Koudia Al Baïda - Morocco

A 50 MW wind farm

Sheet n° 9

The EDF Group’s commitment to sustainable development

Each week before the Second Earth Summit to be held in Johannesburg from 26 August to 4 September 2002, the EDF Group will present its concrete commitments towards sustainable development.

Second Earth Summit
26 August – 4 September 2002

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Press Contact:

tel.: 33 (0) 1 40 42 22 22
With an annual output of almost 200 million kWh, corresponding to around 2% of Moroccan electricity consumption, or the equivalent of the consumption of more than 400,000 inhabitants, the Koudia al Baïda wind farm is the first of its kind in Morocco, one of the largest in the Arab and African worlds and the largest wind power project in which EDF has been involved.

**The wind farm of Koudia al Baïda**

An air generator in a windy site is today a very interesting energy solution: it does not require fossil fuel and its operating cost is very low. It is in fact one of the cheapest among renewable energies when the local potential is sufficient as is the case of the Koudia al Baïda site.

The exceptional quality of the wind potential in the strait where powerful, regular winds blow, particularly the Chergui which blows from east to west, from the Mediterranean towards the Atlantic, justifies the exploitation of this exceptional natural resource. The windspeed is between 7 and 15 m/s for more than half the year and the wind direction is relatively stable: 56 % of winds are from the east and south-east and 40 % from the west. These conditions permit generation at a full power of 4,000 hours per year.

**Protecting the environment**

The wind farm of Koudia Al Baïda will avoid emitting 140,000 tonnes of carbon gas, on average, into the atmosphere. This figure has been calculated with regard to the average emissions of the Moroccan generation plants over the 19 operating years of the site by the Compagnie Eolienne du Détroit (Strait Wind Power Company). Wind energy permits electricity to be generated without burning fossil fuels (coal, fuel oil, natural gas, etc.). Its development is one of the solutions for fighting the greenhouse effect.

An impact study was carried out before the construction of the wind farm of Koudia Al Baïda. It takes into account the effects of the wind farm on the physical environment, the landscape, the neighbouring populations and their activities, the wildlife and particularly migrating birds which are numerous in this region of north Africa near the strait of Gibraltar. In order not to hinder the bird migration corridors, the turbines are organised into three separate groups with several hundreds of meters between each group.
An evaluation of the impact of the wind farm on migrating birds was carried out, after it was commissioned, by the Morocco Ornithological Group during the post-courtship migration from the end of August to the end of October 2001.

During this period, 9,000 long-flight birds and 1,300 passerines were observed in the west wind (in the east wind, migration takes place in the Tangiers region). The long-flight birds react to the presence of the air generators by going around them to the west, either by using the special corridors between the air generators, or by flying at a higher altitude, while the passerines use the corridors. Only two migrating birds have died after colliding with the blades of an air generator.

**Technical characteristics of the Koudia Al Baïda wind farm**

- **Geographical location:** 20 km north of Tetouan, 30 km east of Tangiers
- **Number of air generators:** 84 spread out along a crest 8 km long at an altitude of between 370 and 560 m
- **Capacity:** 600 kW each
- **Total installed capacity:** 50.4 megawatts
- **Weight of an air generator:** 26 tonnes
- **Mast height:** 45 ms
- **Three-blade propeller:** diameter 42 or 44 metres
- **Blade weight:** 8.5 tonnes of steel and fibreglass
- **Civil engineers:** SOGEA and EMT (Entreprise Marocaine de Terrassement – Moroccan Earthworks Company)
- **Pylons:** Elecam and DLM (Delattre Levivier Maroc)
- **Electricity:** Alstom Entreprise and Alcatel Maroc
- **Air generators:** Vestas, a Danish manufacturer
- **Construction time:** from March 1999 to July 2000.
The Compagnie Eolienne du Détroit: an ad hoc creation

Koudia Al Baïda is financed and operated by a Moroccan company created for this purpose in 1998. The capital of the Compagnie Eolienne du Detroit (CED) is divided as follows: EDF (49%), Paribas Industrial Affairs (35.5%), Jean Michel Germa, the promotor of the wind power project and president of the company (15.5%).

The contract signed between the Compagnie Eolienne du Détroit (CED) and the Moroccan Office National d’Electricité (National Electricity Office - ONE) is a BOOT (Build Own Operate Transfer) type contract: the CED designs, builds and operates the wind power site for a period of 19 years before transferring the facilities to the ONE. During this 19 year operating period, the ONE purchases all the electricity generated. The industrial commissioning of the equipment took place on the 30th August 2000.

The future

Morocco has major wind power potential due to its windy coastline. After the Koudia Al Baïda wind farm, the ONE envisages developing new generation sites on the north and south coasts of the country.

Two new wind farms could be located in the Tangiers region and another near Tarfaya, to the south of the country. These two facilities represent a total capacity of 200 MW. These projects will be led within the framework of a BOT contract. In June 2002, the companies Oismine and Union Fenosa were selected by the ONE for final negotiations concerning the Tangiers site.

Five other sites with lower capacities should also be located on the south coast of Morocco, between Essaouira and Dakhla. In total, this will represent a power of between 2.8 and 3.5 MW.

Besides these large sites, the ONE has participated with the FONDEM (Fondation Énergie pour le Monde – Energy for the World Foundation) and the Province of Essaouira in the electrification of the fishing village of Moulay Bouzerktoune. Around a hundred people now have access to electricity due to the installation of a 15 kW air generator by the French company Vergnet.

1 The FONDEM, of which EDF is one of the founding members, is an NGO specialising in electrification projects using renewable energies located in developing countries.
Recourse to solar energy is also frequent to permit the development of decentralised rural electrification projects.

**The example of the company Temasol:**
A consortium led by Total Energie, alongside its shareholders, TotalFinaElf with its subsidiary Total Maroc, and Electricité de France (EDF), was selected in May 2002 to electrify 16,000 households in Morocco.

This solar electrification programme, totalling an estimated 13 million Euros, falls within the general framework of the Programme d’Electrification Rurale Globale du Maroc (Global Moroccan Rural Electrification Programme - PERG), led by the ONE. It involves rural regions far from the electricity distribution network and scattered households located at the south-east of Rabat and Casablanca.

Each household will be fitted with a system including a solar panel and a battery which will permit lighting and domestic equipment to be powered. These systems should be installed over 4 years from the second half of 2002.

In order to implement this programme, to maintain the reliability of the systems, to guarantee the quality of service and to ensure the collection of fees paid by the users over 10 years, the three partners have created a Moroccan company “Total EDF Maroc Solaire” (Total EDF Morocco Solar - TEMASOL).

Total Energie, TotalFinaElf and EDF have pooled their skills to make this project a success and have introduced not only economic and social innovations but have respected the environment at the same time. This solar electrification programme falls clearly within the sustainable development approach of the partners.

**EDF in Morocco**

**The EDF Delegation in Morocco**

In 1997, the General Delegation of EDF was created in Casablanca, the financial capital of the country and the head office of the ONE.

**Lydec: EDF’s first investment in Morocco**

Since the 1st of August 1997, the company Lydec (Lyonnaise des Eaux de Casablanca) in which EDF holds shares of 18% of the capital, took over the electricity and water distribution and water purification for the urban community of Casablanca, a city of more than four million inhabitants and with a strong urban growth.
The first actions taken were to clean the drains, (indispensable in order to prevent catastrophies such as the floods of December 1996), the improvement of customer management and service and human resources.

**Franco-Moroccan solidarity during the storms**

Since the 31st December 1999, Morocco has participated in the international solidarity movement of electricity companies which came to the assistance of France when it was ravaged by violent storms. From Casablanca, 25 LYDEC fitters and 22 tonnes of equipment were sent to the EDF Gironde Distribution Centre. EDF was also able to count on the help of the ONE.

Since then, the ONE and LYDEC have also assisted EDF in increasing network safety: 35 ONE fitters came to Perigueux and 25 Lydec fitters worked at Mont de Marsan.

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**Wind energy:**

An air generator can be compared to a hydro plant where the wind replaces the water. The two or three blade propeller of the air generator is the equivalent of the hydro turbine; either the propeller or the turbine, when turned by the wind or water, propel a sort of “large dynamo” (which is called an alternator for hydro generation and a generator for wind power) which produces the electrical current.

For this current to be produced, a minimum wind speed is required: air generators can only start when the wind speed is greater than around 5 m/s and the output is then proportional to the cube of the speed.

The efficiency of air generators therefore depends on the quality of the wind “reserve” available, which preliminary studies can evaluate. Conversely, excessive speeds can be dangerous for the equipment and special technology is required: high strength materials to confront the sharp changes and exceptional peaks of wind speed, control systems intended to prevent the propellers from going too fast in the case of excessive wind (variable step propellers), wind plants which can be flattened when cyclones are predicted (like those that EDF operates at la Désirade).