



## MASEN - EDF RENEWABLES

Fahs Anjra Province – M'diq-Fnideq Prefecture

# Environmental Impact Assessment for the Koudia El Baida Wind Farm Repowering Project

## Non-technical summary

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Fahs Anjra Province – M'diq-Fnideq Prefecture

## Environmental Impact Assessment for the Koudia El Baida Wind Farm Repowering Project

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## 1. Project location

The project is located in the north of Morocco, in the Rif area. It is located in the geographical area of the existing wind farm of Koudia Al Baida (also known as Abdelkhalek Torres; see map below).

The project comes under the following administrative structures (see map below):

- Tanger-Tetouan-Al Hoceima region;
- Fahs Anjra province and M'Diq-Fnideq prefecture;
- Tlat Taghramt and Allylene communes.

More specifically, the project is spread over two major blocks:

- The main ridge starting from the main highway RN16 from Douar Ain El Jir and running along the provincial highway RP4703 to the centre of Tlat Taghremt. This ridge houses blocks A1, A2, A3 and D1.

The repowering project also includes the installation of two power lines over approximately 10 kilometres (km) (see impact map).

## 2. Project justification

The Moroccan Wind Energy Project will enable Morocco to reduce its energy dependence on oil, as the country is poor in fossil energy resources. It will contribute to the development of Morocco's considerable wind energy potential, estimated at 25,000 megawatts (MW), almost 6,000 MW of which will be achievable by 2030 with wind speeds varying from 9.5 to 11 metres per second (m/s) at a height of 40 metres.

The Koudia El Baida repowering project will help to achieve the aim of providing 12 per cent of domestic national production by 2030. It is estimated that, by implementing this capital investment programme, the country will reduce its fuel imports, thus saving 1.5 million tons of oil equivalent in fossil fuels.

From a design point of view, the number, power and location of the wind turbines were designed to reduce the impact on the landscape and on migratory birds. This was supported by environmental studies that were carried out to identify ridges with fewer constraints and challenges in terms of implications for ornithology and the landscape.

The choice of project site is based on the wind-generating potential of the northern region of Morocco. The site of this wind farm is very well exposed and the winds are consistent. The average wind speed over the entire site is around 10 m/s at a height of 40 metres.

## 3. Project description

### 3.1 Overview of the Koudia El Baida wind farm

#### 3.1.1 General description

The future Koudia Al Baida wind farm will host 20 wind turbines, each with an output capacity of 5 MW, thus producing a total potential power of 100 MW. The footprint of the wind farm, which includes roads, associated easements, wind turbine supports, security building, ancillary buildings and the substation land, will cover an area equivalent to 390 hectares (ha).

The wind farm will consist of four groups of wind turbines, with the turbines of each group being connected by underground power cables. The electricity produced by the different groups will be transported to the transmission substation via an overhead network.

The connection between the transmission substation and the Jbel Moussa substation will be made via two 225-kilovolt (kV) overhead lines.

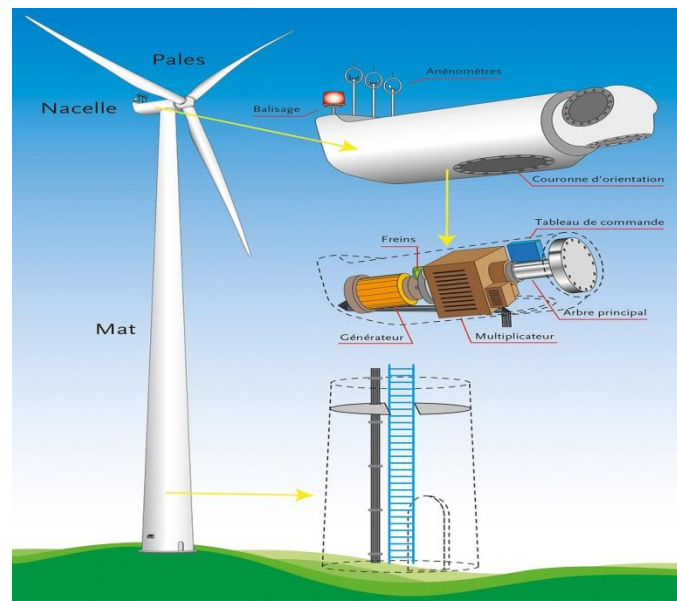
The repowering of the Koudia El Baida wind farm first requires the dismantling of the current ONEE<sup>1</sup> wind farm. This wind farm consists of 83 existing Vestas V42-600 kW turbines and seven existing Enercon E40-500 kW turbines on site.

The dismantling of existing wind turbines requires mechanical works, involving lifting and crane operations, and working at height. These activities will take place in reverse sequence to the assembly works.

### 3.1.2 How a wind turbine works

A wind turbine produces electricity using the wind, which sets a rotor (the moving part of the generator) in motion, enabling it to be converted into mechanical energy. The speed of rotation of the shaft driven by the movement of the blades is accelerated by a gearbox. This mechanical energy is then transmitted to the generator.

A transformer inside the nacelle raises the voltage of the electric current produced by the generator, so that it can be more easily transported through the medium-voltage lines of the electricity grid. The figure below shows the components of a wind turbine.



**Figure 3-1 The components of a wind turbine (Source: M-A Guichard Observ'ER)**

[Translation of figure annotations: Pâles = blades; Nacelle = nacelle; Mat = tower; Balisage = warning light; Couronne d'orientation = yaw drive; Freins = brakes; Tableau de commande = control panel; Générateur = generator; Multiplicateur = gearbox; Arbre principal = main shaft]

A wind farm consists of several wind turbines spaced several hundred metres apart and connected to each other by an internal underground network and to the public grid via a transmission substation. The figure below shows the routing of the energy produced from the turbines to the end use.

### 3.1.3 Description of the wind turbines

The wind turbines making up the Koudia Al Baida wind farm will have a nominal power of 5 MW. These wind turbines have a rotor with three blades, with a voltage of 690 V.

When the wind farm is operating, technical improvements can increase the nominal power of the wind turbines to 5.2 MW, meaning that the total capacity of the wind farm could reach 105 MW.

<sup>1</sup> Translator's note: ONEE: Office National de l'Electricité et de l'Eau Potable – National Office of Electricity and Drinking Water.

**Table 3-1 Technical characteristics of wind turbines**

Technical characteristics	Unit	Model SG 5-132
Number of wind turbines		20
Nominal power (MW)	MW	5
Diameter	m	132
Blade length	m	64.5
Tower height	m	84
Start-up speed	m/s	3
Nominal wind speed	m/s	13.5
Disconnection speed	m/s	27
Frequency	HZ	50
Nominal output voltage	KV	33

### 3.1.4 The wind farm's power grid

The connection between the individual wind turbines in each circuit will be provided by medium-voltage power cables that will run parallel to the track on the ridge.

The transit of the energy accumulated by a circuit to the transmission substation is made via 33 kV overhead lines.

### 3.1.5 Electricity substation

In order to minimise loss of energy, owing to the distance between the wind farm and the Jbel Moussa substation owned by the ONEE Electricity Branch, the energy produced will be raised from 33 kV to 225 kV via a 130 metres squared (m<sup>2</sup>) transformer substation.

### 3.1.6 Connecting power lines

The energy produced at the wind farm will be routed to the Jbel Moussa substation via two 225 kV overhead lines. They run parallel to the existing lines from the Jbel Moussa substation to the road that connects the wind farm to the Al Alyineye road.

The distance covered by the two connecting lines is approximately 10 km.

### 3.1.7 Roads and accessibility

#### ► Access roads

Access to the wind farm will be via the RN16 main highway between Tanger and Fnideq. No changes or upgrades are planned for this road.

Access to the wind farm from the RN16 is via the provincial highway RP4703, which will be upgraded with the following improvements:

- Point P14 (PK-19 + 000, right-hand turn from the RN16 to the RP4703)
- Point P15 (PK-19 + 400, left-hand turn from the RP4703)
- Point P17 (PK-22 + 270, right-hand turn from the RP4703)

- Point P18 (PK- 23 + 000, right-hand bend on the RP4703)
- Point P19 (PK-23 + 280, right-hand turn from the RP4703)

#### ► **The wind farm's internal roads**

There are plans to restore existing access roads (completely or partially) at the existing wind farm in order to ensure direct access to the wind turbines, especially in areas where the current design is suitable for the new configuration.

The wind farm's internal roads will cover an overall distance of 36.6 km. The width of the roads will be 5 m.

### **3.2 Carrying out the work**

The work will include a first phase to dismantle the 90 existing wind turbines, followed by the installation of the new turbines.

Construction site facilities, including site access improvements, the installation of storage, cutting up and assembly areas and the construction site base camp, will be completed before the initial dismantling activities begin.

#### **3.2.1 Construction site installation areas**

Construction site areas have been identified at the various ridges, notably for technical reasons, and may be used by the construction company, providing that it ensures there will be a low environmental impact (no destruction of sensitive habitats).

#### **3.2.2 Dismantling of the existing wind farm**

Dismantling the current wind farm will entail:

- Disconnecting the electricity supply and shutting off of all electrical equipment;
- Permanently disconnecting and shutting off of all hydraulic equipment;
- Temporarily storing the dismantled equipment;
- Cutting up and packaging the dismantled equipment;
- Removing all equipment, material and waste.

The concrete platforms of each turbine, including the steel anchors, will be cut down to just below ground level. The material will be taken off site and the platform area covered with topsoil to encourage vegetation to return to the site.

#### **3.2.3 Deployment of new wind turbines**

##### **3.2.3.1 Mobilisation of wind turbines**

The wind turbine blades will be produced in the Siemens GAMESA blade production unit in the Tanger Automotive City industrial estate. They will then be transported to the site.

The towers will also be produced in Morocco and transported to the project site.

The nacelles will be imported and transported from the port of Tanger Med to the project site.

##### **3.2.3.2 Foundation construction**

The wind turbines will require the following foundations:

- For type 5-132 wind turbines, circular concrete footings 19.4 m in diameter and 3.05 m in depth, and a metal base plate 6 m in diameter;

- For the SG 5-145 wind turbines, circular concrete footings 20 m in diameter and 3.05 m in depth, and a metal base plate 8 m in diameter.

The stages of constructing the foundations will be:

- Strip topsoil;
- Excavate soil;
- Lay blinding concrete;
- Install metal base plate and cover it with 10 centimetres (cm) of concrete;
- Install steel reinforcement;
- Construct anchor cage;
- Construct formwork;
- Pour concrete;
- Remove formwork;
- Backfill with excavated material.

During the construction of the foundations, two types of PVC ducts will be inserted into the anchor cage to protect the power and fibre optic cables. The diameters of the PVC ducts are 200 millimetres squared (mm<sup>2</sup>) and 90 mm<sup>2</sup>.

### 3.2.4 Preparation of assembly areas

Assembly areas or platforms will be set up to allow the installation of the wind turbines. These will house the crane, and allow for the storage and assembly of turbine parts.

The assembly areas will be located at the foot of each turbine and will have an area of approximately 2,000 m<sup>2</sup>. They will be provided with a compacted hard-core base for the construction phase to support the weight of the turbines.

The assembly areas will be retained once the wind farm is operational. They will be used for the maintenance of the wind turbines.

## 3.3 Operating procedures for the wind farm

The wind farm will be operated by site-based qualified personnel trained during the construction of the facility.

Around 20 technicians will be employed to carry out preventive and corrective maintenance on the wind turbines, distribution networks and transmission substation.

## 3.4 Dismantling at the end of the operating period

The lifetime of the wind farm is estimated to be 20 years. At the end of this period, the wind farm can be dismantled and/or replaced.

All the elements of the wind farm can be easily dismantled and partly recycled. Only the foundations buried at more than one metre below the natural soil, the buried cable networks and the access roads will remain on site.

## 3.5 Security measures

The wind farm will not be fenced. Only the transformer substation will be fenced off with controlled access.

### 3.6 Project schedule

The works will take place over a period of 20 months with a projected commissioning date of July 2023.

### 3.7 Investment cost

The amount of investment throughout the project lifecycle will amount to MAD 1,061 million during the construction phase and around MAD 29 million per year for the operational phase.

## 4. Existing environmental conditions

### 4.1 Study areas

#### ► Wind farm

The Koudia Al Baida wind farm repowering project is being carried out in the geographical area of the current Koudia Al Baida wind farm. The new configuration of the project involves four ridges. These are ridges A1, A3, A2 and D1, which correspond to the area of the current wind farm.

The environmental and social analysis of the Koudia El Baida wind farm project and its cable network has been conducted in the following areas:

- **Immediate study area:** This area corresponds to the area where the wind turbines are located, including the turbines and the internal electricity network of the wind farm.
- **Construction area:** This area includes the immediate area as well as the areas required for the construction site, the access roads and tracks from the national grid, the power line corridors to the national grid and the storage areas for dismantled equipment.
- **Operating area:** This includes an area of land of at least 600 m on either side of the wind turbines within which residential buildings may experience an acoustic impact.

#### ► Power lines

**A specific study area** has been defined, corresponding to 500 m on either side of the route of the future connecting power lines.

### 4.2 Physical environment

#### 4.2.1 Air and climate quality

The study area includes the wettest geographical areas in Morocco. Rainfall occurs mainly during the rainy season. Thus, the average annual rainfall is 800 mm, varying between 600 and 800 mm along the coastal plains and between 800 and 1,000 mm on the highlands of the Haouz mountain range. In the summer, however, rainfall is almost non-existent, and average evaporation varies between 1,200 mm and 1,900 mm per year.

Peak rainfall is usually in December or January. The driest months are always July and August, with almost no rainfall.

Snow falls every year on the high peaks and can remain there until April.

Furthermore, average temperatures (daily maximum and minimum) vary between 12.5°C and 25.5°C with a minimum in January and a maximum in August.

Two wet periods interspersed with a dry period from May to October follow each other during the year.

Wind patterns are very irregular and influenced by the existence of both the Atlantic and Mediterranean sea masses. Two types of strong winds predominate throughout the year:

- Westerly winds (Gharbi), from the Atlantic, often cause precipitation and predominate between November and March. These winds blow from May to October;



- Easterly winds, from the Mediterranean, often predominate in summer and spring (October to February).

In the study area, the average wind speed varies between 9 and 10 m/s. The prevailing winds are from the west and from the east-south-east.

With regard to air quality, the study area does not contain any significant point sources of air pollutant emissions. However, it is worth noting the presence of several quarries for the extraction of building materials, mainly along the limestone hills. In these quarries, dust and exhaust emissions from extraction and transport equipment are common. A large quarry borders the southern part of the A2 ridge.

#### 4.2.2 Topography and geomorphology

At the local level, the wind-farm blocks under study are spread out from west to east on the ridges of the limestone range, which is the case for the southern part of A1 and A2, then on the low mountains of the Ghomarids and Sebti units (belt of low, round-peaked mountains) for the remaining blocks.

The altitude of the blocks studied ranges from 370 m to 570 m.

The slopes of most of the ridges in the limestone range are steep. The east-facing slopes are often the steepest. The dominant slope class ranges from 10 to 20 per cent; slope values above 30 per cent have been recorded.

#### 4.2.3 Geology

From a geological point of view, the entire study area is part of the Rif geological area. The latter is subdivided into three main areas (Durand Delga *et al.*, 1960-1962):

- The internal area, to the north of the current Rif;
- External area, to the south;
- Middle area, made up of flysch layers, forming a bank between the two earlier furrows.

Within the internal area, three major structural groups can be distinguished: the limestone ridge, the Sebti and the Ghomarids:

- The limestone ridge: this range is a series of thin, scaly sheets framed in Triassic-liaistic carbonate with Jurassic-Cretaceous and Paleocene pelagic layers, made up of oligo-Miocene terrigenous flysch-molassic layers. It consists of the Haouz mountain range to the north of Tetouan and the limestone ridge between Tetouan and Assifane, forming a border for the internal areas of the northern Rif to the west and south. The limestone ridge is subdivided into an internal, an intermediate and an external ridge;
- The Sebti: a series of metamorphic terrains, with ultrabasic rocks at their base (Beni Bousera peridotite massif). From bottom to top, there are peridotites, a halo of kinzigites, gneisses and micaschists (Filali Unit), and towards the top, Paleozoic and Triassic metasediments (Federico Unit);
- The Ghomarids: they form a series of four Paleozoic layers that are scarcely or not metamorphosed – they are the Aahaili, the Koudiet Tizian, the Hozmar Beni and the upper layer of Talembote.

It should be noted that the existing wind turbines are built on generally rocky and solid dolomitic limestone, but old or recent landslides can be observed on colluvial deposits, shale, flysch or mudrocks with structures more likely to lead to landslides.

#### 4.2.4 Erosion risk

Wind turbines at risk of instability are those located near steep slopes or on rocky terrain beneath which active landslides may overhang the field site.

Due to the high density of vegetation cover on both sides of the new wind turbine area, landslides are rarely observed. Nevertheless, the predominance of shale, colluvial and pelitic soils will be a trigger factor for landslides during and after the earthworks.

#### 4.2.5 Surface water

The river system draining into the study area is dense. From the limestone range that follows the alignment of the main ridges of the study area, the main tributaries and confluences of the catchments of the four main rivers – the Nègre, Fnideq, Amezzouk and R'mel, as well as the Marsa – drain the study area.

These surface water resources constitute the bulk of the water resources in the study area. Indeed, the abundance of rainfall, the predominance of low-permeability facies (including shale and clay) and the steep slopes hinder underground infiltration and have the following consequences:

- Runoff is significant and predominant in all catchments;
- The rivers have an irregular hydrological system with torrential flows during flood periods and very low to zero low-water flow rates;
- The maximum monthly inflows are recorded between December and February in the form of floods, which constitute the bulk of river inflows. On the other hand, low-water levels are significant, with low-water flow rates falling to almost zero, except for the rivers draining the limestone range.

At the level of the limestone range (A2 ridge), the permeable and fractured carbonate formations favour the infiltration of water into the subsoil compartments. In the immediate vicinity of this range, there are no permanent watercourses in the study area. However, as it is an elevated ridge, many trenches and streams originate here. The range is therefore not a catchment.

#### 4.2.6 Groundwater

The existing wind turbines are crossed to the north-west and south-east by the Haouz de Tetouan water table.

However, the new wind turbine site is not crossed by any regional water table, with the exception of a few small perched water tables with very limited reach and reserves.

In the latter area, the soil is not very permeable, allowing the creation of water springs, which can be explained by two theories:

- Either the location of these springs corresponds to contact areas between permeable limestones and shales, flyschs and marls of low permeability;
- Or because of the presence of fractures.

In general, these springs have a medium to low flow rate with small fluctuations between flood and drought periods, except for the springs with low flow rates (less than 0.05 litres per second (l/s)).

Some springs show an alignment that suggests a major fault draining most of the deep-water sources.

#### 4.2.7 Acoustic environment

The main sources of noise and vibration identified are related to road traffic on the roads mentioned in the previous chapter. Similarly, the existing quarries are sources of noise pollution in the immediate, near and distant areas.

The residual noise in the most exposed neighbourhood was measured. Residual noise measurement points were chosen according to their noise exposure to the wind turbines and weather conditions, as well as the geographical sectors of the area. These points were chosen as being representative of the noise environment in each area.

The findings of these measurements showed that the average daytime noise level recorded in the whole study area does not exceed 45 decibels (dB) at a wind speed of 3 m/s and 58 dB at a wind speed of 12 m/s, while the average night-time residual noise level recorded does not exceed 37 dB at a wind speed of 3 m/s and 55.5 at a wind speed of 12 m/s.

## 4.3 Natural environment

### 4.3.1 Overview of biodiversity

The project site is part of the Rif mountain range (the Western Rif). It is characterised by a sub-humid bioclimate and a thermo-Mediterranean vegetation layer. This part of the Western Rif, influenced by both the Mediterranean and the Atlantic, provides the region with a very interesting diversity of biocenoses. The vegetation cover is also very diversified and is composed of two main strata: *Erica arborea* and *cistus* scrubland; and pine-dominated forest.

As far as migratory birds are concerned, the future Koudia Al Baida wind farm is located in the hinterland of the Strait of Gibraltar, which is one of the most important known migration corridors for millions of birds in the Western Palearctic, including birds of prey and other large soaring birds such as storks, which are at risk of harm from wind turbine blades.

The area is also known for its great diversity of ecological habitats, including:

- rugged terrain with ridges, cliffs and escarpments, valleys and ravines;
- karst systems that tend to have caves, crevices and fissures;
- forests and shrubby matorral.

### 4.3.2 Breeding birdlife

The breeding species most at risk from the wind farm project are mainly represented by three species of the crow family (*Corvidae*, chough and jackdaw). Although none of the three species is protected in Morocco, the latter two are very common to the local area. Indeed, the nesting sites of these species are scattered over the main rocky ridge (ridges A1 and A2).

This main rocky ridge is therefore a relatively sensitive site for the wind farm project.

Steppe species will see the surface area of their nesting sites reduced to a very low level, given the high prevalence of this type of habitat in the project area. These species will be particularly affected by noise and dust emissions during the construction work.

Forest species (including the two endemic species the Great Tit and the Western Olivaceous Warbler) will be the least affected as their habitats will be mostly away from any destruction or disturbance during the works.

### 4.3.3 Migratory birdlife

As for migratory birds, due to the geographical location of the project, tens of thousands of important birds of prey and storks (birds that are at most risk from wind farms) cross the Strait during both migratory periods.

The ornithological studies carried out at the Koudia El Baida wind farm provide the following conclusions:

- During both migratory phases, birds avoid flying over the main AïnJir-Tlata-Taghramt ridge (ridges A1 and A2), except for a mountain pass over which birds fly at low altitude in both autumn and spring;
- The valley to the north of the site is crossed from west to east or *vice versa* in particular windy situations, forcing pre-breeding migrating birds to seek passage points either through the eastern part of the Strait or through the western part; similarly, this valley is used by post-breeding migratory birds who have to follow migratory routes either along the east coast or along the west coast of the Tingitane Peninsula towards their African wintering grounds;
- The creation and maintenance of a feeding pit at Jbel Moussa to attract vultures from the vicinity of the future wind farm is an important measure;
- On cloudy or foggy days (frequent in the region), the risk of collision could be quite high in an area well known for the passage of tens of thousands of birds vulnerable to wind farms (large soaring birds: birds of prey and storks) but also a vulture dormitory at Jbel Moussa (less than 3 km away) or the future vulture feeding pit (about 2 km NNE of the site). The International

Union for Conservation of Nature (IUCN) recommendation is to move these away from the wind farm turbines, to a distance of at least 4.5 to 5 km.

#### 4.3.4 Bats

The baseline study showed that out of 19 species observed or likely to be present in the region, 12 were found in the study area.

According to the data collected, the bat population in the region is of average interest, both in terms of the number of species (three dominant species, four rarer regular species, and five rare to very rare species), and in terms of frequency (less than 150 sequences recorded per night). The frequent strong winds in the region, the heavy rainfall and calm-weather mists probably limit the frequency of bats on the ridges, and activity should be higher in the quieter valley bottoms.

The Greater Noctule, a species classified as Vulnerable (VU – IUCN category) that appears to be very rare in the study area, is highly threatened because of the height at which they fly.

The other four endangered species (IUCN Near Threatened (NT) category), owing to their flight habits, have a low mortality risk. Only one of them, the *Schreibers Miniopter*, is fairly abundant on the site.

Only one endemic species, *Serotin isabella*, which is not endangered, is at serious risk of mortality.

Due to differences in wind speeds, and to a lesser extent differences in bat densities, two areas of different sensitivity have therefore been identified:

- A low sensitivity area, corresponding to the ridge (corresponding approximately to the location of the old wind turbines; ridge A1 and A2 and D1), which is very windy, both from the west and east, with low bat densities;
- A moderately sensitive area to the east of the previous one, of lower altitude, more wooded, with lower wind speeds, and in particular protected from westerly winds, with generally higher bat densities. The ridges to the east of the ridges in the project.

#### 4.3.5 Protected areas

##### ► Jbel Moussa Site of Biological and Ecological Interest

The Jbel Moussa Site of Biological and Ecological Interest (SBEI) was identified during the national study on protected areas as a priority, with a surface area of 4,000 ha, part of which is a marine area.

A development and management plan was drawn up for this SBEI in 2008, as well as a funding process in 2019, with a redefinition of boundaries. An aviary was constructed for the rehabilitation of vultures and is now in operation.

##### ► The Ben Karrich Site of Biological and Ecological Interest

This SBEI covers an overall area of 22,100 ha and was classified as category 3 in 1995, during the inventory of natural areas to be protected in Morocco by the Water and Forests Department. Its vegetation, reduced to scrubland, has long been subject to high grazing pressure, which has led to significant degradation. This protected area is not located in the area of the project's sphere of influence.

##### ► The Morocco–Andalusia (Spain) Intercontinental Biosphere Reserve of the Mediterranean

The Intercontinental Biosphere Reserve of the Mediterranean (IBRM) is the third Biosphere Reserve in Morocco, which was definitively accepted and declared by UNESCO in October 2006.

The project is located in an area identified for its ecological interest and is a core area for the IBRM for the main ridge, which runs north–south, the secondary ridges and the bulk of the power line in the buffer zone.

The protection status as such does not lead to any particular regulatory constraints.

## 4.4 Social and economic environment

### 4.4.1 Administrative situation

The Koudia El Baida wind farm project comes under the commune of Taghramt for administrative purposes, while the power lines come under the commune of Allyene. The details of the administrative situation are as follows.

The commune of Taghramt comes under the following administrative structures:

- Tanger-Tetouan-Al Hoceima economic region;
- Fahs Anjra province;
- Anjra *cercle*;
- Taghramt *caïdat*.

The commune of Allyene comes under the following administrative structures:

- Tanger-Tetouan-Al Hoceima economic region;
- M'diq-Fnideq province.

### 4.4.2 Land ownership

The land of the Koudia Al Baida wind farm includes:

- The original land base of the existing 50 MW ONEE wind farm transferred to MASEN (242 ha);
- New neighbouring plots, needed for the repowering project, which are collective lands (5 ha) and seven houses located on a collective plot and which have been the subject of preliminary studies (land survey, Land Acquisition Plan (LAP));
- The power lines will pass through public, forested and private land. However, the installation of the power lines **does not require the acquisition of land or the displacement of the population, only the temporary occupation procedure for the installation of the pylons, which will be carried out in compliance with existing regulations;**
- The land for the electricity substation is also part of the land transferred by the ONEE to MASEN.

An application for the lease of an additional 5 ha of collective land was submitted by MASEN to the Fahs-Anjra Province. Following agreement by the *nouab*<sup>2</sup> and the competent authorities and the meeting of the administrative valuation committee, the lease contract was drawn up and signed jointly by the two parties concerned: the central management of the central office of the Directorate of Rural Affairs (Rabat) and MASEN;

This land is not used for housing by the local population, but is used occasionally by the beneficiaries of the collective concerned for livestock grazing;

A resettlement process has been initiated by MASEN to relocate the seven houses located in the middle of the A1 ridge to reduce the impact of the wind farm on the local population. This mainly relates to seven properties, one of which is a farm.

### 4.4.3 Land use and occupation

The study area for the Koudia El Baida wind farm is occupied as follows:

- Main highway RN16, which forms the northern boundary of the future wind farm and serves Douars Dchicha, Ain Jir and Biout;
- Provincial highway RP4703, which crosses the ridge of the wind farm from north to south;
- The ONEE's existing wind farm;
- The existing transfer substation;
- Six telecommunication antennas;
- A quarry to the south of the wind farm on the way to Tlat Taghramt (the market);
- Forestry area;

<sup>2</sup> Translator's note: tribal representatives

- The douars:
  - Dhar Loudarssa, giving access to the eastern ridge,
  - Dhar Drarida in the east,
  - Amezzouk and El Kahalline to the north-west of the south-western ridge of the wind farm,
  - Lmgharba to the east of the transfer substation and the south-eastern part of the wind farm,
  - Tlat Taghramt to the south of the wind farm.
- Seven houses within a 600 m perimeter of wind turbines T28 and T29.

For the connecting power lines, the land is occupied as follows:

- A semi-arid environment: rugged, stony terrain with very low productivity potential due primarily to skeletal soils;
- The land is made up of forests interspersed with a mosaic of agricultural plots (of varying sizes) given over to cereal monocrops (mainly barley) and to fallowing;
- A number of bushes of various forest species;
- The high-voltage line entry area is the ONEE site – 225/60 kV Jbel Moussa substation.

#### 4.4.4 Population and demographic development

The commune of Taghramt had 8,685 inhabitants in 2014: 4,460 men and 4,246 women. In 2020, this population grew to 9,298 inhabitants, with an average annual growth rate of 1.03 per cent.

The commune of Allyene had 6,570 inhabitants in 2014: 3,353 men and 3,230 women. In 2020, this population grew to 6,919 inhabitants, with an average annual growth rate of 0.76 per cent.

#### 4.4.5 Habitats

The study area is characterised by rural and fairly scattered settlements. More than 65 per cent of the houses are built of solid materials, while 25 per cent are built with local materials.

No residential buildings have been identified in the immediate vicinity of the future wind turbines. Indeed, the project has been designed to avoid residential areas such as the eastern ridges of the project and to adhere to the regulatory thresholds for noise pollution for the nearest houses.

#### 4.4.6 Economic activities

According to field investigations, the main economic activity of the local population is sheep and cattle farming, but the most common activity is goat farming. Agriculture is also practised but, given the difficulty of the terrain, is limited to subsistence farming, where fodder is the main crop.

Before the borders closed following the spread of COVID-19, young people from the douars in the study area used to work as traders in Ceuta (generally clothes and small electrical appliances). These young people are now trying to find work in local projects (Tanger Med, the Tanger and Tetouane industrial estates, in quarries, etc).

Taghramt has a weekly *souk* every Tuesday. This market is located to the south-west of the A2 ridge, about 500 metres as the crow flies.

Beekeeping also takes place in the study area, particularly in the forest, where local beekeepers keep their hives.

#### 4.4.7 Education and health

Allyene has six primary schools and a secondary school.

Taghramt has five primary schools and one secondary school located in the town centre.

The three communes in the study area each have a rural health centre, mainly located in the centre of the commune, with the exception of Allyene, where the rural health centre is located in Douar Oufrasou.



#### 4.4.8 Road infrastructure

The northern ridges of the wind farm are served by the RN16 linking the city of Tangier to the city of Ceuta, as well as the provincial highway RP4703 passing through the town of Taghremt, which also serves the ridges in the centre and south of the wind farm. The eastern ridge of the wind farm is served by the track passing through Dhar Loudarssa.

Fairly developed tracks also pass through the study area, generally serving the douars, outlying dwellings and quarries.

A project for the development and opening of tracks in the municipality of Allyene is under way.

#### 4.4.9 Landscape

Although the study area is located in a rural area, the general landscape is more industrialised, with the presence of the first wind turbines in the region, pylons for high-voltage lines, a quarry for the extraction of building materials and the road leading to Taghramt. The natural landscape is notable for its forest and scrubland and is dominated by the Jbel Moussa mountain, with the other shore of the Mediterranean in the background.

#### 4.4.10 Cultural heritage

The project area does not contain any sites classed as a Moroccan heritage site.

During the archaeological survey carried out on foot in July 2020, no sites of heritage or archaeological interest were identified.

Archaeological investigations were carried out on foot between 2008 and 2012 by mixed teams over a large part of northern Morocco, including the project area. These investigations led to the production of an archaeological map of Morocco listing archaeological sites dating from prehistory, from the Palaeolithic to the Neolithic eras.

The map showed the existence of some archaeological sites scattered throughout the study area. However, the sites identified so far are of minor value. They are not currently classified or undergoing a classification procedure.

The power line route does not go near any sites of archaeological interest.

## 5. Assessment of environmental and social impacts and proposed mitigation measures

### 5.1 Positive impacts

**During the construction phase**, the project will also have positive impacts on the local and regional community. Indeed, the project will help in the creation of local jobs and the use of local businesses/services. The workforce to be employed during the construction phase would amount to at least 1,000 workers at the peak of construction. In addition to the direct financial impact on the families employed, local workers' wages will also stimulate the local economy, as the money earned in the project will be spent locally and be injected into the local economy.

In addition to the direct economic impact of the employment created during the construction works, there is also the potential for the project to promote the passing on of best construction practices from the local workforce. Given that the development is likely to prove to be a catalyst for regional development, the skills acquired are likely to be readily marketable after the project is finished. Another secondary impact is likely to come from spending on local goods during the construction process.

**During the operational phase**, the Koudia El Baida wind farm project will help to create jobs, with priority given to local residents.

Moreover, the business tax will mean that the profits from the project operations will be very much shared with the municipality/local authority, yet the wind farm operations will not increase the burden on the local authorities/municipalities (no waste products to be collected, no need for a water or sewage system, no need for road maintenance).

While ideas about aesthetics and landscape are, of course, subjective and depend on how each individual perceives them, it is expected that the repowering of the existing wind farm will have a positive impact on the site's landscape. Through the modern design of the wind turbines, with fewer and more spaced out machines, the project will be developed to enhance the site's identity as a landscape by ensuring it retains more of its natural features.

**The project will also help to reduce energy dependency and create a competitive energy advantage, in addition to reducing greenhouse gases.** Indeed, wind energy is a clean method of producing electricity, which does not emit any gas, smoke or dust pollutants into the atmosphere. This project will therefore help in the:

- Prevention of all air pollutants (NO<sub>x</sub>, SO<sub>2</sub>, etc);
- Prevention of greenhouse gases, in particular an estimated 7 million tonnes of CO<sub>2</sub> over 20 years.

## 5.2 Negative impacts before and during construction

### 5.2.1 Dismantling the current wind farm

#### ► Impacts

Dismantling the current wind farm will entail:

- Disconnecting the electricity supply and shutting off of all electrical equipment;
- Permanently disconnecting and shutting off of all hydraulic equipment;
- Temporarily storing the dismantled equipment;
- Cutting up and packaging the dismantled equipment;
- Removing all equipment, material and waste.

The concrete platforms of each turbine, including the steel anchors, will be cut down to just below ground level. The material will be taken off site and the platform area covered with topsoil to encourage vegetation to return to the site.

The impacts of dismantling the current wind farm are comparable to those that occur during the operational phase in terms of noise pollution, changes to air quality and increased traffic flows around the wind farm access roads. That said, waste management impact is different in that the dismantling of the current wind farm will generate more types of waste that will require appropriate handling. The types of waste generated by the dismantling of the wind farm are:

- **Inert waste:** derived from the removal of the foundations and the demolition of the current substation;
- **Composite materials:** the blades and nacelle are made of a reinforced polymer matrix of fibreglass and carbon fibre;
- **Steel and other metals:** the tower, cables, metal components of the foundations, shafts, gearing and other internal wind turbine mechanisms are made of metal: steel, cast iron, stainless steel, copper, aluminium;
- **Electric and electronic waste:** oil from transformers and wind turbines;
- Other waste associated with on-site personnel (household waste, waste from the first aid room etc).



### ► Planned measures

To minimise the impacts of activities relating to the dismantling of the current wind farm, the following measures are planned:

- Draft a dismantling management plan that includes management of the waste material from the dismantling equipment for the tower, nacelle and rotor;
- Level out the platform foundations to just below ground level, shave down the metal components and cover the area with topsoil;
- Recycle the scrap metal in line with current recycling categories. Promote the recycling and/or the reuse of material from the current turbines;
- Send no waste from the current wind farm to landfill (blades etc);
- Set up appropriate temporary storage units to house harmless waste in designated areas to avoid the waste being spread across the whole site;
- Install appropriate secondary containment units for storing fuel tanks and various liquids (lubrication oils and hydraulic fluids);
- Develop a plan to manage transport and special traffic flows for when the current wind farm is being dismantled (schedules, specialist convoys, signalling etc);
- Use dust control techniques such as sprinkling water or non-toxic chemicals to reduce the amount of dust released by the flow of traffic;
- Use inspected and well-maintained lifting devices appropriate for the load to be lifted;
- Apply general guidance for good construction site management in terms of noise and odour pollution, accident risk management, and staff and community safety.

## 5.2.2 Construction of the future wind farm

The construction of the Koudia Al Baida wind farm and its connecting power lines will require temporary accommodation for workers. This will lead to solid and liquid waste being produced. During construction, a range of works will be undertaken, including earthworks and grading, structural engineering, the transport and assembly of equipment, and the construction of technical and administrative buildings. Impacts during construction will include:

### ► Air quality

The impacts on air quality during the construction phase are:

- Congestion caused by heavy vehicles on the roads RN16 and RP4703 as well as roads accessing villages. These vehicles will be in addition to the traffic associated with the current quarry;
- Spread of dust and exhaust fumes, including during work on the tracks and access roads, particularly the RN16 and RP47603.

### ► Noise and vibration

The impacts related to changes in the sound environment within the study area when works are ongoing are:

- Noise pollution as a result of digging and grading;
  - On-site work occurring between 7 am and 6 pm with limited and monitored work at night; there will be information in the surrounding area about the construction site schedule;
  - Use of EPI Oreillette noise-reducing ear defenders for those who operate compression tools or are involved in any activity where noise pollution levels are above the regulatory threshold;
  - Where possible, electric tools will be prioritised over alternative powered solutions; vehicles will be fitted with high-quality mufflers where necessary;
- The traffic flow of heavy vehicles will be reduced during the night.

### ► Traffic flow

The impacts on traffic management in the study area when works are ongoing are:

- Significant flows of vehicles to transport workers during construction work;
- Risk of traffic accidents in the project area involving members of the local community as well as those who use the access roads to the project site;
- Traffic delays due to the transport of construction materials; movement of machinery and various carrier vehicles for transporting wind farm components.

### ► Soil and groundwater

The impacts on the earth and groundwater in the study area when works are ongoing are:

- Changes to topography due to earthworks and grading;
- Movement from excavation and filling;
- Accidental soil and groundwater pollution (spills of hydrocarbons, oils, paints, solvents etc);
- Discharge of wastewater into the natural environment;
- Erosion risks.

### ► Storm water management

The impacts of bad storm water management in the study area when works are ongoing are:

- Changes to the hydrological structure of waterways and their tributaries;
- Degradation of the quality of surface water resources as a result of direct or indirect discharges when works are ongoing;
- Flooding of surrounding land.

### ► Biodiversity

When works are ongoing, the following impacts could occur:

- Destruction of particular fauna and/or nests in the working area;
- Destruction of habitats used by bats;
- Disturbance of birds who nest on or near the site. Certain species are very sensitive to disturbance, which could result in reproductive failure within the area in question;
- Disturbance and death of livestock;
- Destruction of rare species constituting a critical habitat around the A2 ridge and the beginning of the route of the electricity line;
- Protected areas: the project is located in the Morocco–Andalusia Intercontinental Biosphere Reserve of the Mediterranean (noting that the wind farm was constructed before the creation of the Biosphere Reserve).

### ► Management of waste and hazardous materials

The impacts of the management of waste and hazardous materials when works are ongoing are:

- Pollution of soil and groundwater by the waste produced during the construction phase (non-toxic waste, pharmaceutical waste, benign industrial waste, waste from stripping work etc);
- Accidental spills of hazardous materials (oils and lubricants, paint residues, resin, latex, plasticisers, glue, absorbent materials, cleaning rags etc).

### ► Archaeology

In the construction phase, the impacts on archaeological sites mainly relate to the destruction of unknown archaeological remnants identified on site. If unidentified sources of archaeological or cultural heritage are discovered during the earthworks and grading phase of construction, that will have a very negative impact before mitigation measures are rolled out.

### ► Landscape and visual impacts

The impacts on the landscape in the study area mainly relate to changes in the landscape's characteristics that would have an impact on the field of view (spread of dust, cranes, enclosed areas etc).

### ► Social and economic issues

During the construction phase of the wind farm, its access roads and electricity connection cables, the local community will experience some negative impacts due to various disturbances caused by the works:

- Changes in air quality due to increased levels of dust;
- Noise pollution from digging and grading;
- Traffic disruption due to construction materials being taken to site and various carriers transporting components of the wind farm;
- Limited access, particularly on the weekly market day (Tuesdays);
- Disruption to grazing or forestry activities;
- Disputes between the local community and workers due to cultural and religious differences;
- Disruption to work at existing quarries;
- To avoid noise pollution, the seven houses within a 600-metre radius of T28 and T29 will need to be relocated. This will involve physical relocation and will also affect the families concerned. However, as access to land used by certain families will remain open, there will be no economic displacement;
- Mobilisation of land parcels required for the pylon mountings of the new electricity lines. The parcel for each pylon is around 50 m<sup>2</sup>. The loss of farmland will be low-level with a minor impact. The mobilisation of the areas of land will lead to a very low degree of economic displacement.

### ► Workers' health and safety

Workers could be exposed to several health and safety risks related to not only the structural engineering but also the electrical work that will take place on site. The main risks and hazards predicted as part of the project are:

- Vibration and noise-related risks;
- Risk of accidents: during construction work, staff will also be exposed to different workplace risks linked to structural engineering work and working at height, such as the risk that material or workers might fall, or facilities may collapse. This impact mainly relates to the service building;
- Toxic risks: there are various ways in which the workers could be exposed to chemical, biological or radioactive products;
- Risk of electrocution or fire.

In view of the short construction period and the size of the project, these impacts are considered moderate.

## 5.2.3 Mitigation measures – construction phase

To mitigate the construction phase impacts, the companies responsible for delivering the construction work at the Koudia El Baida wind farm, its access roads and electricity lines will need to implement the full range of good environmental management measures relevant to construction sites.

### ► Soil and groundwater

The main measures proposed for the construction phase are:

- A geotechnical study should be conducted before work begins to optimise the turbine foundations;
- Use of current roads will be prioritised; the preferred option will be to repair and widen them in line with project requirements rather than building new roads;
- Earthworks will be kept to a minimum;

- Reintroducing vegetation, including reseeded work, is recommended to rehabilitate the dismantled turbine platforms on the A2 ridge;
- Removal of debris produced by cutting down the platforms must be done in locations that the project owner authorises;
- Particular care will be taken to fell as few trees as possible on the other ridges;
- The road will preferably be laid out in parallel where the ridges are at their steepest gradients so as to avoid a perpendicular blockage of any rainwater that has not drained into the soil;
- Vehicles will be well maintained to reduce the likelihood of accidents;
- Material used to stabilise or lay roads must be non-hazardous, drainable and comparable to what is currently on site;
- If there is an accidental spill (a pipe empties or ruptures), the construction site will deploy large absorbent impervious tarpaulins designed for hydrocarbons;
- Operators will need to receive training on spill prevention and what to do if a spill occurs;
- Contaminated soil will be dug out immediately by the machinery available and stored in the impervious area prior to treatment at an appropriate facility;
- The construction site sanitary facilities must not discharge anything into the natural environment. Chemical toilets will be provided and the wastewater will be channelled into a watertight reservoir for processing at appropriate treatment facilities.

#### ► Noise and vibration

The main measures proposed during the construction phase are:

- To ensure appropriately chosen and well-functioning machinery that will reduce atmospheric emissions and noise pollution, atmospheric emission filters and noise mufflers must be fitted to the machinery.

#### ► Traffic flow

- Deploy sufficient and appropriate traffic signalling, including outside the construction site;
- As far as possible, plan heavy goods traffic during the day to reduce damage due to driving through villages;
- Cover trucks carrying building materials to reduce the spread of dust;
- Check the loads of heavy vehicles carrying building materials;
- Use collective transportation (buses, vans) for workers to reduce the number of vehicles on site;
- Organise secure transport in special convoys for project components;
- Give the local community advance warning of the work and, if applicable, give notice when special convoys are to be scheduled.

#### ► Management of waste and hazardous materials

- Ensure that waste is well managed at the construction site by:
  - Sorting and recycling waste as far as possible;
  - Ensuring that a management plan for hazardous waste such as fuel or machinery lubricants is in place with a defined emergency intervention plan;
  - Setting up an area for washing and maintaining machinery so as to stop fuel or lubricants from seeping into the ground, as this would lead to soil pollution;
  - Providing liquid waste sanitation for employees on site by installing mobile toilets and regularly emptying the effluent at the nearest purification plant in cooperation with the plant's management.

#### ► Archaeology

- Before construction begins, the builder must draft a construction-specific environmental and social management plan that takes account of the possibility that archaeological sites or ancient objects may be dug up. The competent authorities will be notified of the discovery of any ruins and the appropriate procedure will be followed: work stops in the relevant area, including within protection perimeter; Ministry of Culture begins investigation.

## ► Biodiversity

The main measures proposed during the construction phase are to:

- Locate the building site facilities and construction infrastructure within the boundaries of the project site and remove them as soon as possible after operations begin just after any acceptance reservations have been lifted;
- Reduce the impact of the LDA9 works area around the A2 ridge so as to avoid the destruction of any critical habitats identified;
- If any natural/critical habitats are destroyed, suitable remedial measures must be deployed;
- Re-establish habitats for species (planted areas, reptile refuge zones etc) in the areas that were used during the works;
- Give top priority to natural recolonisation, and lightly decompact the soil once construction is complete to encourage germination of seeds in the soil;
- Run an awareness-raising campaign targeted at workers about environmental values and the benefits of wild flora and fauna;
- Conserve the upper layers of soil during grading earthworks to preserve those layers and potentially use them for revegetating the area.

## ► Social and economic issues

The project will require the physical and economic displacement of part of the community impacted by the project. To mitigate this impact, the following is proposed:

- Limit displacement of the community as much as possible;
- Ensure compensation is provided to those entitled to it in line with current regulations;
- Ensure that those who are physically displaced have properly regained their livelihoods;
- Mitigations enabling the local community to maintain their livelihoods must be developed, ensuring that vulnerable groups can access and benefit from them without discrimination;
- Ensure that the construction site is enclosed so that the public has no access to it and is not exposed to its various risks (falling materials, inhalation of chemical products, burns etc);
- Limit the size of the construction site and avoid placing material outside the site itself so as to maintain the movement of livestock as far as possible;
- Only areas where construction is happening at risk (laying foundations, erecting turbines) will be temporarily closed;
- Display clear signage prohibiting public access;
- Consult local stakeholders about the development and planning of the project so as to maximise synergies for the local economy;
- Further reduce the project footprint during the remaining part of the design phase so as to minimise the impact on land use and households;
- Anyone not working on the project must only be allowed access to the construction site if they are accompanied or have been allowed access by someone with the authority to do so and have the correct protective equipment with them;
- Establish a land acquisition plan in consultation with government and community stakeholders.

## Workers' health and safety

- The building site/construction areas must be designed so that they prevent fires from breaking out by implementing fire codes that apply to the construction sectors;
- Apply essential fire prevention measures, such as:
- Equip facilities with fire detectors, alarm systems and firefighting equipment;
- The equipment must be accessible and kept in good working order. It must be appropriate to: the size and purpose of the facilities; the equipment installed in them; the physical and chemical properties of substances in the facilities; and the maximum number of people they can accommodate;
- Handheld firefighting equipment must be easily accessible and straightforward to use;

- Set up a fully equipped medical station;
- First aid staff must be clearly designated, trained and competent;
- A fully equipped ambulance with medical staff must be in place throughout the construction period;
- Appropriate precautions, such as installing barriers or gutters, must be taken to protect workers from material, tools or equipment that might fall during lifting operations;
- Guard-rails and platforms that conform to national regulatory requirements must be installed to prevent staff working at certain heights from falling;
- Unprotected ears must not be exposed to peak (sudden) sound pressure of more than 140 dB (C);
- Establish a fall prevention system that must be suited to the structure of the tower and movements required around it, particularly ascent, descent and movement from one location to another.

## 5.3 Project impacts and associated measures in operational phase

### 5.3.1 Operational phase impacts

The following impacts are expected throughout the operational period of the Koudia El Baida wind farm.

#### ► Noise and vibration

When working, the turbines can emit sound. Acoustic modelling has been completed to evaluate the acoustic impact of the future wind farm. The modelling results showed that the receptors (houses) most susceptible to the noise were those located in the vicinity of turbines T19 and T16. A noise reduction strategy consisting of placing noise reduction equipment on the blades will allow day and night noise levels to be kept within the thresholds for all susceptible areas.

#### ► Soil and groundwater

During the operational phase, groundwater will not be impacted by activity on site. No hazardous products will be stored and no earthworks (compacting or movement of soil) will take place during this phase.

The operation of the wind farm involves no modifications to the soil or subsoil under normal conditions except in the case of largescale maintenance operations.

#### ► Surface water and rainwater

The project will not affect the geographical architecture of the water system and so will not lead to flooding conditions.

Under the project, ground waterproofing will be restricted to the turbine foundations. The tracks and platforms will not be waterproofed (they will be made of compacted earth covered in gravel).

In addition, when operational, the wind farm will not discharge any dirty water or pollutants onto the soil. Runoff water is unlikely to be polluted, as the turbines are inert. The project will therefore have no impact on water quality.

As a result, when the site is operational, water consumption is close to zero. Rainwater will be drained via a drainage system that is already partly in place.

#### ► Biodiversity

When the Koudia El Baida wind farm is operational, the main impacts on biodiversity are considered to be:

- Migrating birdlife colliding with rotating turbine blades;
- Physiological imbalances among bats caused by depressurisation in the vicinity of the turbines;



- Risk of death among nesting and large birds of prey (buzzards, kites, eagles) and vultures as they hunt in the cleared areas and use the air currents rising off the hill slopes to gain height; the turbine blades are located at the apex of these currents;
- Fire risk in vegetation and natural habitat.

The impact on biodiversity of the medium and low-voltage overhead power lines in operation can lead directly to the death of birdlife from:

- Electrocution (due to birds establishing a connection between two live wires); and
- Collision due to low visibility of power cables.

The impact of turbine noise on birdlife will be negligible. The experiences of other wind farms suggests that it is possible to detect that birds are scared when the facility starts operating but that these reactions come to an end and birds rapidly return to the site.

#### ► **Waste management**

No impact is deemed significant in terms of how the electricity power line works.

Waste produced by the wind farm while operational is set out below. The waste listed is only produced in small quantities during maintenance work.

- Transformer oil
- Turbine oil and lubricant
- Turbine coolant
- Waste electrical and electronic equipment
- Sections of metal
- Household waste and non-hazardous industrial waste

#### ► **Traffic et transport**

Road traffic during the operational phase will not be significant. Consumables and other equipment will be delivered in low volumes except during specific maintenance periods.

#### ► **Wastewater**

When the Koudia El Baida wind farm is operational, predicted liquid waste will be:

- Household waste from sanitary units in the electricity substation and adjoining buildings (offices, toilets etc);
- Rainwater soiled by the lubricants and oils from particular parts of the wind turbine (such as the nacelle).

No impact is deemed significant in terms of how the electricity line, substation and wind farm will work. No wastewater discharges are expected throughout the operational phase.

#### ► **Archaeology and heritage**

As there will be no significant impacts on historical and cultural heritage during the operational phase, there are no proposed mitigations.

#### ► **Landscape and visual impact**

In comparison to the ridges where the current ONEE wind farm is, constructing more widely spaced new turbines could reduce the site's visibility; it would become less noticeable and more spaced out given the smaller number of turbines and the larger distances between them. Changes made to the landscape at the A2 ridges would have a positive impact.

Changes to the landscape due to the construction of new wind turbines in the area are rather subjective. They mainly depend on how observers see matters as well as how they use the area. Therefore, residents will see wind turbines as a substantial change to a familiar landscape, but at the same time, as tools for progress.

The power lines will also have an impact related to a change in the landscape as it was previously.

### ► Social and economic activity

When operational, the impact of the project on the community's social and economic activities is rather positive (see section on positive impacts).

### ► Health and safety of the local community

The impact on the health and safety of the local community mainly relates to:

- Stroboscopic effect: this occurs when the sun is behind the turbine and casts a shadow;
- Noise (see paragraph above);
- Falling blades or chunks of ice;
- Risks relating to public access to the wind farm;
- Electromagnetic field (power lines and wind farm).

### ► Workers' health and safety

The main workplace health and safety risks relating specifically to the facilities and turbine activities are:

- Working at height and falling objects;
- Working in inaccessible places (far away from healthcare equipment or supplies, restricted methods communication etc);
- Lifting operations where a broken-down turbine is being replaced;
- Isolated working conditions: certain maintenance operations require one single person to do jobs in circumstances where she or he cannot be seen or heard by other workers;
- Electricity risks: related to maintenance of electricity connection equipment for the wind turbines, the transfer station, or the 225kV power lines;
- Risks relating to arrangements in the working areas at the bottom of the turbines when turbines are being replaced or during maintenance work; risk of accidents while moving machinery or vehicles; risks associated with falls at ground level due to steps or drops in the working area, uneven ground or awkward manual handling work and postures;
- Work environment: risks to hearing, heat stroke and hypothermia, working at high altitude etc.

## 5.3.2 Mitigation measures – operational phase

### ► Noise and vibration

The following noise reduction measures are proposed for the wind turbines whose noise levels could impact susceptible receptors in the vicinity of the turbines:

- The level of ambient noise should not exceed 3 dB around the susceptible receptors (residential area nearest to the turbines);
- Ensure noise level monitoring suitable for operational conditions;
- Restrict operation of the turbines (T16 and T19) above wind speeds where the noise of the turbines become unacceptable in the specific circumstances of the project.

### ► Soil and groundwater

Measures recommended to minimise the impact of accidental water and soil pollution are:

- Ensure that all areas used to treat or store wastewater are correctly sized;
- Ensure proper maintenance of the inlet/outlet points of rainwater drainage networks to avoid uncontrolled flooding of the environs;
- During significant maintenance operations that require the use of construction site machinery (such as a crane), specific measures to protect soil and groundwater quality during the building works must be applied. A permanent waterproofed parking area will be kept and maintained for this throughout the operational life of the wind farm. This parking area will be large enough to accommodate the construction machinery needed for maintenance work.

### ► Biodiversity

The measures proposed to mitigate the impacts on biodiversity are:



- Train staff to: collect any amphibians, reptiles or mammals on site and release them quickly into a favourable habitat; record any deaths if possible;
- Monitor the maintenance and mortality rates of birdlife and bats; take additional measures if high mortality rates are recorded. Design and rollout of a procedure for the preventative shutdown of wind turbines based on additional studies. The procedure will be adjusted in line with the results of specific post-construction monitoring programmes and the results of monitoring the mortality rates of birds and bats;
- Observe a minimum distance of one kilometre in positioning the wind turbines on both sides of the pass chosen between the A1 and A2 ridges that form the main ridge;
- Take action focused on rain water management to avoid small pools of water forming at the bottom of the turbines that might encourage birds and bats to gather, as they might then feed or nest in the vicinity of the wind farm;
- Establish a comprehensive programme to tackle parasites; it will avoid using pesticides and herbicides.

The recommendations for the power lines are:

- The pathways of the transport corridors avoid critical habitats (such as nesting sites, heronries, rookeries, feeding corridors for bats and migration corridors);
- The technical design of the power lines takes account of the directives on how to avoid or mitigate the impact of power lines on migratory birds in the Africa–Eurasia region, established by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds, and by the Convention on Migratory Species (the Bonn Convention). The directives include provision to:
  - Maintain a 1.5-metre (60-inch) gap between live and earthed components or, where that distance cannot be accommodated, cover the live components and equipment;
  - Install objects that improve visibility, such as marker balls and other devices designed to keep birds away;
  - Appropriate bird deterrents will be installed above insulators that are not suspended to avoid the potential of birds dying from electrocution;
  - The cables will be clearly visible due to appropriate markers / bird-flight deviation devices. Examples of deviation devices / flight markers<sup>3</sup>
  - The markers will be installed so that they produce a visual deviation effect every 10 metres. The markers will be installed as per an alternative model. This approach can reduce collisions from 50 per cent to 85 per cent.

## ► **Wastewater**

Measures proposed to mitigate the impacts of liquid waste from the use of the substation and its adjoining buildings (toilets, kitchen etc) are:

- A specific rapid-reaction procedure must be established in case a pollutant leaks or is spilled;
- Training will be delivered to all staff as soon as they arrive, and practical exercises must be carried out;
- Absorbent material must be available at regular intervals in the vicinity of the transformers and in areas where oil or other hazardous products are stored;
- In case of a leak or spillage, soiled products will be gathered up and disposed of through specialist channels;
- Oil processors will be placed on collecting trays;
- An effective maintenance system will be established to ensure the processors function at maximum efficiency;
- The purification system for the wastewater from the building's sanitary facilities must be plumbed into a septic tank;
- The tank will be emptied as required using trucks, and the effluent that is drained off will be sent to the nearest purification plant;

<sup>3</sup> Translator's note: sentence appears incomplete.

- Septic tanks to be regularly inspected;
- Documentary records to be kept of emptying activities.

Operating the power lines does not result in any soiled water or pollutants being discharged onto the soil or into the subsoil. As the operational phase will have no impact on groundwater, no specific support measures are in place.

#### ► **Waste and hazardous material**

The proposed measures to mitigate the impacts of solid waste derived from the maintenance or replacement of wind turbines where they break down are:

- Draft a waste management plan tailored to the site, including for hazardous and non-hazardous waste. The plan should include staff training;
- As much metal waste as possible will be recycled, taking account of available facilities;
- Waste can be reduced by ordering materials that are produced loose, or that use reusable or recyclable packaging. These approaches should be prioritised if possible;
- Suppliers should be requested to minimise their use of packaging;
- Chemical products must be ordered in reusable drums;
- Buyback agreements must be made with lead suppliers so that surplus chemical products or materials can be returned;
- To facilitate recycling, waste streams must be separated. All deposit points must be well organised with waste managed appropriately to allow the hazardous and non-hazardous waste to be kept separate. Each category of waste will be subdivided by type (paper, plastic, metal) and according to whether or not the material is recyclable. A waste register will be kept on site and, as a minimum, will include information on quantities, types of management solution (according to the waste management hierarchy set out in the reference section), operators, removal/final destination etc);
- Install adequate deposit facilities for non-hazardous waste in designated zones to prevent its being spread across the whole site;
- At the beginning of the staff training package, include modules that enable personnel to improve their knowledge of waste management procedures, including how to correctly handle and deposit waste, how to intervene and the need to be aware of emergency plans;
- Food waste must be deposited in a bucket or bin with a metal or plastic lid to prevent vermin/parasites;
- Light waste such as paper, cardboard and plastics must be deposited in a bucket covered by sheeting or appropriate fixed mesh to prevent the waste being spread around.

#### ► **Archaeology**

No specific measures for operational phase.

#### ► **Health and safety of the local community**

Measures relating to the health and safety of the local community are:

- Put in place policies designed to encourage employment of the local workforce and procurement from local businesses to optimise the positive impact;
- Put in place a procedure for managing grievances;
- Establish a code of conduct to maintain respect for local customs;
- Erect barriers on the site access roads;
- Close off access to the ladders that provide access to the turbine towers;
- Display information posters about the risks present on site and about the services to contact in case of emergency;
- Follow Moroccan legal processes while also applying IFC standards with regard to land acquisition and compensation, as well as the procedures for re-establishing livelihoods;
- Establish a security perimeter and design/construct the turbines so that no building or residential area is on the potential trajectory of a blade if one were to fall. The security perimeter does not need to be greater than 300 metres, although this distance can vary according to the size, form, mass and speed of the rotor, and the height of the turbine;

- Equip the turbines with vibration monitors capable of recording the slightest imbalance in the rotor blades and to shut down the turbine if necessary;
- Regularly maintain the turbines;
- Display warning signs to alert the public to the risk of falling objects;
- Prioritise the use of wind power equipment whose components are designed to minimise interference with radar signals (for example, the form and material of manufacture of the nacelle) and use materials that absorb radar waves (for example, blades made of epoxy or polyester reinforced with fibreglass) so as to prevent any electrical interference;
- Tailor the design of the wind farms as required, including in terms of geometric layout and location of the turbines, as well as the routes of aviation transport corridors.

Measures relating to stroboscopic effects are:

- Determine the placement and orientation of the wind turbines so as to avoid residential zones in the densely packed areas, which tend to be found to the south west and south east of the turbines and in which there is a higher level of sun glare on the blades;
- The turbines identified in the stroboscopic studies as having an impact will be programmed to shut down when the shade limitations have been exceeded (as defined in the studies).

#### ► **Workers' health and safety**

Health and safety measures for workers and the local community are:

- Implement a fall prevention programme that includes, in particular, training in lifting techniques and the application of fall prevention measures; inspection, maintenance and replacement of fall prevention equipment; and rescue of workers who have fallen but been caught by the equipment;
- The fall prevention system must be suited to the structure of the tower and required movements, particularly ascent, descent and movement from one location to another;
- Ensure ground-level access at the foot of each wind turbine, with the entry point at the same level as the work area in front of the turbine.
- Install permanent fixtures on components of the tower to facilitate the use of the fall prevention system;
- Install a good system of positioning equipment for the workers. Positioning system connectors must be compatible with the fixtures on the tower to which they are attached;
- Install a fixed ladder providing access to all the floors (from the lowest level up to the nacelle). It should be surrounded by a cage and have an anchor line that enables the use of personal fall prevention equipment for working at height;
- Use safety harnesses;
- Ensure that workers using powered equipment at height wear a second (backup) safety sling;
- Remove panels and other obstacles from the posts or structures before beginning work;
- Use an approved tool bag to lift up or down the tools or material used by personnel working on high-up structures;
- Avoid doing installation and maintenance work in bad weather, particularly when lightning is forecast;
- Install anchor points to ensure access to the inside of the tower, and also to enable operators to use fall prevention equipment for working at height;
- Encourage remote monitoring equipment to reduce the amount of work needed at the top of the nacelle;
- Minimise as far as possible instances of solo working by putting in place remote monitoring and control equipment (data collection, malfunction identification system etc).

## **5.4 Impacts related to dismantling**

At the end of the operational lifetime of the Koudia El Baida wind farm, the options are:

- Extend the wind farm's operations by several years (the turbines can operate for longer than 20 years);

- Replace the current turbines with new-generation machinery and then renew all required authorisations;
- Dismantle the wind farm and return the site to its original condition and purpose.

In all three scenarios, the wind farm will eventually be dismantled. As with the construction phase, the dismantling stage will require the use of construction and transportation machinery. In addition to industrial recycling processes, these activities will lead to greenhouse gas emissions. However, emissions will be negligible in comparison with the positive results of the project.

## 5.5 Cumulative impacts

The geographical limit within which cumulative impacts will be measured has been set at a 20-km radius from the approximate centre of the Koudia El Baida wind power project.

Within this 20-km radius, the following developments have been identified:

- Two current wind farms: the Khelladi and the El Houma (see attached map);
- Power lines;
- Two substations;
- Four operational quarries.

The most significant cumulative impacts are exerted on the landscape, birdlife and the bat population.

Having several wind farms in close proximity increases the impact on the landscape, the barrier effect and collision risks for birds and bats. It is recommended that the wind farms be several kilometres apart from one another to ensure risk-free crossing points for birds and to reduce the size of the viewshed.

In terms of birdlife, the barrier effect and risk of collision are the most significant issues for birds and bats. It is recommended that the wind farms be several kilometres apart from one another to ensure risk-free crossing points for birds and to reduce the size of the viewshed.

The two current wind farms are relatively parallel to migration corridors. The repowering of Koudia al Baida takes account of the main migration corridor around the main ridge, A2. The Khelladi and Haouma wind farms are parallel to the migration corridors and the Koudia Al Baida repowering project has taken account of the constraints of those corridors; as a result, the cumulative impact of the Koudia Al Baida repowering project has been limited significantly.

## 6. Monitoring and control

The programme of environmental monitoring control will be based on:

- Environmental monitoring of the construction site, which will include implementing the mitigation measures set out in the Environmental and Social Impact Assessment (ESIA);
- Carrying out worksite inspections, highlighting and recording instances of non-compliance. Inspection teams will include an ecologist;
- Identifying alternative mitigation measures to resolve all unforeseen problems that could arise during the work.

Environmental monitoring during the operational phase, which will mainly focus on natural and social environmental issues, will include:

- Types of waste produced while the wind farm is operational (oil, waste electrical and electronic equipment);
- Noise pollution monitoring, particularly around the most susceptible receptors;
- Tracking of birdlife mortality;
- Tracking of bat mortality;
- Follow up of grievances (local community and workers);
- Measurement and monitoring of stroboscopic effect on susceptible receptors if complaints are lodged.