' accommodations may be considered during classification of a project as Category A or Category B.

*Impact Mitigation.* For access roads and transmission lines, IFC's EHS Guidelines for Toll Roads and for Electric Power Transmission and Distribution should be consulted and recommendations applied.

For workers' accommodations, projects should adhere to international standards for worker housing such as "Workers' Accommodation: Processes and Standards: A Guidance Note by IFC and the EBRD" ([http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p\\_WorkersAccommodation/\\$FILE/workers\\_accomodation.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_WorkersAccommodation/$FILE/workers_accomodation.pdf)).

#### 4.6 Impacts on Navigation, Radar, Telecommunication

*Description of Impact.* Wind turbines can create electromagnetic interference where the turbines are located between a signal source and the receiver. This interference can affect television and radio signals and radar, including that related to aviation. Aircraft safety can be affected if the wind farm is located near an airport or in known flight paths.

*Screening.* Impacts on navigation, radar, and telecommunications can be mitigated to acceptable levels by applying mitigation measures laid out in IFC's Environmental, Health and Safety Guidelines for Wind Energy. Implementation of appropriate mitigation measures with respect to impacts on navigation, radar, and telecommunications would assist in screening the Project as Category B.

*Impact Mitigation.* Prevention and control measures include development in accordance with air and maritime safety regulations, siting wind farms away from airports and ports, and outside of known flight paths or shipping lanes, and use of anti-collision lighting and marking systems on towers and blades.

A representation of good practice requirements of the Federal Aviation Administration (FAA) in the United States and its European equivalent include the following:

- Wind turbines not to exceed 200 ft. above ground level.
- Wind turbines are not located within 20,000 ft. of a public use or military airport which exceeds a 100:1 surface ratio from any point on the runway of each airport with its longest runway more than 3,200 ft.
- Wind turbines are not located within 10,000 ft. of a public use or military airport which exceeds a 50:1 surface ratio from any point on the runway of each airport with its longest runway no more than 3,200 ft.
- Wind turbines are not located within 5,000 ft. of a public use heliport, which exceeds a 25:1 surface ratio, any highway, railroad, or other traverse way whose prescribed adjusted height would exceed the above noted standards.
- Wind turbines are not located on a public use airport or heliport regardless of height or location.
- Wind turbines are not located within 5 miles of a Air Traffic Control radar (Patterson, 2005).

In addition, proposed wind energy project sites within “radar line of sight” up to 60 miles away from a joint use facility may be considered sensitive depending on the potential impact of the wind turbines on radar system performance.

In general the wind tower rotor sweep should be less than 199 ft. (60.6552 m) tall and over 6 miles (10 km) from any airport, radar, or communication facility. Projects that do not meet these basic requirements are more likely to be screened as Category A. If the wind tower rotor sweep exceeds 199 ft., then consideration of air and maritime safety regulations, including the FAA regulations, should be incorporated.

Regarding telecommunication and television systems the site of the wind facilities should avoid direct physical interference of point-to-point communication systems and away from the line-of-sight of broadcast transmitters.

#### 4.7 Cumulative Effects

*Description of Impact.* Often specific regions with good wind resources will have more than one wind farm proposed and cumulative impacts should be considered. Cumulative effects can also result from the additive effects of other activities from different projects in a region, or secondary development that is likely to occur as a result of project development, each of which taken individually may not create significant impacts but taken together could result in considerable impacts.

*Screening.* The additive effects of land use conversion and bird/bat impacts can result in a project being classified as Category A rather than Category B. Cumulative impacts from ancillary features should also be considered. If there are potential significant adverse impacts to the environment or nearby communities due to cumulative effects, a project may be classified as Category A rather than Category B.

*Applicable Guidelines and Standards.* The potential for cumulative impacts should be identified during the Project’s environmental and social assessment process. Opportunities exist to reduce land-clearance impacts through shared use of power transmission lines, substations and access roads. Monitoring plans and procedures should take into account the cumulative effect of impacts.

## Section 5.0 - Information Needed from Project Applicant

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Information that can be supplied by a project applicant that would assist OPIC in the screening and review of any proposed wind project includes:

- **Technical information on wind turbines**
  - Manufacturer.
  - Number of turbines to be installed on site and total installed capacity.
  - Design, height, material and color of turbines.
  - Turbine speed.
  - Noise emissions.
  - Rotor size.
  - Information regarding layout and spacing.
- **Project site**
  - Exact location including latitude and longitude coordinates.
  - Current land use of the site including whether or not there are existing structures on the site that will need to be removed.
  - Presence of protected/endangered plants or animals on the site.
  - Proximity to important wildlife habitat areas including Special Protected Areas (SPAs), Important Bird Areas (IBAs) and statutorily designated or qualifying International or National sites for nature conservation including Natura 2000 sites.
  - Presence of migratory pathways.
  - Presence of roosting, breeding, nesting sites in or near the site.
  - Proximity to protected area or area of cultural significance.
  - Proximity to closest residence/neighborhood.
  - Information regarding physical or economic displacement of any person or persons.
  - Information regarding potential impacts on indigenous peoples.
  - Information regarding how the land for the Project was acquired.
  - Any public meetings held with nearby residents and issues that arose.
  - For offshore projects, migratory patterns for marine mammals, as well as any shipping corridors or navigational devices in the Project area.
  - Information relating to the surrounding topography.
- **Project impacts**
  - Specifics on the Project installation such as how the cables connecting turbines will be installed, depth of holes to mount the turbines.
  - Plans for disposal of solid waste and sewage.
  - Measures to control erosion.
  - Presence and storage of hazardous substances on site.
  - Amount and source of water needed for the Project including potable water for drinking and water for panel washing.
  - Plans to screen the facility from nearby residences.

- Whether or not a social and environmental impact assessment, social and environmental management plan, social and environmental policy and grievance mechanism have been prepared for the Project.
- Whether or not an Occupational Health and Safety plan has been prepared for the construction and/or operational phase of the Project.
- Whether or not Life and Fire Safety and Emergency Response plans have been prepared for the Project.
- **Connection to the electrical grid and other related infrastructure needed for the Project**
  - Description of any on-site substation to be constructed.
  - Complete description of how the Project will tie into the existing transmission system including whether or not there will be construction of a transmission line, its length, its route and who is responsible for the construction of the line.
  - Whether or not roads will be constructed for the Project and their length, width, and route (whether in existing right-of-way or not).
  - Whether or not there will be worker housing needed on site and the plans for the construction of that housing.

## Section 6.0 - Monitoring Recommendations

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Because each project and site is unique, monitoring requirements should be determined on a project-by-project basis and should be largely based on the significant issues that were identified during the environmental and social impact assessment of the Project.

In general, monitoring for a wind project may include the following:

### Construction phase

- Monitor that occupational health and safety measures are carried out in accordance with IFC's General Environmental, Health and Safety Guidelines.
- Monitor that impacts from construction such as erosion and sedimentation, solid and sanitary waste disposal, hazardous materials (including fuels and lubricants) management, are being mitigated in accordance with IFC's General Environmental, Health and Safety Guidelines Erosion.
- If applicable, monitor that any cultural heritage that may be found or affected during construction is treated in accordance with IFC P.S. 8.
- Respond to and record community grievances including those related to transportation of turbines.
- If applicable, monitor habitat and species impacts in accordance with IFC P.S. 6 and/or the Project's biodiversity management plan.
- If applicable, monitor that temporary worker housing is constructed and maintained in accordance with Workers' Accommodation: Processes and Standards: A Guidance Note by IFC and the EBRD.

### Operation phase

- Monitor bird/bat mortality, both at the Project level and if applicable, cumulative impacts.
- Ensure that restoration of any disturbance during construction has occurred.
- Monitor noise levels to nearest receptors (i.e. residences, neighbors).

## Section 7.0 - Resources

Presence of Critical or Sensitive Habitat	American Bird Conservancy [ABC]. (2010): <b>Wind Energy: Frequently Asked Questions.</b> <a href="http://www.abcbirds.org/abcprograms/policy/collisions/wind_faq.html">http://www.abcbirds.org/abcprograms/policy/collisions/wind_faq.html</a>
Presence of bird or bat migration routes or areas of congregation	American Bird Conservancy [ABC]. (2010): <b>American Bird Conservancy's Policy Statement on Wind Energy and Bird-Smart Wind Guidelines.</b> <a href="http://www.abcbirds.org/abcprograms/policy/collisions/wind_policy.html">http://www.abcbirds.org/abcprograms/policy/collisions/wind_policy.html</a>
Land Acquisition and Land Use	AWEA. (2010): <b>Wind Turbines and Health.</b> American Wind Energy Association. May 2010. <a href="http://www.awea.org/learnabout/publications/upload/Wind-Turbines-and-Health-Factsheet_WP11.pdf">http://www.awea.org/learnabout/publications/upload/Wind-Turbines-and-Health-Factsheet_WP11.pdf</a>
Socio-Cultural Issues	
Community Issues	Baerwald, E.F., D'Amours, G.H., Klug, B.J., Barclay, R.M.R. (2008): <b>Current Biology: Barotrauma is a significant cause of bat fatalities at wind turbines.</b> Vol. 18 No 16 R696. Department of Biological Sciences, University of Calgary, Calgary, AB Canada. August 2008. <a href="http://www.wbwg.org/conservation/papers/BaerwaldetalCurrentBiology2008.pdf">http://www.wbwg.org/conservation/papers/BaerwaldetalCurrentBiology2008.pdf</a>
The Potential for Infrastructure Interference	BirdLife International. (2012): <b>The African-Eurasian Flyway.</b> <a href="http://www.birdlife.org/flyways/africa_eurasia/index.html">http://www.birdlife.org/flyways/africa_eurasia/index.html</a>
Impacts Related to the Construction of Ancillary Facilities	Colby, W.D., Dobie, R. Leventhall, G, Lipscomb, D.M., McCunney, R.J., Seilo, M.T., Søndergaard, B. (2009): <b>Wind Turbine Sound and Health Effects: An Expert Panel Review.</b> AWEA & CWEA. December 2009. <a href="http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf">http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf</a>
Cumulative Effects	Cornell University. (2009): <b>Steuben County Wind Turbine Viewshed Analysis.</b> Cornell Cooperative Extension of Schuyler County for Southern Tier Central Regional Planning and Development Board. June 2009 <a href="http://www.stcplanning.org/usr/Program_Areas/Wind_Resources/Steuben_Viewshed_Analysis_Draft_rev.pdf">http://www.stcplanning.org/usr/Program_Areas/Wind_Resources/Steuben_Viewshed_Analysis_Draft_rev.pdf</a>
	Commission Electrotechnique Internation [IEC] (1994): <b>International Electrotechnical Vocabulary - Chapter 801: Acoustics and Electroacoustics.</b> 60050-801:1994
	Lampeter, R.M. (2011): <b>Shadow Flicker Regulations and Guidance: New England and Beyond.</b> New England Wind Energy Education Project (NEWEEP) Webinar #5: Understanding the Current Science, Regulation and Mitigation of Shadow Flicker February 10, 2011. <a href="http://www.windpoweringamerica.gov/pdfs/workshops/2011/webinar_shadow_flicker_lampeter.pdf">http://www.windpoweringamerica.gov/pdfs/workshops/2011/webinar_shadow_flicker_lampeter.pdf</a>
	Leistritz, F.L. (2009): <b>AgMRC Renewable Energy Newsletter: Socioeconomic Impacts of Developing Wind Energy.</b> July 2009. <a href="http://www.agmrc.org/renewable_energy/wind_energy/socioeconomic_impacts_of_developing_wind_energy.cfm">http://www.agmrc.org/renewable_energy/wind_energy/socioeconomic_impacts_of_developing_wind_energy.cfm</a>

	<p>Macalester College. (2011): <b>Understanding Wind Initiative: Viewshed ID Letter: V</b> <a href="http://www.macalester.edu/understandingwind/responsesreport/V_Viewshed.pdf">http://www.macalester.edu/understandingwind/responsesreport/V_Viewshed.pdf</a></p> <p>Mielke, E, Anadon, L.D, Narayanamurti, V. (2010): <b>Water Consumption of Energy Resource Extraction, Processing, and Conversion: A review of the literature for estimates of water intensity of energy- resource extraction, processing to fuels, and conversion to electricity.</b> Harvard Kennedy School: Belfer Center for Science and International Affairs: Energy Technology Innovation Policy Research Group. October 2010. <a href="http://belfercenter.ksg.harvard.edu/files/ETIP-DP-2010-15-final-4.pdf">http://belfercenter.ksg.harvard.edu/files/ETIP-DP-2010-15-final-4.pdf</a></p> <p>National Health and Medical Research Council. (2010): <b>Wind Turbines and Health.</b> NHMRC Public Statement, July 2010. <a href="http://www.nhmrc.gov.au/files/nhmrc/publications/attachments/new0048_public_statement_wind_turbines_and_health.pdf">http://www.nhmrc.gov.au/files/nhmrc/publications/attachments/new0048_public_statement_wind_turbines_and_health.pdf</a></p> <p>Natura 2000 Networking Programme. (2007): <b>Special Protection Areas (SPAs) and Special Areas of Conservation (SACs).</b> <a href="http://www.natura.org/">http://www.natura.org/</a></p> <p>New Hampshire Division of Historical Resources [DHR]. (2007). <b>Guidelines for Wind Farm Development Projects: Cultural &amp; Historic Resources Survey Requirements for Wind Farm Development Projects.</b> State of New Hampshire, 2007 <a href="http://www.nh.gov/nhdhr/review/windfarm.htm">http://www.nh.gov/nhdhr/review/windfarm.htm</a></p> <p>NextEra Energy. (2008): <b>Langdon Wind I &amp; II Energy Centers</b> <a href="http://www.nexteraenergyresources.com/content/where/portfolio/pdf/langdon.pdf">http://www.nexteraenergyresources.com/content/where/portfolio/pdf/langdon.pdf</a></p> <p>NREL. (2010): <b>Wind-Wildlife Impacts Literature Database (WILD).</b> <a href="http://nrelpubs.nrel.gov/Webtop/ws/avianlit/www/web_data/SearchForm">http://nrelpubs.nrel.gov/Webtop/ws/avianlit/www/web_data/SearchForm</a></p> <p>NYDEC. (2010): <b>New York State Department of Environmental Conservation (DEC) Review of Wind Energy Generation Projects.</b> November 2010. <a href="http://www.dec.ny.gov/energy/66494.html">http://www.dec.ny.gov/energy/66494.html</a></p> <p>O'Neil, R.D, Hellweg, R.D, Lampeter, R.M. (2011): <b>Low frequency noise and infrasound from wind turbines.</b> Noise Control Engineering Journal 59, 2, pp. 135-157 (2011)</p> <p>Orkney Islands Council. (2011): <b>Onshore Wind Energy Development: Supplementary Guidance.</b> April 2011. <a href="http://www.orkney.gov.uk/Files/Planning/Development-Planning/Onshore_Wind_Energy_Development.pdf">http://www.orkney.gov.uk/Files/Planning/Development-Planning/Onshore Wind Energy Development.pdf</a></p> <p>Protected Planet. (2010): <b>Discover and learn about protected areas: Search the protected areas of our planet.</b> 2010 <a href="http://www.protectedplanet.net/">http://www.protectedplanet.net/</a></p> <p>TNEI. (2007): <b>Onshore Wind Energy Planning Conditions Guidance Note: A report for the Renewables Advisory Board and BERR,</b> Department for Business, Enterprise and Regulatory Reform (BERR) October 2007 <a href="http://webarchive.nationalarchives.gov.uk/+http://www.berr.gov.uk/files/file35240.pdf">http://webarchive.nationalarchives.gov.uk/+http://www.berr.gov.uk/files/file35240.pdf</a></p>
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	<p>Tribal Energy and Environmental Information Clearinghouse [TEEIC]. (2010): <b>Wind Energy Decommissioning/Site Reclamation Impacts</b>. Office of Indian Energy and Economic Development. Washington, D.C. 2010 <a href="http://teeic.anl.gov/er/wind/impact/decom/index.cfm">http://teeic.anl.gov/er/wind/impact/decom/index.cfm</a></p> <p>UK Department of Energy and Climate Change. (2011): <b>Update of UK Shadow Flicker Evidence Base: Final Report</b>. March 2011 <a href="http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20energy/ORED/1416-update-uk-shadow-flicker-evidence-base.pdf">http://www.decc.gov.uk/assets/decc/What we do/UK energy supply/Energy mix/Renewable energy/ORED/1416-update-uk-shadow-flicker-evidence-base.pdf</a></p> <p>Windrush Energy. (2004): <b>The Health Effects of Magnetic Fields Generated by Wind Turbines</b>. Mississauga, Ontario, CAN. October 2004 <a href="http://www.windrush-energy.com/update_Jul_24/Appendix_D_-_Magnetic_Field_Survey/Magnetic_Field_Report.pdf">http://www.windrush-energy.com/update_Jul_24/Appendix D - Magnetic Field Survey/Magnetic Field Report.pdf</a></p>
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## Section 8.0 - Glossary of Terms - Wind

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**Anthropogenic Sources** - Human impact on the environment or anthropogenic impact on the environment, include impacts on biophysical environments, biodiversity and other resources. Sahney, S. Benton, M.J. and Ferry, P.A. (2010).

**Ambient Noise Level** - The ambient noise level is the measured level of all noises from all sources near and far; the normal measured existing level of environmental noise at a given location.

**Audio Impacts** - Sound-wave-like variations in air pressure that occurs at frequencies that can stimulate receptors in the inner ear and, if sufficiently powerful, be appreciated at a conscious level.

**A-weighted Sound Pressure Level dB(A)** - The sound pressure level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighted filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.

**Barotrauma** - Injury of a body part or organ as a result of changes in barometric pressure; such as decompression of a bat's lungs causing death by rapid air-pressure reduction near moving turbine blades. Barotrauma involves tissue damage to air-containing structures caused by rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation. Air pressure change at turbine blades is an undetectable hazard and helps explain high bat fatality rates.

<http://www.wbwg.org/conservation/papers/BaerwaldetalCurrentBiology2008.pdf>

**Categorically Prohibited Project** - A project of the type listed in Appendix B of OPIC's Environmental and Social Policy Statement where potential adverse environmental or social impacts of the Project preclude OPIC support.

**Category A** - Category A projects are likely to have significant adverse environmental and/or social impacts that are irreversible, sensitive, diverse, or unprecedented. In the absence of adequate mitigation measures, Category A projects are considered higher risk.

**Category B** - Category B projects are likely to have limited adverse environmental and/or social impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures. Category B projects are considered medium risk. For these reasons, the scope of OPIC's environmental and social assessment for a Category B project is narrower than that required for Category A projects.

**Critical Forest Areas** - A type of Natural forest that qualifies as Critical Natural Habitat. Critical Forest Areas include, but are not limited to, primary forests and old growth forests that may serve as critical carbon sinks.

**Critical Natural Habitats** - (i) Existing internationally recognized protected areas, initially recognized as protected by traditional local communities (i.e. sacred groves), and sites that maintain conditions vital to the viability of protected areas (as determined by the environmental assessment procedure); (ii) Sites identified on supplementary lists by authoritative sources identified by OPIC. Such sites may include areas recognized by traditional local communities (i.e. sacred groves), areas with known high suitability for biodiversity conservation and sites that are critical for vulnerable, migratory or endangered species. Listings are based on systematic evaluations of such factors as species richness, the degree of endemism, rarity, and vulnerability of component species, representativeness, and the integrity of ecosystem processes.

**Cultural Heritage** - Tangible property or sites having archaeological (prehistoric), paleontological, historical, cultural, artistic and religious value, as well as unique environmental features that embody cultural values, such as sacred groves. Cultural Heritage also includes intangible forms of culture, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

**Decibel (dB)** - A unit describing the amplitude of sound, equal to twenty times the logarithm to the base ten of the ratio of the measured pressure to the reference pressure, which is 20 micropascals ( $\mu\text{Pa}$ ).

**Economic Displacement** - Loss of assets or access to assets that leads to loss of income sources or means of livelihood.

**Electromagnetic Field** - An electromagnetic field (EMF) is produced by electrically charged objects. It is a combination of an electrical field (created by voltage or electrical charge) and a magnetic field (created by an electrical current). Wind turbines convert wind energy into electricity. The electricity is carried from the turbine by a cable, either underground or overhead, to the main electricity transmission grid for distribution, creating a small magnetic field. When a charged object, such as an animal, crosses the path of this magnetic field, a very small, momentary electric field may be created. <http://www.naikun.ca/information/NaikunEMF.pdf>

**Environmental and Social Action Plan (ESAP)** - A systematic program designed to prevent, mitigate and monitor anticipated environmental and related human impacts of prospective and ongoing activities. An ESAP is required on all Category A projects.

**Environmental and Social Impact Assessment (ESIA)** - A comprehensive analytical body of work designed to evaluate environmental impacts of major projects having the potential to have significant, diverse, and irreversible impacts on the natural environment and on humans dependent on that environment. An ESIA is required for all Category A projects involving new ("greenfield") developments or significant expansion of existing facilities.

**Environmental and Social Management System (ESMS)** - Part of a project's overall management system that includes the organizational structure, responsibilities, practices and resources necessary for implementing the Project-specific management program developed through the environmental and social assessment of the Project.

**Forest** - An area of land not less than 1.0 hectare with a tree crown cover (or equivalent stocking level) of more than 10 percent that has trees with the potential to reach a minimum height of 2 meters at maturity *in situ*. A forest may consist of either closed forest formations, where trees of various stories and undergrowth cover a high proportion of the ground, or open forest. Young natural stands and all plantations that have yet to reach a crown density of ten percent or tree height of 2 meters are included under forest, as are areas normally forming part of the forest area that are temporarily destocked as a result of human intervention such as harvesting or natural causes but that are expected to revert to forest. The definition includes forests dedicated to forest production, protection, multiple uses, or conservation, whether formally recognized or not. The definition excludes areas where other land uses not dependent on tree cover predominate, such as agriculture, grazing, or settlements. In countries with low forest cover, the definition may be expanded to include areas covered by trees that fall below the 10 percent threshold for canopy density, but are considered forest under local conditions.

**Fragmentation of Habitat** - The emergence of discontinuities (fragmentation) in an organism's preferred environment (habitat), causing population fragmentation. Geological processes that slowly alter the layout of the physical environment can cause habitat fragmentation. Sahney, S, Benton, M.J. & Falcon-Lang, H.J. (2010). "Rainforest collapse triggered Pennsylvanian tetrapod diversification in Euramerica" (PDF). *Geology* 38 (12): 1079–1082. doi:10.1130/G31182.1.

**Guy Wires** - For the majority of domestic wind turbines the most cost effective tower is constructed from scaffolding poles and held upright using guy wires. A concrete foundation is required for the base of the tower and also for the guy wire anchor points. The only disadvantage of guy wires is that the footprint of the turbine tower is much larger and safety around the wires must be considered carefully - for example fencing everything in to prevent children tripping over or running into the guy wires. <http://www.reuk.co.uk/Wind-Turbine-Tower-Basics.htm>

**Hertz (Hz)** - A unit of measurement of frequency; the number of cycles per second of a periodic waveform.

**Illumination Flicker** - When several turbines are in line with the sun or moon's shadow there is flicker from a combination of blades from different turbines, which can have a higher frequency than from a single turbine. If the blades of a turbine are reflective then there is the possibility of flicker from reflected light at viewing positions that are unaffected by shadows. Exposure to flicker from a turbine is determined by the hub height and the diameter of the blades, the height of the sun or moon and the direction of the blades relative to the observer. These variables are affected by the time of day, time of year, wind direction, and geographical location (Verkuijlen & Westra, 1984).

**Industry Sector Guidelines** - Technical reference documents issued by the International Finance Corporation with general and industry specific performance levels and measures.

**Infrasound** - According to the International Electrotechnical Commission, infrasound is: acoustic oscillations whose frequency is below the low frequency limit of audible sound (about 16 Hz). However this definition is incomplete as infrasound at high enough levels is audible at frequencies below 16 Hz. (IEC (1994): 60050-801:1994 International Electrotechnical Vocabulary - Chapter 801: Acoustics and electroacoustics).

**Low-Frequency Sound** - Sound in the frequency range that overlaps the higher infrasound frequencies and the lower audible frequencies, and is typically considered as 10 Hz to 200 Hz, but is not closely defined. [http://www.canwea.ca/pdf/talkwind/Wind\\_Turbine\\_Sound\\_and\\_Health\\_Effects.pdf](http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf).

**Natural Forests** - Forest lands and associated waterways where the ecosystem's biological communities are formed largely by native plant and animal species and where human activity has not essentially modified the area's primary ecological functions.

**Noise** - The presence of sound, but also implies a response to sound: noise is often defined as unwanted sound.

**Performance Standards** - Technical reference documents issued by the International Finance Corporation with environmental and social impact management performance criteria.

**Physical Displacement** - Relocation or loss of shelter.

**Project** - All facilities owned or controlled within a physical project boundary that constitute a commercially viable business unit eligible for OPIC support.

**Project Affected People** - Individuals, workers, groups or local communities, which are or could be affected by the Project, directly or indirectly, including through cumulative impacts. Emphasis should be placed on those who are directly and adversely affected, disadvantaged, or vulnerable.

**Renewable Energy** - Energy supplied from renewable energy sources, such as wind and solar power, geothermal, and hydropower not otherwise categorically prohibited, and Renewable Biomass, but does not include nuclear power.

**Visual Effects** - Visual effects relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity (LI-IEMA, 2002).

## **Appendix A**

### **Flowchart**

### Screening Flow Chart Wind Projects

