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Cabeolica Wind Farm Project

Cape Verde

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SUMMARY

Project Name: Cabeolica Wind Farm Project
Country: Cape Verde
Project Number: P-CV-FE0-001

1. Introduction

Cabeólica S.A. (a Private-Public-Partnership or PPP between the Government of Cape Verde, Electra S.A. and Infraco Limited) have requested the African Development Bank (AfDB) to support the development of a new wind farm project. This includes a request for provision of an AfDB loan to install wind turbines to generate 28MW and associated transmission lines to deliver power to existing consumers. Cabeólica will ensure that the wind farm project will be implemented consistent with appropriate international best practices to minimize any adverse environmental and social impacts, and that the development outcomes of the project will deliver environmental, social and economic benefits, particularly by offsetting polluting emissions and reducing the amount of fuel purchased by the country for thermal generation. Other multilateral development banks (e.g. European Investment Bank - EIB) are also expected to participate in the financing of the proposed project as well as provision of a Political Risk Guarantee (e.g. Multilateral Investment Guarantee Agency – MIGA).

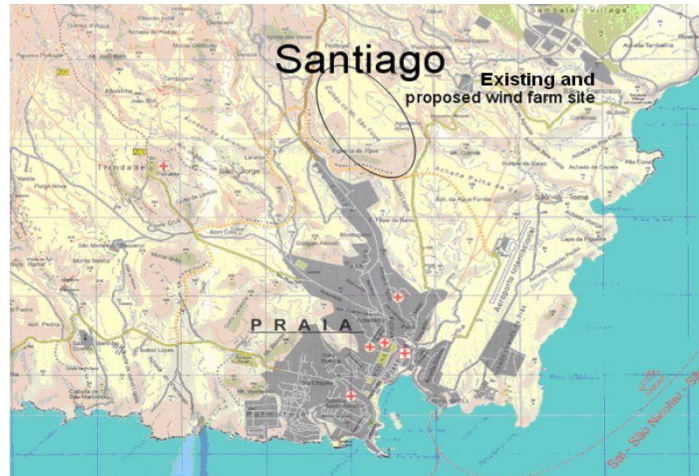
Gabinete de Advocacia, Consultoria e Procuradoria Jurídica (a local legal firm) was appointed by Cabeólica to oversee local independent environmental and social consultants in conducting an ESIA to meet local legislation requirements. Sinclair Knight Merz (SKM) was also appointed by Cabeólica as an independent consultant to provide expertise in investigating environmental and social aspects as required by international standards such as those of the World Bank Group (including AfDB and EIB). The Cabeólica Project's ESIA and Non-Technical summaries have been finalized, fully disclosed to the public and approved by the Cape Verdean Ministry of Environment, Rural Development and Marine Resources.

2. Project Description and Justification

The Cabeólica Project involves the construction, operation and decommissioning of four wind farms on the islands of Santiago, São Vicente, Sal and Boa Vista in the Republic of Cape Verde. The wind farms will comprise of between 30 to 32 – 850kW wind turbines creating a total installed capacity of about 28 MW.

The wind farm on Santiago will be located in the southern part of the island in Monte São Felipe, near the city of Praia, in the same area currently hosting an existing wind farm (Fig. 1). The new wind farm will occupy roughly 30 hectares of land owned by the Municipality and contain 11 wind turbines, which translates into an installed capacity of approximately 10 MW.

Figure 1: Location of proposed Santiago



The wind farm in São Vicente will be located in the eastern part of the island in the region of Selada de Flamengo, some 6 kilometers from the city of Mindelo, on a hill adjacent to the existing wind farm (Fig. 2). The wind farm will occupy roughly 15 hectares of land owned by Electra, the Cape Verde electric utility and contain 7 wind turbines, which translates into an installed capacity of approximately 6 MW.

Figure 2: Location of proposed São Vicente wind farm



The wind farm in Sal will be located in the eastern part of the island in the region of Lajedo de Ribeira de Tarrafe (Fig. 3). The farm will occupy roughly 32 hectares of Government owned land and contain 9 turbines, which translates into an installed capacity of approximately 8 MW.

Figure 3: Location of proposed Sal wind farm



The wind farm in Boa Vista will be located in the northwestern part of the island in the region of Morro da Vigia – Ponta do Sol which is situated inside the boundaries of a national protected area (Fig. 4). The wind farm will occupy roughly 18 hectares of Government owned land and contain 3 to 5 turbines, which translate into an installed capacity of approximately 2.5 to 4 MW.

Figure 4: Location of proposed Boa Vista wind farm



Each wind farm will consist of the following main components: towers with wind turbines (Vestas V52-850 kW OptiSpeed® Wind Turbine), transformer poles, underground cables for the transportation of electrical energy, a command center, a substation and access roads to the towers, interconnection installations and other complementary infrastructure, installations or equipment. Additionally, according to a ruling from the Civil Aeronautics Institute issued in 2003, signal lights will have to be installed at the top of each wind turbine for aviation safety purposes.

The wind farms will be connected to the existing electrical network on each island. The connection points are known; however, the exact cable routes have yet to be finalized but will more or less follow the access roads. Each interconnection will be achieved using underground cable connections. Construction of the entire project on all four islands will take up to approximately 18 months. The wind farms will be designed to operate for a total lifetime of at least twenty years, after which they will either be decommissioned and the site restored, or a new planning application submitted to re-power the site with either rehabilitated or new equipment. The post operation decommissioning and removal is

estimated to take up to 12 months, with the majority of components and materials being recycled either on the islands or shipped to an outside approved recycling location.

The Cabeólica Project proposes to install a total capacity of between 25.5 to 28 MW which comprises 20-25% of current energy demand in Cape Verde. This level of renewable energy penetration is rare and Cape Verde will be the first country in Africa to achieve such ratios. The main benefits that the project will bring to the country include:

- The Project will enable the country to diversify its energy matrix which is currently dominated by diesel thermal power generation (97% of total installed capacity). The diversification of the energy matrix will allow for a more stable grid system which will help reduce the frequency of blackouts in the country.
- The Project will also allow for a stabilization of energy tariffs due to the volatile prices associated with the importation of fossil fuels – currently a huge burden on the country's economy. The price of the energy produced by wind will remain stable which constitutes an advantage in relation to energy produced conventionally which oscillates in accordance with the market price of oil.
- Additionally, the project offers some distinct environmental advantages considering that this type of power production is created by clean energy from the wind. Therefore, with this project, the polluting emissions, and other environmental problems created by the conventional methods of energy production are reduced. One of the main factors in emission reduction is the displacement of CO₂ and other equivalent greenhouse gases, and the potential economic benefits from the generation of CDM carbon credits.

3. Policy, Legal and Administrative Framework

The Cabeólica ESIA was undertaken to meet the requirements established in the national legislation as well as international requirements, more specifically requirements established by the World Bank Group

The national legislative framework is aimed at analyzing and evaluating the Project from the point of view of its adaptation to the environmental demands stipulated through the current environmental legislation on a national and international level, namely:

- The Environment Policy Base Law (Law number 86/IV/93), which establishes the foundations of Cape Verdean environmental policy, based on the principle of prevention and founded on the reduction or elimination of the causes, as well as on the correction, of the effects of actions or activities susceptible to altering the quality of the environment.
- Legislative Decree number 14/97 of July 1, the objectives of which are to optimize and guarantee the utilization of natural resources, both qualitatively and quantitatively, as a basic assumption for self-sustained development, and to safeguard citizens' right to a salubrious and ecologically balanced living environment, as well as the duty to defend and preserve it, giving the State and Municipalities the responsibility of promoting improvement in the individual and collective quality of life.
- Decree-Law number 29 of March 6, 2006, establishes the legal regimen for the evaluation of the environmental impact of public or private projects liable to produce effects on the environment (as is the case of the project in question), as well as the

procedures, requisites and specifications to be followed for the authorization and licensing of the Project, requiring the Project to be submitted to the government department responsible for the environmental area. According to the current structure of the Ministry of the Environment, Rural Development and Marine Resources, the department responsible for the environment in Cape Verde, the process in question must be submitted to the General Directorate of Environment for its evaluation and approval by the government official responsible for the sector;

Other relevant pieces of legislation, given their importance to the legal framework of the project and for the elaboration of this study, were analyzed as well:

- Decree-Law number 3/2003 of February 24, which establishes the legal regimen regarding natural spaces, landscapes, monuments and other spaces that merit special protection and should be included in the National Network of Protected Areas due to their ecological function, their importance in conserving biodiversity and any intrinsic interest from a socio-economic, cultural or scientific point of view;
- Law number 102/III/90 of December 29, which establishes the basis for what is to be considered cultural and natural patrimony;
- Law number 48/V/98 of April 6, which regulates all forest related activities, establishes the attributions of the State and defines instruments of intervention, forest regulations, declassification, the management of specially protected areas and state and private lands subject to forest regulations, planting and forestry operations, expropriation, incentives and support for participation in forestry activities, policing, infractions and penalties;
- Decree-Law number 31/2003 of September 1, which establishes the essential requisites to be considered in the elimination of solid urban, industrial and other waste, and the surveillance thereof, with the ultimate aim of protecting the environment and human health;
- Laws related to the quality of air and water, specifically Decree-Law number 5/2003 of March 31, which defines the national air protection and control system, Law number 41/II/84 of June 18, which approves the Water Code, Decree-Law number 8/2004, which regulates water quality and classification criteria and norms, and Decree-Law number 7/2004, which regulates the discharge of waste waters;
- Laws on territorial and land asset management: Legislative Decree number 1/2006 of February 13, which approves the foundations for territorial ordering and urban zoning, and Legislative Decree number 21/2007 of July 19, which establishes the principles and norms for land use by both public and private entities;
- Laws related to the exploitation of inert substances: Decree-Law number 2/2002 of January 21, which prohibits the removal and use of sand from dunes, beaches and waters along the coastline and in Cape Verde's territorial waters, and Decree-Law number 6/2003, which establishes the legal regimen for the licensing and utilization of rock quarries for profit;

Also taken into due account were the main conventions ratified by the country in the realm of the environment, namely those related to the fight against desertification, climate change, biodiversity, the protection of the ozone layer, the exploitation of halieutic resources, hydrocarbon pollution, persistent organic pollutants, among others.

An analysis of pertinent and essential aspects related to the implementation of wind farms on the four islands was also undertaken, with these aspects including current legislation, the institutional framework and legislation specific to the project.

In addition to complying with the Cape Verdean environmental and social legislation, policies and guidelines, the ESIA also conforms to the AfDB's Environmental and Social Assessment Procedures (ESAP, 2001) and the EIB Statement of Environmental and Social Principles and Standards (EIB, 008). The Project has been assigned Category 1 by the AfDB and Category A by the World Bank (MIGA), reflecting the scale of potential environmental impacts.

The Cabeólica ESIA includes an environmental and social impact assessment of the four sites proposed by the project as well as the corresponding transmission lines and access roads. Along with the ESIA, four separate non-technical summaries (one for each site) were submitted to the Ministry of Environment, Rural Development and Marine Resources in February of 2009 and approved by the same Ministry in April of 2009.

Subsequent to the submission of the ESIA, and as part of its mitigation measures, two additional studies related to biodiversity were conducted: An avifauna collision risk assessment report and a behavioural study of an endemic data deficient gecko.

4. Description of the Project Environment

The proposed wind farm sites are located on four different islands. None of the four sites are within any internationally designated or protected areas and, with the exception of the Boa Vista site, there are no such sites within 10 km of a protected area. The baseline environmental aspects that were studied included: climate, topography, water flow, soil, land use, landscape, fauna and flora, and social and economic aspects.

▪ Santiago – Monte São Felipe

Climate

The island of Santiago is one of the least arid in the archipelago of Cape Verde. Most of the year it is under the influence of Northern hemisphere trade winds, and during the humid months (August, September and October) it is common for precipitation to occur.

Average precipitation over the ten-year period between 1998 and 2007 was approximately 160 mm, with the highest average amounts falling in the month of September, approximately 70 cm. The dominant winds on the island of Santiago, like in the rest of the archipelago, come from the Northeast, reaching average speeds on the order of 19 km/h. The seasonal regimen of winds is dominated by the presence of the trade winds (winds from the northeast quadrant), which blow predominantly between November and May along the entire eastern coast.

Topography

The area proposed for the installation of the Santiago wind farm is a plateau with average altitudes varying between 170 and 300 meters above sea level. The Monte São Filipe is covered by layers of basalt. The plateau's surfaces present a slight inclination toward the southeastern coast of the island which leads to practically constant slopes that vary between 2° and 4°.

Water flow

Because of the area's plateau-like characteristics, there are several streams of which headwaters are located in Ilhéu de São Filipe. These streams flow into some valleys, such

as Água Funda, on the eastern side of São Filipe and to the west of the area proposed for the implementation of the project. The valley of Água Funda and the valley of São Filipe, are the main tributaries to the formation of most of the occasional flash floods that make their way through the valley of Lém Ferreira and discharge into the ocean at Praia Negra beach during the rainy season.

In the Project's area of influence, namely in the streambeds of the above-mentioned valleys, there are several sources of water, such as wells, which, despite presenting a high degree of salinity as a result of their intensive use over the course of the years, are still used to provide water to some of the rural communities that remain along the periphery of the city of Praia, such as the valleys of Água Funda, Trindade and São Filipe.

Soil

Within the project site, the following categories of soils are found Halpic xerosols, Vertisols, Vertic cambisols and Luvic Phoezemes. These soils are generally associated with plateau surfaces. They are argillaceous soils of rather fine texture which are, in general, thin and not very deep. The soil is covered with rocky material and sparse vegetation.

Land use

The existing land area is currently being used as a wind farm, as there are already three wind turbines installed and providing energy to the Electra network. The land is also used for extensive pasture for cattle and goats, which feed on a number of the plant species present in the area.

Immediately to the south of Ilhéu de São Filipe is a basaltic rock-oriented industrial unit, the objective of which is the production of blocks of considerable size and aggregates for civil construction.

Landscape

The visual quality of the land where the Santiago project is to be built is high, when taking into account its visibility characteristics from other locations, considering that its location and altitude allows ready visibility to people living in the city of Praia.

Flora and Fauna

The flora found on the site in Santiago presents clearly steppe-like characteristics, interspersed at times with shrubby or tree vegetation, characterized by the presence of species typical of semi-arid and arid zones, with representatives of the genus *Caylusea*, *Cleome*, *Ipomea*, *Aerva* highlighted, among others. The most common plants found on the site area include Hog weed, Pili grass, Mesquite, Bitter melon, Chinese lantern, Beach morning glory, Heliotrope and Mat chaff flower.

In the area surrounding the site it is possible to find typical species of native birdlife, such as: *Columba livia* (common pigeon), *Passer iagoensis* (Iago sparrow), *Ammomanes cinctures* (Bar-tailed lark), *Falco tinnunculus alexandri* (Kestrel), *Cursorius cursor* (Courser), *P. hispaniolensis* (Spanish sparrow), *Eremopterix nigriceps* (Black-crowned sparrow lark), (Crow), *Apus apus* (Common swift), and *Numida meleagris* (Guineafowls). It is also possible to find specimens of *Bubulcus ibis* (Cattle egret), which is a migratory species that visits the islands every year. In terms of reptiles, the existence of specimens of the *Mabuia*, a genus of long-tailed skinks, is probable.

- **São Vicente – Selada do Flamengo**

Climate

The island of São Vicente is subject to constraints that affect its climate, such as its rugged topography, high altitudes and exposure to regular wind gusts. These climatic conditions are well pronounced throughout the island where there is a certain climatic variability ranging from very arid to sub-humid.

The average annual precipitation during the last 10 years in the region in question was approximately 120 mm, with the highest monthly average (43.9 mm) occurring during the month of September. The evaporation in the area is also quite elevated.

The dominant winds of the island blow from the Northeast, reaching average speeds of roughly 20 km/h. The seasonal winds are dominated by the presence of Northeasterly winds which occur predominantly between November and May.

Topography

The project area presents greatly varied morphological characteristics composed of a mixture of ridges, peaks and valleys. In Selada do Flamengo there are certain typical deposited materials that are accumulated along the coast containing primarily basaltic materials.

Water Flow

Selada do Flamengo is composed of an upland where some watercourses are formed which contribute significantly to the formation of the Flamengo stream flowing to the agricultural area of Chão de Fonte de Manuelinho. Even with the lack of hydrographic watercourses within the project area, there are diverse formations of depressions as a consequence of the altitude and geomorphologic formations. The streams within of the project area, similar to those found throughout the the island of São Vicente, are rather shallow.

Soil

The entire Selada do Flamengo area and surroundings are composed of different soil types, with a clear predominance of the following: *Eutric Cambisols Chromic Cambisols Eutric Leptosols*. These soils are generally strand deposits, generally deep with volcanic filaments and clusters as well as diverse granular rocks and generally presenting brown to brownish-yellow or orange coloration.

Land use

Traditionally, the area of Selada do Flamengo was utilized as a general grazing area for goats, most commonly the valley areas containing some humidity. Currently, grazing and other cultural use are somewhat limited due to the prevailing drought conditions in the area.

Landscape

On the land where the Project is to be built, the visual quality may be considered high since it is located between the city of Mindelo, the Porto Grande Bay, as well as the São Pedro area with its beaches and village easily visible from the highest point of Selada do Flamengo. In relation to its own visual exposure and due to the characteristics of its slope, it is an area of high visibility from various points of the island.

Flora and Fauna

The Project area is a part of the very arid climatic zone, and is characterized by vegetation cover which is typical of steppes; low density and composed of vegetation communities which are common of very arid areas. The vegetation cover is composed primarily of species such as *Alternanthera caracasana* (Washerwoman), *Lavandula rotundifolia*

(Button Fern), *Dactyloctenium aegyptium* (Crossfoot grass), *Heliotropium ramosissimum* (Wavy halioptrope), *Lotus sp* (Lotus), *Portulaca oleraceae* (Purslane), *Aerva javanica* (kapokbush), *Amaranthus spinosus* (Giant swallow wort), *Sonchus oleraceus* (Sow thistle), *Calotropis procera* (Spiny amaranth).

The fauna situation in the project area is poor. It is only possible to observe reptile and bird species with domesticated habits, as well as some insects associated to plants.

In relation to avifauna the presence of 2 species were confirmed, one being migratory, *Bulbucus ibis* (Cattle Egret) and *Passer iagoensis* (Iago Sparrow).

▪ **Sal – Lajedo da Ribeira de Tarrafe**

Climate

The island of Sal is one of the most arid in Cape Verde. It is under the influence of Northern hemisphere trade winds nearly year-round, with precipitation rare even in the months considered humid (August, September and October) and suffers from high rates of evaporation. Average precipitation over the ten-year period between 1996 and 2005 was approximately 60 mm, with a maximum monthly average in the month of August, 24.1 mm. The dominant winds on the island of Sal come from the northeast, reaching average speeds of 24 km/h. The seasonal regime of winds is dominated by the presence of the trade winds (winds from the northeast quadrant), which blow mainly between November and May throughout the entire eastern portion of the island.

Topography

The proposed wind farm project area has plateau-like topography characterized by a flattened platform that occupies a surface with altitudes varying between 60 and 70 meters. The flattened characteristics lead to the non-existence of significant slopes, which vary between 1% and 2% in almost 90% of the area.

Lajedo da Ribeira de Tarrafe is covered, in part, by limestone slabs (marine calcarenite and limestone). The southernmost patch is also covered by a limestone substratum, which for its part is covered, however, by a layer of limestone sand deposited by wind.

Water Flow

As the project area is a relatively high and flat surface, various streams originate here. Some of these streams are short with potentially insignificant volumes of runoff, while others could produce larger runoff volumes. However, because the island of Sal is the driest in the archipelago, the flow volumes of these streams is always very low in comparison to those located on the more humid islands. The project area contains no wells or groundwater able to provide any significant quantities of water.

Soil

In the area in which the project is to be implemented, the soil type is characterized by the presence of: Eutric leptosols, *Lithic leptosols* and *Rendzic leptosols*. These soils generally caused by basaltic formations and contain limestone, are of fine and medium textures and contain a base saturation level of more than 50%. In the project area, the soil layer is frequently interrupted by rocky, non-consolidated material or is covered by a thin layer of sand.

Land Use

Within the project area there are no human activities in the occupational sense, nor are any agricultural activities. The sole activity consists of the illegal removal of limestone rock for use in construction creating a visible degradation of the area's geological resources affecting the southeastern part of the platform. There are some sporadic limited grazing

activities during very short periods due to the rarity of vegetation. Most of the soil is not used for any specific purpose.

Landscape

On the land in which the project is to be implemented, the visual quality may be considered to be high from the point of view of visibility from other points, as its location and altitude allow for good visibility for observers from various locations on the island, such as Pedra de Lume, Espargos, or along the road connecting this town to the town of Santa Maria in its northernmost stretch.

Flora and Fauna

The vegetation in the project area is very scarce. The area's orographic uniformity corresponds to steppe-like characteristics made up mostly of short-cycle (annual or pseudo-annual) species tolerant to high levels of dryness and salinity.

As it is a very arid region, the fauna in this area, like its flora, is rather poor. Only reptile and bird species with domesticated habits may be found, in addition to some insects associated with plants.

In terms of bird life, the presence of one species of bird endemic to the archipelago of Cape Verde has been registered there, *Passer iagoensis* (Iago Sparrow). This species, however, is considered abundant and is found on all of the islands in the archipelago.

▪ Boa Vista – Morro da Vigia (Ponta do Sol)

Climate

The island of Boa Vista, together with the islands of Sal and Maio, is one of the most arid in the archipelago. Most of the year it is under the influence of northern hemisphere trade winds, and precipitation is rare even in the months considered humid (August, September and October). The island of Boa Vista is also influenced by Harmattan, the warm and dry eastern wind blowing from the African continent that, along with dry haze, reduces humidity and increases evapo-transpiration. The dominant winds on the island are from the Northeast, reaching average velocities near 20 km/h. The seasonal wind regime is dominated by the presence of the trade winds (winds from the Northeastern quadrant), which blow predominantly between November and May.

Topography

The topography of the project area is a sierra-type volcanic cone, Morro da Vigia, which rises above the flat coastal platform surrounding it and is characterized by relatively unpronounced hills that correspond to the volcanic features. The central part of the Ponta do Sol peninsula, where the proposed project area will be situated, is an almost barren, rocky volcanic plateau. The plateau rises from about 70 m above sea level in the southeast to 150 m in the north and northwest and is surrounded by steep 30 – 100 m high slopes descending toward the sea. The slopes of the area vary between 15% and 35%.

Water Flow

In the project area and its surroundings, several water courses form during the rainy season transporting some of the runoff in the direction of the sea. Due to the considerable inclination of the terrain, these streams flow with runoff water that occurs within a short period of time but with relatively insignificant volumes, primarily due to the low levels of rainfall occurring in the area.

The various streams with headwaters on Morro da Vigia, drain rain water directly into the sea through the lower zones of Ponta do Sol, Lajão and Areia Branca, forming the gullies of Furna and Curral on the eastern side and Manuel Piedade on the western side.

Soil

There is a certain degree of contamination of the superficial layers of soil by heavy metals, considering the presence of metallic waste due to uncontrolled dumping on the surface, which, with rain fall, means metals are transported in the direction of the surface runoff and infiltrate into the ground.

Land Use

The accentuated slopes associated with the difficult access to the area constitute a serious limitation to the development of certain economic activities, such as agriculture and tourism related activities, including excursions, bird-watching, etc. Therefore, there are practically no current land use throughout the project area and surroundings, except for temporary pasture for animals in limited locations.

The Lagoa de Rabil RAMSAR site on Boa Vista island is located approximately 8 km south of the proposed site, near the airport. Additionally, the Boa Vista site will be located within part of the Ponta do Sol Nature Reserve.

Landscape

On the land where the project will be implemented, visual quality can be considered to be low, as its orientation limits visibility when the observer is looking from a vantage point to the south, which is where all of the economic and social activities on the island of Boa Vista are located. In this regard, it is a hard-to-view zone from various points on the island.

Flora and Fauna

The Project area is located within a very arid climatic zone and is characterized by a sparse vegetation covering typical of a steppe environment, composed of plant communities adapted to very arid zones. common vegetation species include: *Zygophyllum fontanesii* (Salt plant), *Launaea melanostigma* (Craqueja) and *Crotalaria sp* (Rattle pod), *Cleome viscosa* (Yellow spider-flower), *Acrachne racemosa* (Goosegrass), *Malvastrum americanum* (Spiked mallow) and *Cenchrus ciliaris* (African foxtailgrass), among others.

The area is important in terms of fauna, as, in addition to containing various different species of numerous groups of invertebrates and reptiles, it also attracts important populations of Cape Verdean bird species:

- The Red-billed Tropicbird (*Phaethon aethereus*) nests in holes in the rocky sides of the mountain range.
- There are active Osprey (*Pandion haliaetus*) nests in the area, some of them occupied annually.
- The Kestrel (*Falco tinnunculus alexandrius*), a subspecies endemic to Cape Verde, is also often seen in Ponta do Sol, where abundant nesting and feeding areas are found.
- Recently, the presence of Vultures (*Neophron pterocopterus*) and Barn Owls (*Tyto alba detorta*) were also cited in the area, nesting in the surrounding areas.
- The remains of marine birds such as Petrels and Oceanodromas are also found, which indicates the probability of nesting in the area, although this has not been confirmed.

5. Project Alternatives

Site Alternatives

A wind atlas developed by the Government and Riso indicated the ideal locations for wind energy development. In assessing the suitability of the Cape Verde wind farm sites for use as wind farms, Cabeólica applied the Best Practise Guidelines similar to those published by the British Wind Energy Association (BWEA) in 1994 in respect of Technical and Commercial considerations and local Planning and Environmental criteria. Under the criteria a detailed wind resource assessment was conducted by SKM/Riso to estimate the wind speed on all sites. The assessment indicates that wind speeds at the sites are sufficient to make the proposed developments viable. To complete site selection evaluation, it was assessed by Cabeólica that the landholding available at all sites is sufficient for a viable projects. Furthermore, discussions with Electra (the operator of the electrical distribution system on the islands) indicated that connection to the local grid would be available at the four chosen locations and the sites are seen to have good access to the local road network and onward to local ports.

Government EIA Regulations require an Environmental Statement (ES) to include *“An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects.”* This is not a requirement to consider alternatives, but rather a requirement to indicate why a choice is being made where alternatives have been considered. In this instance, as the initial site viability assessment indicated that the sites, with the exception of an ecological designation at Boa Vista, met all of the relevant criteria for the development of a wind farm, no alternative sites were studied.

No Project Alternative

The only alternative scenario to the project is the “Do not implement any project activity” (continuation of the current situation, where no project activity or alternatives are undertaken and there is the continuation of fuel fired plants). The alternative to develop the project is common practice with well-known technologies so this type of project presents a very attractive option to investors. However when compared with options that would use non renewable energy sources that will consequently emit greenhouse gases and imply that future energy demand (that the project intends to meet with wind energy) would most likely be met through installing additional diesel power plants. This option is considered to be economically, socially and environmentally less attractive in compared to the option of building the Project due to the implication of expensive oil importation, polluting emissions, and continued dependence on the exports.

In the case of Boa Vista, technical requirements precluded the selection of an alternative site, leaving the only other option as the “no action” option. Upon further consideration and discussions with the environmental authority, and upon conducting significant scientific studies of the local avifauna, it was concluded that the apparent economic and social benefits largely outweigh the environmental risks, as these will be mostly mitigated through strong conservation efforts.

Technology alternatives

Several wind turbine makes and sizes were considered for this project. Given the logistics constraints of the islands and implication to avifauna (bird) collision risk the preeminent option was found to be the Vestas V52-850 kW OptiSpeed® Wind Turbine.

The site areas in Santiago, Boa Vista and São Vicente present certain terrain limitation and require large turbines for the proposed wind energy installation, while port constraints in Sal and Boa Vista and relatively small grids implicate smaller turbines. Considering that it is desired that the same turbines be installed in all four project sites, due to issues

regarding maintenance and stock of spare parts, the Vestas V52-850 kW OptiSpeed® Wind Turbine was seen to be the better option since it meets the size and capacity requirements needed to be implemented in all four islands.

From the specifications of the different turbine options that had presented bids to build the project, a bird collision risk model was developed which showed that the Vestas 850 kW turbine option offers one of the lower collision risk probability due to its height, rotor swept plane, rotor speed and numbers of turbines required to make up the proposed wind energy capacity. Further adjustments were done during micro-siting to further reduce collision risk.

6. Potential Impacts and Mitigation/Enhancement Measures

▪ Beneficial and Adverse Impacts

- From an energy related point of view, and in comparison with an equivalent thermal power plant, the production of energy by wind farms will reduce sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and carbon dioxide (CO₂) emissions. The project's annual average emission reduction has been estimated at 94.989 tCO₂eq/year.
- The project will provide economic and social benefits through the reduction of oil importation and establishing independence in local energy production. Energy costs will be less volatile with the reduction of fossil fuels imports which follows volatile commodities market. Prices of the energy produced by the wind farms will maintain practically inalterable, which constitutes an advantage in relation to energy produced conventionally. Furthermore, the project's wind energy will contribute to diversifying the energy matrix further strengthening the economic benefits of the project. The project will help reduce the frequency of blackouts in the country, with special incidence in the city of Praia. The project will generate employment in the areas of implementation. Roughly 50-60 employment opportunities will be created during the construction and operation phases, 6-17 of which are expected to be occupied by women. Throughout the construction and operation, local workforce will be used, whenever possible, with the objective of increasing the benefits of the social and economic aspects of the resident population throughout the local and nearby areas.
- Construction and maintenance of the towers, substations, access roads and transmission lines will generate a limited amount of solid waste which will be disposed at approved designated sites.
- Construction and operation will increase the risk of soil contamination from oils and lubricants leaking from construction equipment and during turbine maintenance.
- Where adequate access roads for the construction of the wind farms do not exist, they will have to be built. In these cases, the implications of the construction of these access roads are of extreme importance, namely due to the fact that this often implies encroaching into an environment that has never before been explored, and/or opening up access roads to isolated areas for the first time. Construction of some of the project's access roads could implicate the possibility of providing improved access into suitably

remote areas for illegal garbage dumping and/or illegal extraction of sand and limestone material.

- During the phase of the construction period involving soil excavation there are risks of soil erosion, fragmentation of biodiversity and dust emission.
- The structures of the wind farms will create a visual alteration of the landscape. In the case of the São Vicente site area, the construction of the wind farm will alter the topographic landscape.
- Construction activities and new access roads may interfere with water runoff.
- During construction of the project there will be an increase in traffic in the areas of implementation.
- Potential impacts on endemic gecko species *Tarentola caboverdiana substituta* if activities are not mitigated. These impacts have been identified as being potential habitat loss, introduction of alien competitors and/or predators and risk to individual animals being crushed by construction activities.
- Possibility impacts on avifauna species if activities are not mitigated. These potential impacts have been identified as being namely disturbance of bird activity due to noise and human presence during construction and collision risk during operation.
- The construction of buried transmission lines can cause soil erosion, soil and water contamination, disruption of traffic, disturbances to the population of the area due to noise and dust, as well as, destruction of natural habitats.

▪ **Preventive and Mitigation Measures**

- Effective demarcation and signage of the construction compound accesses and of the diverse construction work components;
- Circulation restriction of personnel, vehicles and equipment;
- Limiting the areas of intervention from the inherent actions of the construction phase;
- Protection of excavated soil so as to allow for its reuse;
- Preservation of the vegetation cover;
- Temporary storage and proper disposal of waste materials;
- Training of personnel during the construction phase will educate and inform the work force regarding the importance of following the procedures adopted in relation to the proposed mitigation measures.

- Establish and maintain procedures for the construction works to prepare for accidents and emergency situations;
- Avoid soil contamination; avoid discharges into the aquatic environment and surrounding areas; and provide adequate waste management;
- Rehabilitate and protect the areas directly affected by construction of the turbines, fill and restore affected areas to avoid landscape scarring;
- Covering the materials of the soil transportation vehicles;
- Complete ban on soil and fuel handling near water courses and areas with high infiltration capacities;
- Contain storage of oil products and other hazardous liquids in container units;
- Optimize the construction period in order minimize the disturbances on the species which inhabit the areas of interference and to minimize the negative direct and/or indirect impacts on the fauna;
- Shadow flicker is a repeating cycle of changing light intensity caused by a certain positioning of the sun behind rotating wind turbine blades. Shadow flicker caused by a wind turbine is essentially the casting of shadows on an area and can cause visual disturbances to humans. Modeling of the wind farm's shadow flicker effect was conducted at the Santiago site due to its proximity to an inhabited area. The maps for this site show that there are no significant impacts caused by shadow flicker. The representative contours reaching areas of residences do not surpass 10 hours per year of shadow flicker.
- Prevention of habitat alteration and destruction of the ***Tarentola Caboverdiana substituta*** (gecko) by removal of small and medium size rocks along the access track and all turbine pads and placing these rocks outside of the construction zone. This will ensure that the gecko will not seek shelter inside construction zone. A post-construction population checks will be conducted.
- Prevention of potential introduction of alien competitor and predator species to the ***Tarentola caboverdiana substituta*** and other endemic species by checking all incoming construction material for alien species and treating those accordingly. Furthermore, all rubbish will be removed from the site as it arises, and placed in a controlled waste facility where rats and feral cats can be controlled. A periodic check of the area to identify increase in vermin or alien species will be conducted.
- Prevention of disturbances to important bird species in the area as well as minimization of their risk of colliding with the structures to be built in the area. Construction in the Boa Vista site area will be conducted outside of the breeding period or furthest away from the nesting area. An exclusion zone will be created to protect the active nests from disturbance during construction. Transmission lines will be located underground to avoid

collision and electrocution risks. Lighting design will take into account nesting areas to limit disturbances. Regular checks and vantage point surveys will be conducted during and post construction to verify predictions.

7. Environmental Hazard Management

A Health and Safety Risk Manager will be present throughout the construction period. A full Health and Safety Risk assessment will be prepared for key activities performed during construction, commissioning and operation of the wind farm, followed by the development of risk minimization measures and staff training.

The requirements of the Construction (Design & Management) (CDM) Regulations 1994 will be fully complied with. The requirements of the CDM are fully described in the Health and Safety Annex of the EIA report.

A Construction Environmental Management Plan (CEMP) will be prepared by the construction contractor before initiation of construction activities which will identify the potential environmental risks and impacts of key construction activities and the associated mitigation measures as well as actions to be adopted to prevent or minimise these risks and impacts.

8. Environmental and Social Management Plan (ESMP)

The ESMP for the project will address the following: Physical disturbances, biological impacts, waste and risk management, human resource development and training, and health & safety plans. Most of the project environmental management activities will be carried out during the construction and operation phases, since this is when most impacts can be expected to arise. These impacts are principally associated with the construction of the four wind farms and associated structures, the transmission lines and the access roads.

In general terms, the EPC contractor is responsible for implementing the majority of the construction related environmental mitigation measures specified in this report. Furthermore, the costs to carry these activities are included in their overall price. The contractor and the developer will be jointly responsible for implementing the Monitoring Plan which is Annex A of this report.

The Monitoring Program includes the following:

- Establishment of a baseline of the existing conditions of the areas, expected to be directly affected, prior to the initiation of the construction activities;
- Follow and assess the impacts actually caused by the construction of the wind farms during the construction, operation and their potential decommissioning;
- Assess the effectiveness of minimizing or mitigating measures recommended in the EIA;
- Revise as necessary the impact prevention measures during the construction phase;
- Confirm the impact analysis conducted in the EIA and collect information which may be useful in the elaboration of future EIA's for similar projects.

Additionally, the project developer has proposed to finance conservation activities for the two critical species relevant to the project: Osprey and the *Tarentola caboverdeana substituta* gecko in Cape Verde. Conservation actions will be in line with activities undertaken by the national authority on local avifauna management i.e. General Directorate of Environment and the National Institute of Agrarian Investigation and Development (INIDA).

The conservation program will be entirely the responsibility of the developer and will include the following activities:

- Monitoring in relation to the conservation of the Osprey and the *Tarentola caboverdeana substituta* gecko. Pre-construction, construction and post-construction surveys will be undertaken for both species throughout the relevant development area.
- Analysis of breeding data of the species to compare with previous estimates and distribution data and produce updated trend data.
- Awareness activities relating to the Osprey and the *Tarentola caboverdeana substituta* gecko. Research on both species will be used for environmental education at local schools and within the general community to foster local awareness of the importance of the species and their conservation status.

The developer will commit roughly € 50,000 for the implementation of the ESMP activities under its responsibility.

9. Public Consultations and Public Disclosure

While public consultation is required by Cape Verdean law, stakeholder meetings are also required by international guidelines. Both public consultation and stakeholder meetings were conducted for the Project's EIA.

▪ **Public consultation:**

Through advertizing in local newspapers, The Ministry of Environment disclosed that it was making available the non-technical summaries pertaining to the project in the Directorate General of Environment offices in all relevant islands as well as online at www.sia.cv for public consultation during 60 days, between 18th February 2009 and April 17th 2009. Upon termination of the public consultation period there were no comments or suggestions made to the Ministry of Environment regarding the project and the EIA was subsequently approval by the Minister of Environment.

▪ **Stakeholder Meetings:**

The organization and preparation of each stakeholder public presentation was conducted by the EIA consultants and those of the *Gabinete de Advocacia, Consultoria e Procuradoria Jurídica*. Organization of these presentations included advertisements placed in two national newspapers to inform the general public of the occurrence of presentation as well as their dates, times and locations. Individual invitations were also sent to key stakeholder institutions. These letters were approved and signed by the Directorate General of Industry and Energy. Several key institutions, such as Natura 2000 and INIDA (National Institute of Agrarian Investigation and Development), the two main institutions overlooking avifauna protection, were contacted by telephone in addition to written invitation letters.

Under the scope of the EIA stakeholder public presentation, the environmental consultants travelled to the municipalities where each wind farm will be built to deliver stakeholder meeting presentations.

Prior to the initiation of each EIA presentation, a summary of the Project was presented to each municipality where the following topics were summarized: the nature of the Cape Verde Wind Farm Project, the Project developers, current phase of the Project, the scope of the Project, locations of the sites where the Project will be implemented and potential wind turbine and other equipment and structures to be installed. Printouts of the presentation were handed out at each event.

The list of participants at each stakeholder meeting included some institutional representatives as well as some relevant associated persons related to the power generation field (a list of all participants, as well as other pertinent details, can be found in the full stakeholder meeting report).

The primary objectives of the meeting were to inform the public of the project and its implications as well as receiving important feedback on any perceived environmental and social issues. Although the number of participants were relatively few at each meeting, the discussions that took place between the participants and the consultants were quite useful toward the development of the EIA, specifically due to the involvement of relevant institutions and general public.

The participant concerns ranged from issues such as noise pollution during operation, proper soil disposal following excavation, visual and noise impact and outdated information on what the Project would comprise. Most concerns were addressed by disclosing further information on the Projects impacts. Other issues such as concerns over the visual impact prompted more a comprehensive visual impact assessment though the production of Photomontages and Zone of Theoretical Visibility maps. A list of all concerns and how these were addressed can be found on the full stakeholder meeting report annexed to the EIA.

10. Complementary Initiatives

Sustainable Development

The Cabeólica project activities will contribute to the sustainable development of Cape Verde by introducing new practices and technologies, which will enable climate change mitigation to take place. It also contributes to an increase in the energy efficiency of the region.

Although the Government of Cape Verde is a minority partner in the project, it will not receive Cape Verde public funding. This and the fact that the country will reduce its need for expensive oil purchases, will allow for saved funds to be used for other pressing issues in the country.

Carbon Credits

The project will also generate Carbon Credits. The Cape Verdean National Designated Authority has approved the project as a potential Clean Development Mechanism (CDM) project. A Project Design Document, estimating the annual average emission reduction at 94.989 tCO₂eq/year, was submitted to the Clean Development Mechanism Executive Board and a Designated Operational Entity is currently finalizing their appraisal.

Knowledge Transfer

It is also important to highlight that the implementation of wind based technologies in *Cape Verde* will imply not only the importation of equipment/technologies but also of essential technical expertise which does not exist in the country. Through technology and expertise transfer the local technical labour force will receive training in wind power generation and on renewable energy technical issues.

Gender Labor Division

It is estimated that 6 - 17 skilled jobs for women will be created by the project during its construction and operation phases.

11. Conclusion

The four wind farms and their corresponding transmission lines are essential components of the Cabeólica project as they will enable the generation and evacuation of clean wind power from the proposed site areas. During the ESIA process, various specialists assessed the impacts of the proposed project including the underground transmission lines running from each site to their respective Electra-owned substation. No project impeding issues were identified by any of the specialists for the project and the recommendation from the ESIA team is that the project can proceed. A number of impacts are, however, anticipated for the project, will require mitigation to minimize them. It is therefore critical that the measures described in the ESMP are strictly followed. The ESIA and respective non-technical summaries have been publicly disclosed and approved by the Ministry of Environment, Rural Development and Marine Resources.

12. References and Contacts

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<u>Pre-Construction Phase</u>			
Environmental Component	Location	Mitigation/Monitoring/Conservation Actions	Responsibility
Flora, Vegetation and Habitats	Proposed wind farm, access road and transmission line site areas.	Survey and recording of vegetation present in all areas of intervention.	Developer
Fauna	Area within 250 meter radius of proposed wind farm site Boa Vista.	Vantage point surveys of bird species within the area of study in question by sampling.	Developer
	Area within 250 meter radius of proposed wind farm site Boa Vista.	Avifauna collision risk assessment and micro-siting of turbines accordingly with the objective of lowering as much as possible the probability of collision.	Developer
	Proposed wind farm site area, access road and surrounding areas.	Behavioral study of endemic data deficient gecko <i>Tarentola caboverdeana substituta</i> .	Developer
Health and Safety	Proposed construction site compound.	A full Health and Safety Risk assessment will be prepared for key activities performed during project phases.	Contractor
Environmental Hazard	Proposed construction site compound.	A Construction Environmental Management Plan (CEMP) will be prepared to identify risk of impact during construction and corresponding mitigation measures.	Contractor

Construction Phase			
Environmental Component	Location	Mitigating/Monitoring/Conservation Actions	Responsibility
Acoustic Quality	Sites: Source and receptors within a 700 meter radius of the sites areas.	Measurement of noise levels during land moving and wind farm tower foundation excavation work so as to avoid nuisance above the normal level according to the Good Wind Industry Practice.	Contractor
		Inspection of heavy vehicles and machineries so as to guarantee their compliance with Good Wind Industry Practice.	
Air Quality	Site areas, access roads and transmission lines.	Control of dust emission by watering of the relevant section of the construction site whenever necessary.	Developer
Fauna, Flora, Vegetation and Habitat	Work site, work fronts, access roads.	Circulation restriction of personnel, vehicles and equipments, to only absolutely necessary areas to avoid compaction, creation of tracks and/or destruction of important habitat.	Contractor
		Periodic verification that areas used for construction activities are restricted to the areas delimited for this purpose in work site plans.	
		Ensuring environmental recuperation of all areas of intervention, including, whenever possible, the reestablishment of the natural morphology, soil and vegetation cover while avoiding introduction of alien species.	
	Site areas, access roads, transmission lines.	Prevention of potential introduction of alien predators through periodic checks of construction materials and areas.	
		Prevention of habitat alteration of endemic gecko: Removal of small and medium sized rocks from construction sites and depositing them outside construction areas.	
	Site areas, access roads, transmission lines.	Avoid construction during breeding period of birds at risk in Boa Vista or construct furthest from their nesting area.	
		Creation of an exclusion zone to protect active nests from disturbance.	
		Placing of transmission lines underground to avoid bird collision.	
		Taking into consideration nest sites when designing lighting configurations.	
	Site areas, access roads, transmission lines.	Regular vantage point checks to verify risk predictions.	
Monitoring in relation to the conservation of the Osprey and the <i>Tarentola caboverdeana substituta</i> gecko.			
Analysis of breeding data of the species to compare with previous estimates and distribution data and produce updated trend data.			
		Awareness activities relating to the Osprey and the <i>Tarentola caboverdeana substituta</i> gecko involving environmental education at local schools and within the general community.	

Soils	Work site, work fronts, access roads.	Prevention, whenever possible, and the monitoring of, erosion, leaching of solids and sedimentation.	Contractor
		Ensuring the protection of excavated soil for reuse whenever possible in environmental recuperation.	
		Construction of container basins to contain potential accidental oil spills in order to prevent soil contamination.	
		Inspection of equipments with the objection of preventing contamination through leakages of oil and lubricants.	
Waste and Leftover Materials	Work site, work fronts, access roads.	Periodic verification of the implementation of measures aimed at the separation and removal of waste and leftover materials to dump site or for recycling.	Contractor
		Verification of use of licensed dumping zones for depositing of various types of waste.	
		Reuse or removal of vegetation waste materials, avoiding that these are buried, burned or deposited in areas where their natural decomposition is susceptible to provoke water quality degradation.	
Landscape	Work site, work fronts, access roads.	Integration of the project structures into landscape, where possible so as to avoid accentuated contrast. All visible surfaces should be painted in a neutral, non-reflecting color.	Contractor
		Accompaniment and verification of effectiveness of work site removal, cleaning, recuperation and landscape integration work in the areas affected during the construction phase.	
Water Resource	Work site, work fronts, access roads.	Complete banning on soil and fuel handling near water courses and areas of high infiltration capacities in order to avoid their accidental contamination.	Contractor
		Restriction of works involving excavation and soil movement in the proximities of water courses, and areas of high infiltration capacities, with the objective of minimizing degradation and erosion and potential alterations of surface and sub-surface leaching, as well as, avoiding consequential alterations in the soil and ecological conditions of sub-basins.	
		Complete restriction of interferences with important nearby hydrographic basins.	
Health and Safety	Work site, work fronts, access roads.	A full Health and Safety Risk assessment will be prepared for key activities performed during project phases.	Contractor
		Effective signaling of the construction compound accesses.	
		Full compliance with the Construction (Design & Management) (CDM) Regulations of 1994.	
Human Resource Development and Training	Work site, work fronts, access roads.	Training activities to supply workers with information regarding the procedures to be adopted in relation mitigation measures.	Contractor
		Promotion of the use of local workforce in the construction, whenever possible.	

<u>Operation Phase</u>			
Environmental Components	Location	Mitigating/Monitoring/Conservation Actions	Responsibilities
Flora, Fauna, Vegetation and Habitats	All areas of intervention.	Periodic verification of the effectiveness of the measures implemented in order to spur the recuperation and re-colonization of the areas affected by construction activities with the region's natural vegetation, for the possible adoption of corrective measures.	Contractor / Developer
	All areas of intervention.	Ensuring environmental recuperation of all areas of intervention, including, whenever possible, the reestablishment of the natural morphology, soil and vegetation cover while avoiding introduction of alien species.	Contractor
	Area located within 250 meter radius of wind farm site area Boa Vista.	Periodic vantage point survey of bird species within site area with the objective of verifying pre-construction predictions.	Developer
	Area located within 40 meter radius of each wind turbine in site area Boa Vista.	Periodic observation of any collision or electrocution accidents caused in bird or bat life.	
	Site, access road and surrounding areas S. Vicente.	Survey on population density of Tarentola Caboverdeana substituta in site area.	Developer
	Local communities.	Awareness activities relating to the Osprey and the Tarentola caboverdeana substituta gecko involving environmental education at local schools and within the general community.	Developer
Soil	Site area and access roads.	Prevention of soil contamination during maintenance through adequate disposal of used oils, lubricants and other resulting materials.	Contractor/Developer
Waste	Wind Farm operation and maintenance	Verification of the quantities of waste production during maintenance and its subsequent removal to official dump or recycling site.	Contractor
Acoustic Quality	Sources and receptors within a 700 meter radius of wind turbine implementation sites	Measurement of daytime and nighttime noise levels during wind farm operation so as to comply with levels according to Good Wind Industry Practice.	Contractor
Human Resource	Work site	Promotion of the use of local workforce in the maintenance/operation whenever possible with the objective of increasing local employment. Training activities to supply workers with information regarding the procedures to be adopted in relation mitigation measures.	Developer/Contractor