

PROJECT DESCRIPTION



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ENVIRONMENT
ENERGY
GEOHERMIC
WIND ENERGY

WIND PARK „LA VICTORIA“ (24 MW)

CHICLANA DE LA FRONTERA, CÁDIZ, SPAIN

Zurich, January 2010



Table of content

1. Introduction	3
2. Project Location	4
3. Wind Measurements	6
3.1 Concept and Equipment.....	6
3.2 Data Analysis	8
4. Wind Park Layout and Energy Yield	12
4.1 Layout	12
4.1.1 Turbine Type.....	13
4.1.2 Energy Output.....	14
5. Permitting.....	15
6. Realisation of the Wind Farm	17



1. Introduction

The district of Cádiz is known to be one of the windiest regions in Spain. Our company, NEK Umwelttechnik AG, a Swiss engineering group based in Zurich, decided years ago to develop several wind energy projects in this region. Included in these projects was „La Victoria“ in Chiclana de la Frontera, a description of the project is detailed below.

We started developing this site in spring 1999. A comprehensive wind campaign was carried out, which was followed by the calculation of a wind model. For the permitting procedure, an environmental impact study and a 12-month study of avifauna were undertaken. All the required documentation that included the detailed technical project, were submitted to the authorities for the issue of the necessary permits, together with the construction permit.

After having reached these important milestones, it was decided to sell the project to an investor / operator. We do not operate wind farms, since we are an engineering company. The project was sold to the Spanish utility E2 (now E.ON) on July 26, 2006. After the purchase of the project, it was agreed that our company would remain responsible for obtaining all the remaining permits, prior to the construction stage of the project. E.ON started construction of the “La Victoria” wind farm during summer 2009, operation is scheduled to commence in early spring 2010.

This brochure presents the relevant details of the project “La Victoria”.

2. Project Location

Located on the finca “La Victoria” in Chiclana de la Frontera, this project is about 10 km east of the Atlantic coast of Cadiz (Figure 1 and 2). The site lies north of the road which leads from Chiclana de la Frontera to Medina Sidonia, at an altitude of 40 m to 95 m.a.s.l. It covers an area of approximately 830 ha and is the property of one landowner.

The land is mainly grassland that is covered with small shrubs, and has a slight slope from south to north with a ridge running through the centre (Figure 3). The distance to the nearest residential area is about 2 km, while the centre of Chiclana de la Frontera is about 5 km away.



Figure 1: Location of the project area



Figure 2: Detailed location of the project site



Figure 3: View of the Finca "La Victoria" from north.



3. Wind Measurements

3.1 Concept and Equipment

We started our wind measurements in 1999/2000 with the installation of three 50 m measuring towers. On these towers - namely Referencia, Toro and Pajaro - the wind speed was measured at three heights, 10 m, 30 m and 50 m, this was over a period of 12 months until 2001. In addition, a further three 10 m towers were installed on the site (Figure 4).



Figure 4: 10 m tower and 50 m tower “Referencia”

E.ON performed additional measurements at 30, 50 and 80 m above ground from April 2007 to April 2009 on a new tower close to Toro and Referencia. An overview of the different sites can be found in Figure 5 and Table 1.

The measuring towers were equipped with two anemometers (NRG #40 MAX) at each height, and one to two wind vanes (NRG 200P) on the top of the towers. In addition, air temperature, air pressure and global radiation have been measured on the reference tower (Referencia). E.ON used Thies First Class anemometers for the measurements of wind speed.

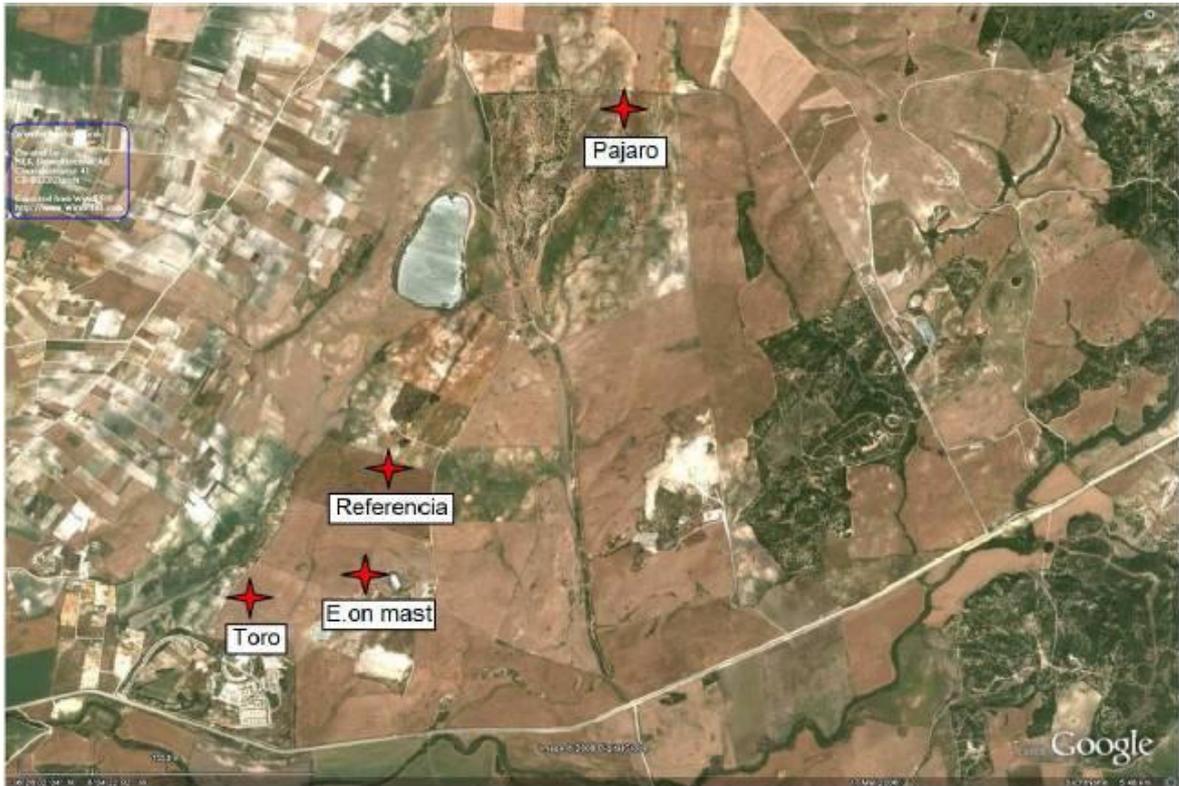


Figure 5: Satellite picture (Google Earth) of the project area with the measuring masts.

Table 1: Coordinates and measurement periods of the evaluated measuring masts.

Site name	Coordinates (UTM ED 50, zone 29)		Altitude (m.a.s.l.)	Start of measurement	End of measurement
	X	Y			
E.ON Mast	761341	4035275	44	12.04.2007	27.04.2009
Toro	760692	4035145	29	02.04.2000	16.05.2001
Referencia	761392	4035845	42	29.03.2000	08.05.2001
Pajaro	762524	4037668	83	30.03.2000	17.05.2001



3.2 Data Analysis

The following steps were taken to analyse the collected wind data:

- Data validation
- Data cleaning
- Extrapolations at hub height (before the start of the E.ON measurements)
- Long term correlation and adjustment
- Data Report
- Wind statistics for different wind direction sectors
- Wind class definition
- Development of a wind statistic
- Wind modelling using WindPRO in combination with WASP including topography and roughness parameterisation
- Development of a wind resource map at different hub heights
- Energy yield calculation for various WTG types
- Losses calculations
- Uncertainty analysis

Figure 6 shows the measured wind speed frequencies at all three levels together with an approximate Weibull distribution.

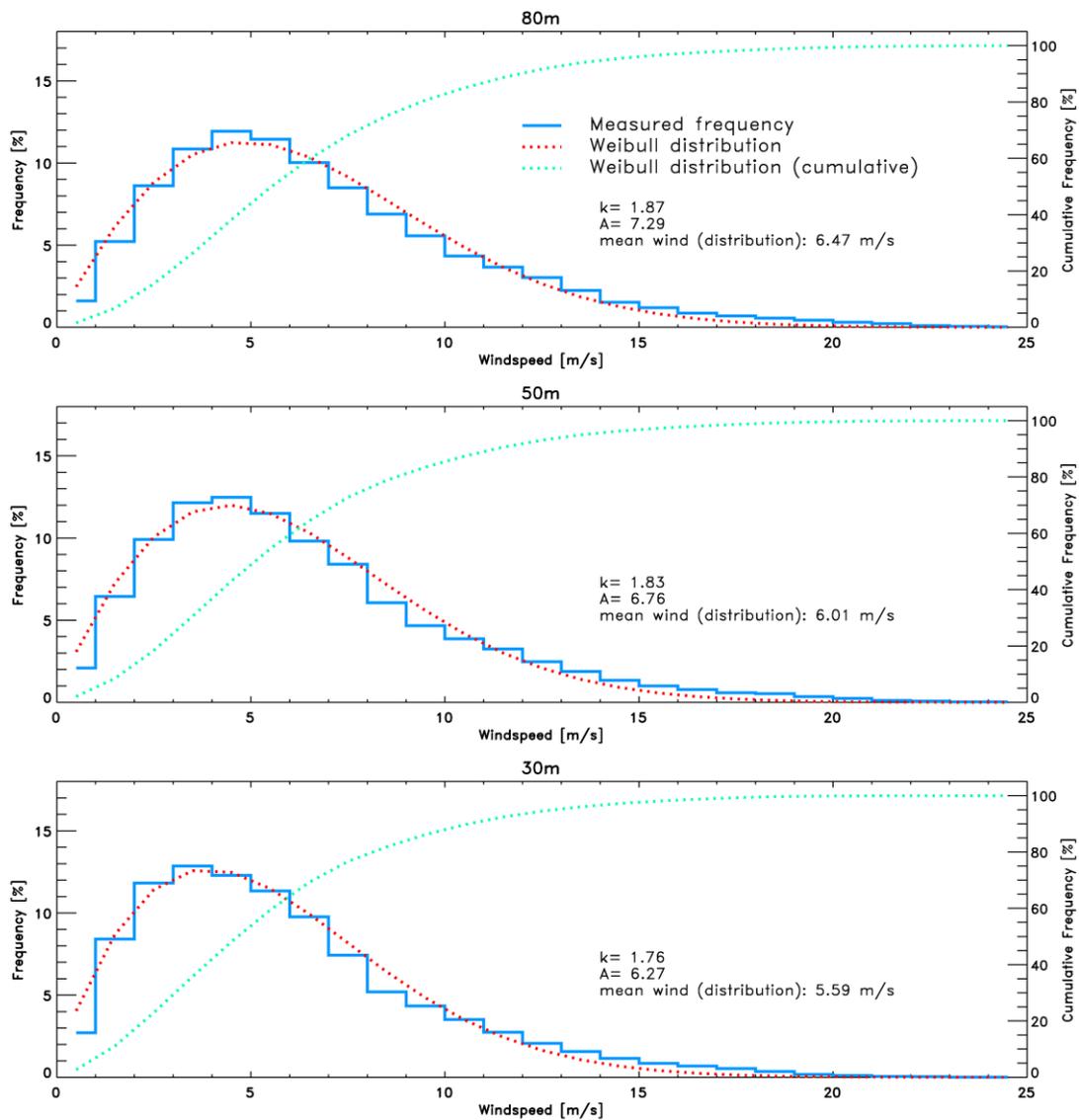


Figure 6: Wind speed (blue), and approximated Weibull (red) distribution with the Weibull parameters, and the mean wind speed at levels of 80, 50 and 30 m.

The wind direction rose in Figure 7 showing a distinct main wind direction, mainly coming from East South East (100 to 110 degrees). There is a westerly wind component that does not contribute significantly to the energy production.

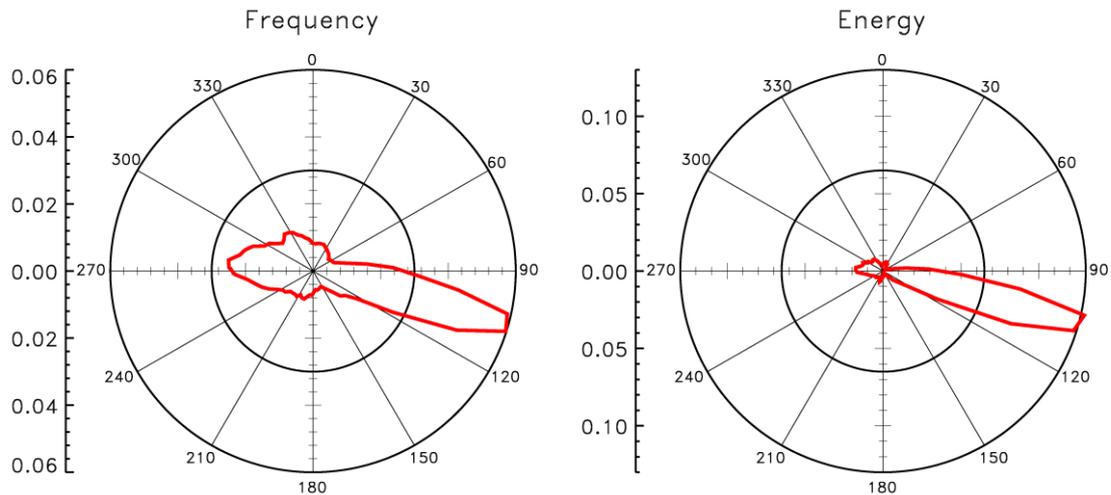


Figure 7: Wind direction rose from the E.ON mast at 50 m during the period 13.04.2007-12.04.2009.

Monthly mean wind speed values can be found in Figure 8. Over the course of 25 months, the mean wind speed for nine individual months reached 7 m/s or more at the 80 m level. Wind speeds from January to April were higher than during the rest of the year. The maximum 10-minute average wind speed found during the reference period is 27.4 m/s, while the maximum gust was 33.0 m/s. The mean value over the whole period was 6.9 m/s for 80 m, 6.4 m/s for 50 m and 5.9 m/s for 30 m height.

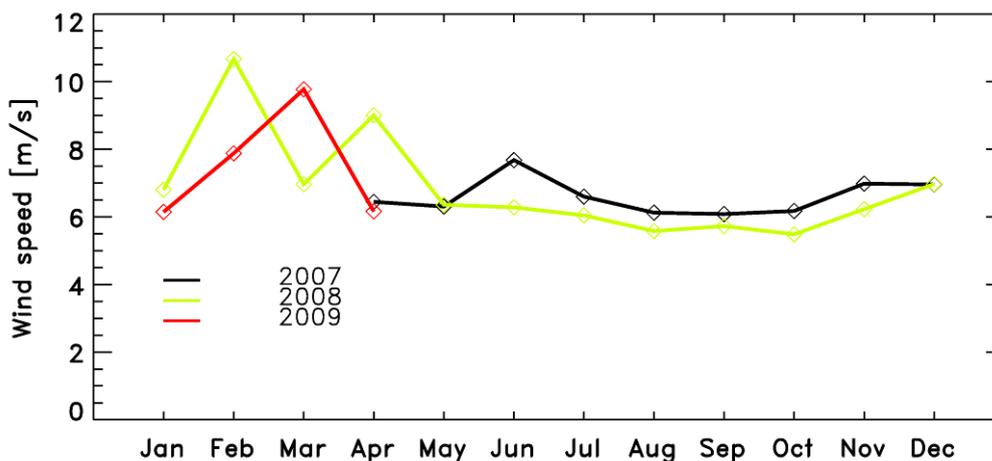


Figure 8: Monthly mean wind speed at 80 m height for the data period April 2007 to April 2009 (2007: black, 2008: green, 2009: red).



The results of the wind resource maps created with WindPRO and WASP are presented in Figure 9 and 10.

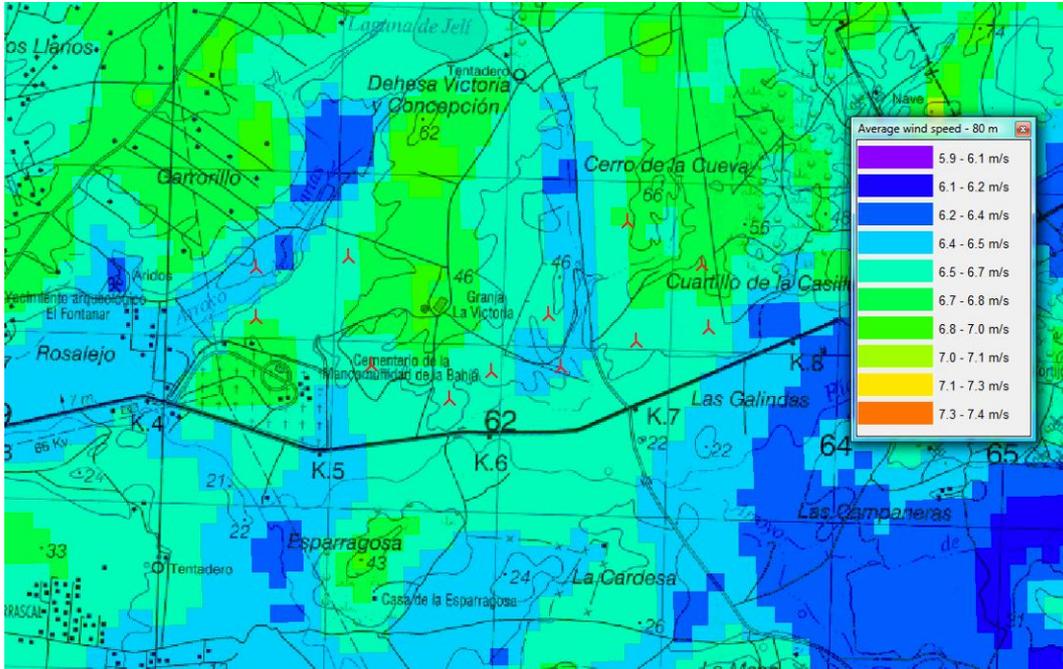


Figure 9: Wind resource map for La Victoria at 80 m above ground.

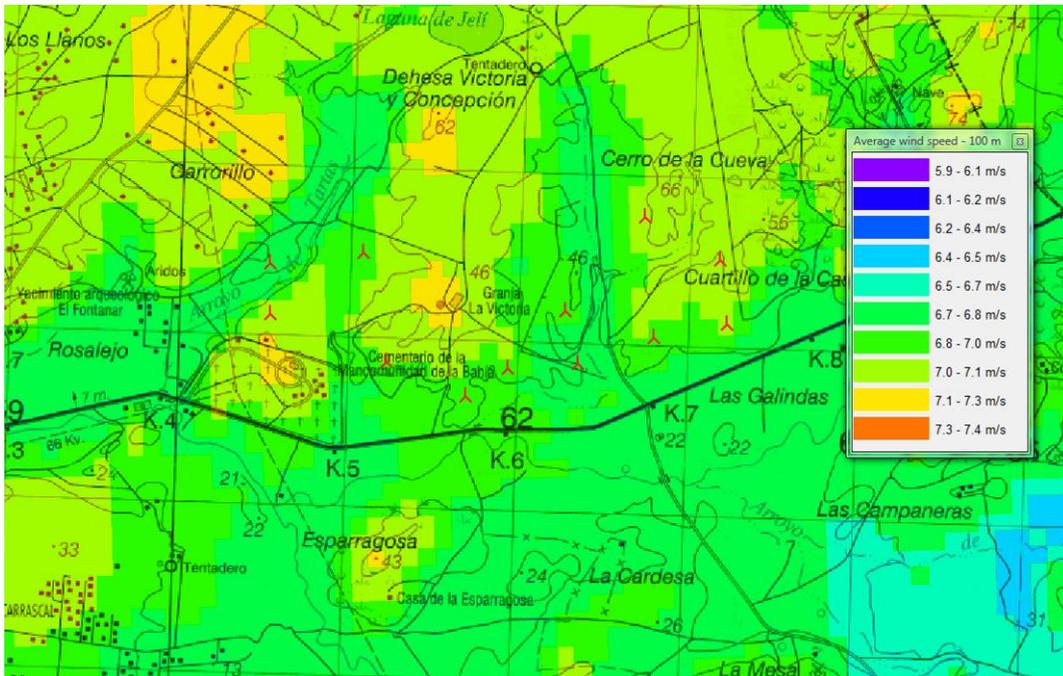


Figure 10: Wind resource map for La Victoria at 100 m above ground.



4. Wind Park Layout and Energy Yield

4.1 Layout

The planned layout for the fully constructed project “La Victoria” consists of twelve turbines (Figure 11). For the selection of the optimal position of each wind turbine, consideration was given to the wind condition, minimisation of shadow effects, land availability, electrical connection and access.

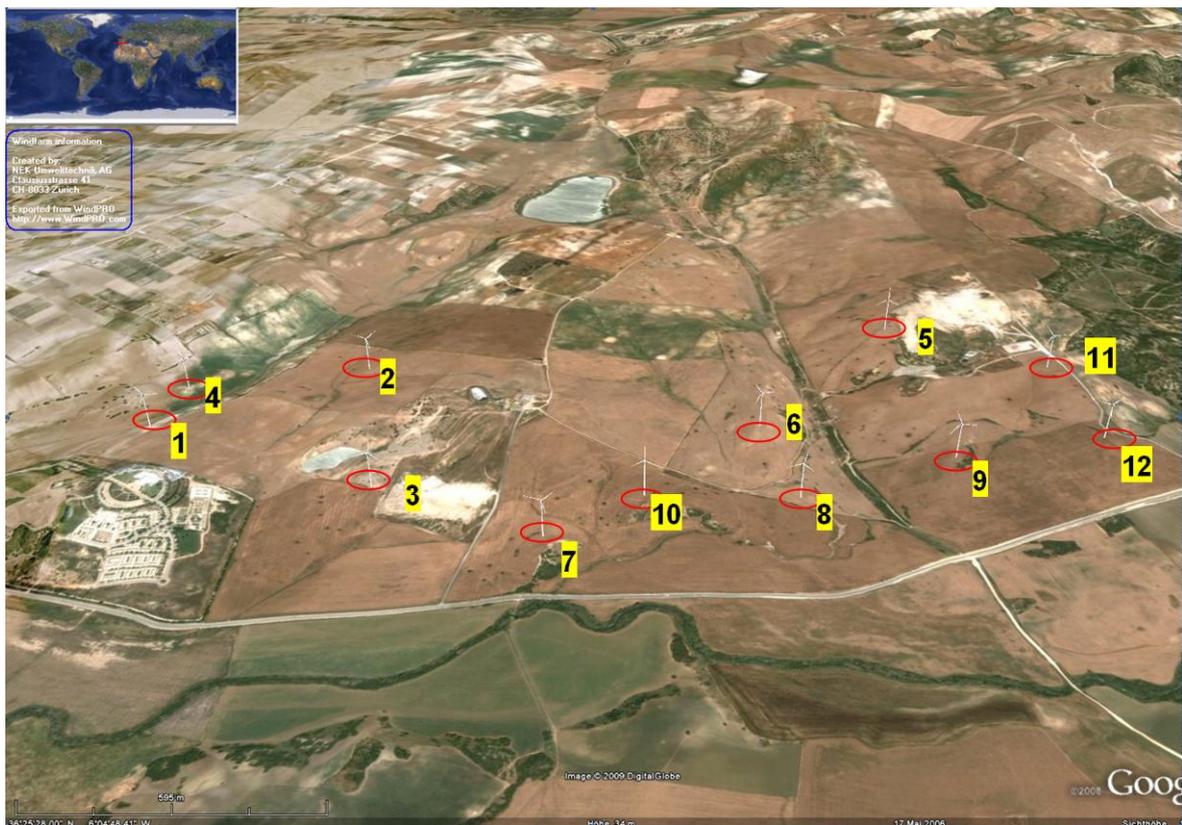


Figure 11: Final wind farm layout (2009) for “La Victoria”.

4.2 Turbine Type

For the “La Victoria” wind park, it was decided to install Vestas V90 2 MW turbines with hub heights of 80 m. Technical specifications are presented in Figure 12 and 13.

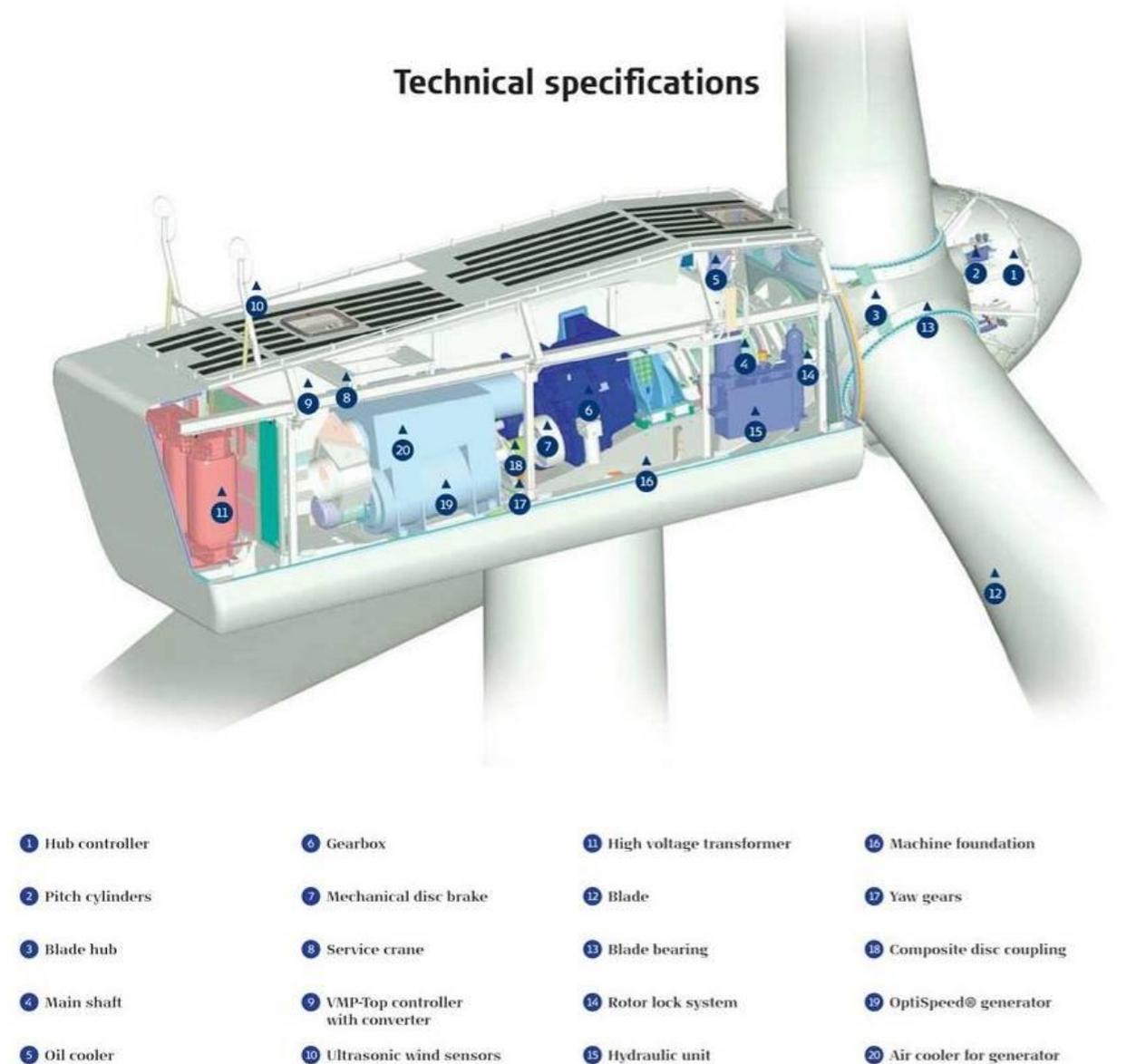


Figure 12: Technical specification of Vestas V90, 2 MW



Figure 13: Power curve for Vestas V90

4.3 Energy Output

The gross energy yield of the wind farm has been calculated with the power curve of the Vestas V90 (2 MW) wind turbine and the PARK module of WindPRO (Table 2). The results are based on the calculated wind resource map, the wind farm layout, the power curve of the V90 and estimated losses from the power production. The total uncertainty of the energy production is estimated to be 9.8 %.

Table 2: Predicted power production of the “La Victoria” wind farm

Turbine	Hub height	Mean WTG Energy	NEH pa	Annual energy	Efficiency
V90	80 m	4'978 MWh	2'489	59'738 MWh	94.1 %



5. Permitting

During the planning process, a number of comprehensive studies, papers, documents and reports were prepared for the construction and operation of the “La Victoria” wind farm:

- Several wind studies
- Environmental impact assessment
- Several avifaunistic studies
- Grid connection study
- Soil study
- Geotechnical study
- Study of the visual impact
- Technical preliminary project
- Execution project
- Study of the land fill site
- New wind zoning map for the region
- Several other studies

In order to realise the wind park, a number of permits were necessary. These have been successfully granted:

- „Declaración de Impacto Ambiental“ (DIA) as of December 20, 2005.
- Publication of the DIA in BOP as of January 26, 2006.
- „Autorización Administrativa“ (AA) as of December 22, 2005.
- Publication of AA in BOP as of January 26, 2006.



- „Comunidad de Bienes Promotores ZEDE Arcos: Acta N° 1: Fundacional de la Comunidad de Bienes Promotores ZEDE Arcos“ as of January 17, 2006.
- „Acuerdo Modificativo del Criterio de Asignación de Potencia Evacuable en la ZEDE de Arcos de la Frontera” as of January 17, 2006.
- „Acuerdo de Proyectos con Derechos de Conexión en la ZEDE Arcos” as of January 17, 2006.
- Junta de Andalucía : Resolución January 23, 2006, de la Dirección General de Industria, Energía y Minas, por la que se acepta el acuerdo entre Promotores y relación definitiva de instalaciones con asignación de potencia en la ZEDE Arcos de la Frontera.
- Gerencia Municipal de Urbanismo: Licencia de obra May 04, 2009.



6. Realisation of the Wind Farm

The final permits for the construction of the wind farm were issued on May 06, 2009. Construction was able to commence immediately as the components for the project had been ordered already in advance. The work on the foundations and access roads was carried out in June / July 2009, and the last turbine was erected in December, 2009. It is scheduled that operation of the 24 MW “La Victoria” wind farm will start in the first 2 months of 2010. Below, are pictures recording the construction work.



Figure 14: Foundation for a wind turbine (in construction)



Figure 15: Foundation for a wind turbine (nearly completed)



Figure 16: Foundation for a wind turbine (completed)



Figure 17: Access road and trenches for drainage



Figure 18: Access road (completed)



Figure 19: Vestas V90 before installation



Figure 20: Two cranes ready for the erection



Figure 21: One of the turbines about to be installed



Figure 22: Traffic during the construction works



Figure 23: Trenches for electrical cables



Figure 24: Wind turbine from access road



Figure 25: The wind park nearly completed

NEK UMWELTTECHNIK AG

A handwritten signature in blue ink, appearing to read 'Ch. Kapp'.

Dr. Ch. Kapp

A handwritten signature in blue ink, appearing to read 'I. Jaisli'.

I. Jaisli

Zurich, January 2010 Kp/Ja/re

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