Wind Energy in Morocco

Resources, Potential & Projects

Presented by

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Summary

- Overview of Electricity Sector in Morocco
- Laws about Renewable Energy & Energy Efficiency in Morocco
- Wind Energy Potential in Morocco
- Cooperation CDER/GTZ (Wind Energy)
- Wind Farms installed in Morocco
- Wind Farms programmed (2010-2012)
- Investment climate in Morocco
- Experience with technology transfer in Morocco
- Technology transfer contributIon to the market development of wind energy in Morocco
- Conclusion

Overview of Electricity Sector in Morocco

Energy Sector in Morocco in 2008

- **In Morocco, conventional energy resources are limited, the country depends almost totally from the outside for its energy supply (97 %)**

- **71 Milliards DH for imports of energy products in 2008 (6.2 Milliards Euro)**

- **Annual average consumption growth of electricity : 7.5 %**

- **Capacity of Power Plant to install until 2015 : 5.500 MW**

- **Total Power plant : 5431 MW**
  - **Thermal Power plant : 3449 MW**
  - **Hydraulic Power plant : 1729 MW**
  - **Wind Farms : 253 MW**

Generation of Electricity in Morocco

- **Electricity Consumption : 24002 GWh (2008)**
- **Electricity Production : 19731 GWh (2008)**
- **National Utility of Electricity (ONE) : 6689 GWh (27 %)**
- **Private Producers (BOT) : 13042.1 GWh (54,33 %)**
  - **JLEC (1360 MW-Coal)**
  - **Tahaddart (384 MW-Gas)**
  - **CED (50 MW-Wind)**
- **Self-producers (Industrials): 40 GWh (0,16 %)**
- **Import (Spain) : 4261.4 GWh (17,75%)**

Laws about Renewable Energy & Energy Efficiency in Morocco

- **Production of Electricity in Morocco :**
  - ONE (National Utility of Electricity)
  - Private producers (BOT) after call of tenders
- **Distribution : ONE + Governmental companies + Private Companies in big cities**
- **Until now, no Agency for regulation of electricity market**
- **Price of electricity fixed by Government,**
- **New Law about self-production of electricity from 10 MW to 50 MW (12 June 2008);**
- **New Law about Renewables Energies & Energy Efficiency (Adopted by Government, in discussion in Parliament);**
- **Now, No ‘’Feed-in-tariff’’ for Renewables Energies**

EnergiPro Programme (Self-Producers - Industrials)

- **Self-producers : Production & consumption of Electricity by Industrials in the the same site of the factory or in others sites via taxes of transport :**
  - **6 cDH/kWh(0.5 c€/kWh) until 2011**
  - **8 cDH/kWh (0.7 c€/kWh) from 2012**
- **ONE Tariffs for industrials (Included Taxes) :**
  - **Peak load time (17H-18H⇨22H-23H) : 1.3010DH/kWh(11.3 c€)**
  - **Medium time (22H-23H ⇨ 07H) : 0.9179DH/kWh(7.98 c€)**
  - **Time of low electricity demand (7H ⇨ 17-18H) : 0.5649 DH/kWh(4.91 c€)**
- **Price to sell ‘’Extra energy’’ to grid : 70 % of ‘’ONE-Tariffs’’**
- **Guaranty of Electricity to industrials in each time from ONE**
- **Wind Farms Programmed by self-producers : 1000 MW**

Wind Energy Potantial in Morocco

Wind Energy Potential in Morocco

Morocco has an excellent wind potential mainly in the North & in the South :

- Essaouira, Tangier & Tetouan with an annual average between 9.5 & 11 m/s at 40 meters.

- Tarfaya, Taza & Dakhla with an annual average between 7.5 m/s & 9.5 m/s at 40 meters.

<u>Wind Potential of Morocco</u> :

- **Total Potential : 7936 TWh/year (2645 GW)**
- **Technical Potential : 4896 TWh/year (1632 GW)**
- **Wind Atlas of Morocco published in 1986, 1995 and updated in 2008.**
- **More than 50 measurements stations installed by CDER between 1990 & 2009**

Cooperation CDER/PSE-GTZ Programme (1988-2002)

- **Installation of measurement stations in some sites in Morocco in collaboration with experts from Germany**

- **Development of two wind farms in Morocco after measurement campaign CDER-GTZ/PSE Programme:**

  - **Wim Farm of 50 MW installed in the site of El Koudia El Baida in august 2000 (BOT)**
  - **Wim Farm of 3.5 MW installed in the site of El Koudia El Baida in march 2001 (ONE)**

- **Trainings for Engineers & Technicians from CDER about some aspects of wind energy in Institutes & Companies in Germany & Europe.**

- **Publication of Wind Atlas of Morocco in march 1995 in collaboration with GTZ-PSE Programme**

Cooperation CDER/GTZ-TERNA Programme (1998-2002)

➔ **Installation by CDER of 3 measurements stations of 40 meters in three sites in collaboration with experts from Germany (DEWI Institute) :**

- **Cap Sim(Essaouira)**
- **Tarfaya**
- **Foum El Wad (Laayoune)**

➔ **Situation now in sites :**

- Cap Sim(Essaouira) : Wind Farm 60 MW (April 2007)

- Tarfaya : Wind Farm 300 MW (BOT)
Start production 200 MW : 09/2011
100 MW : 10/2012

- Laayoune : Development of Wind Farms of 440 MW by self-producers (Industrials).

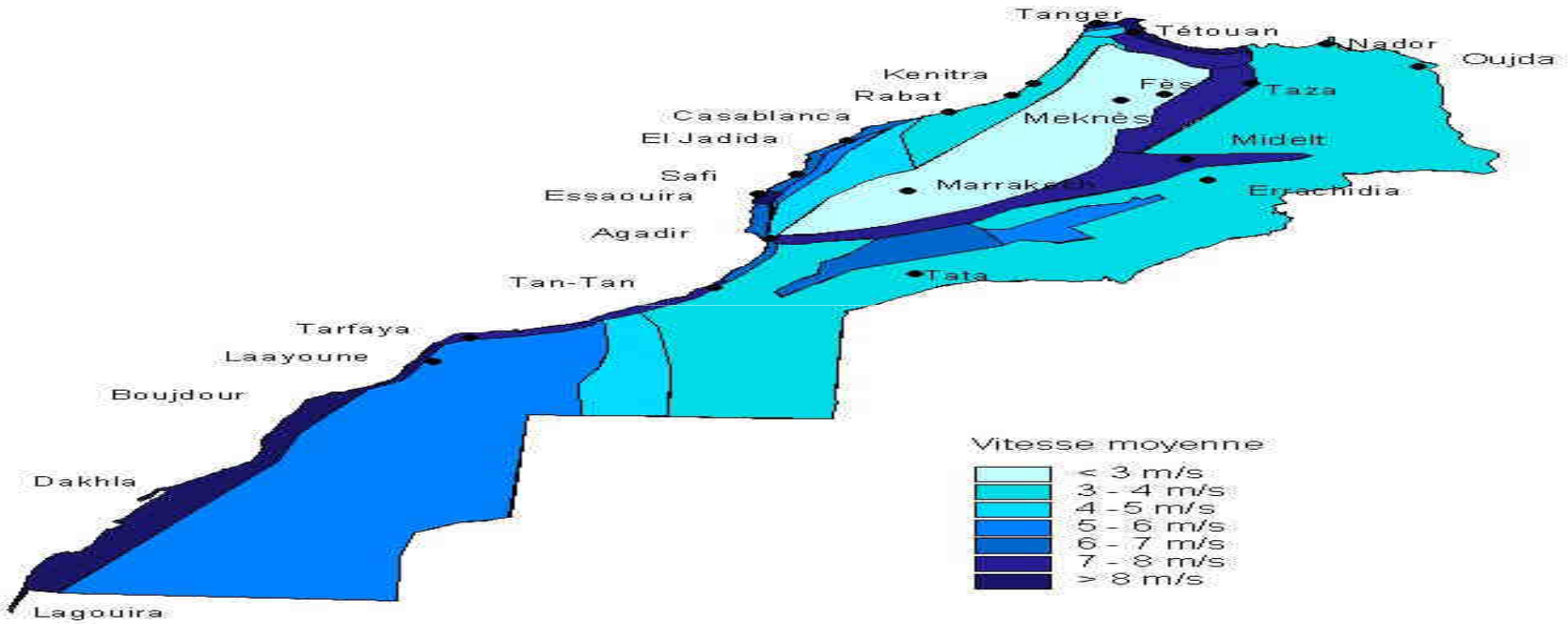
Wind Energy Potential in Morocco
(Study CDER/GTZ – July 2007)

Total Potential	Technical Potential	Estimated capacity to install in 2010	Estimated capacity to install in 2012	Estimated capacity to install in 2020
2,645,310 MW	1,632,030 MW	563 MW	1,065 MW	3,258 MW
7,936 TWh	4,896 TWh	1.9 TWh	3.4 TWh	9.9 TWh

Potential estimated to be installed :

- **until 2012 : 1000 MW to 2000 MW**
- **until 2020 : 4000 MW to 7000 MW**

Wind Resource Map of Morocco



Wind Farms installed in Morocco

Wind Farm of 50 MW
(El Koudia El Baida -Tetouan)

- **Power : 50 MW (84 Vestas 600 kW)**
- **Start production : 8/2000**
- **Production : 200 GWh/year (Average)**
- **Wind measurement : CDER**
- **Operator : CED (EDF-Paribas-Germa/France)**
  (selled to Theolia in december 2007)
  BOT for 20 years
- **Average wind speed : - 10 m/s (at 40 meters)**
  - 11 m/s (at 40 meters)
  in the best location in the site

Wind Farm 50 MW
(El Koudia El Baida -Tetouan)

Wind Farm 60 MW
Cap SIM (Essaouira)

- **Power : 60 MW**
- **Windturbines : 71 Gamesa (G52-850 kW)**
- **Start production : 04/2007**
- **Production estimated : 210 GWh/year**
- **Avearage wind speed (40 m) : 9.45 m/s**
- **Wind measurements : CDER**
- **Operator : ONE**
- **Project Cost : 800 millions DH**
  (72 Millions Euro)


Wind Farm 60 MW
Cap SIM (Essaouira)
12 12 2006

Wind Farm 140 MW
Tangier

- **Power : 140 MW**
- **Windturbines : 165 Gamesa (850 kW)**
- **Start production : 04/2009 (107 MW)**
- **Production estimated : 526,5 GWh/year**
- **Avearage wind speed (40 m) : 9 m/s**
- **Wind measurements : CDER**
- **Operator : ONE**
- **Project Cost : 2875 millions DH (250 Millions Euro)**

Wind Farm 140 MW
Tangier

Wind Farm 32 MW
Lafarge (Cements Factory of Tetouan)

➔ **Power** : **32 MW**
- ***10 MW (12 * 850 kW in 09/2005)***
- ***10 MW (5 * 2 MW in 09/2008)***
- ***12 MW (6 * 2 MW in 06/2009)***

➔ **Start production** : **9/2005**

➔ **Production** : **115 *GWh/year (2009)***

➔ **Wind energy Production** : **- For use in the neigbouring cement factory in Tetouan**
- To transmit any electricity not consumed there to its other productions sites elsewhere in the country (Casablanca), via the ONE grid
- Extra energy selled to ONE-grid)

➔ **Project Cost** : **496 *millions DH* (44 MEuro)**


Wind Farm 32 MW
Lafarge (Cements Factory of Tetouan)

Wind Farms Programmed (2010-2012)

Objective of the Government : Production of 18 % of electricity from Renewable Energy (included Hydro) in 2012

Wind Farms Programmed : 1300 MW until 2012

Wind Farms installed : 253 MW (11/2009)

<u>Projects programmed</u> :

- Wind Farm 140 MW (Tangier) : - Start production of 107 MW in April 2009
- In construction 33 MW (April 2010)

- Wind Farm 300 MW (Tarfaya) : BOT (Call of tenders, selection before 12/2009)
- 200 MW (September 2011)
- 100 MW (October 2012)

- Self-producers projects : 1000 MW (2010-2012)

Investment climate in Morocco

- **Moroccan agency for Development of Investment (AMDI) is a public institution. AMDI is the national organ loaded with the development and the promotion of investments in Morocco (Web site of AMDI : www.inves.gov.ma)**

- **The Fund of Promotion of Investments :**
  The Fund allows the investors to benefit from a partial exemption:
  - Expenses of acquisition of lands (limit at 20 % of the acquisition cost) necessary for the realization of investment

  - Expenses of infrastructure extern (limit at 5 % of the global amount of the envisaged investment).

  - Expenses of vocational training (limit at 20 % of the cost of this training).

Investment climate in Morocco

Companies can benefit from the Fund of Promotion of Investments :

- ⇨ **Investment more than 200 M DH (17 Millions €)**
- ⇨ **Number of stable jobs to create (250)**
- ⇨ **The region in which the investment must be realized**
- ⇨ **Technology transfer**
- ⇨ **Contribution to the environmental protection.**

Experience with technology transfer in Morocco

- **Delattre Levivier Maroc, "DLM", the leading heavy steel construction company, and boilermaking and pipework specialists, has been working for 50 years on Morocco's national market and on international markets**

- **DLM increasing interest in wind power in 2000**

- **In 2008, with the company's long experience and technical know-how, DLM created a new production site at Tit Mellil village (near Casablanca).**

- **DLM has also already equipped all masts of windturbines of Wind Farms of Tetouan (50 MW), Essaouira (60 MW) and Tangier (140 MW)**

Experience with technology transfer in Morocco

DLM has developed the activity by building a new production facility dedicated to wind energy sector.

The plant has :

- Production capacity of 300 wind-energy towers a year.

- Surface area of 100 000 m²,

- Operational since April 2008.

- Masts produced are between 65 and 100 meters high,

Experience with technology transfer in Morocco

Factory of DLM company near Casablanca

Wind Farm Tetouan (50 MW)

Wind Farm Essaouira (60 MW)

Technology transfer contributIon to the market development of wind energy in Morocco

- **Production by local company :**
  - ⇨ **Cost of investment in Morocco will be less than if we import all components of windturbines from outside the country :**
    - **- Expenses of the transport & import costs**
    - **- Others expenses more less**

- **Creation of local industry**

- **Development of market**

- **Creation of jobs**

- **Development of local know-how**

- **Development of local production**

Future expectations with regard to the impacts of technology transfer

- We expect in Morocco to encourage companies to develop technology transfer of all components of wind turbines

- Now, DLM company in Casablanca produce Masts

- We have in Morocco, the capacity & the know-how to produce more than 80 or 90 % of components of wind turbines if we encourage technology transfer :

  ⇨ Generator
  ⇨ Gearbox
  ⇨ Blades
  ⇨ Transformer
  ⇨ Electrical system, etc…

Conclusion

- **Morocco has an excellent wind potential**
- **National Energy Priorities & Strategy :**
  - Production of 18 % of electricity from Renewable Energy in 2012.
  - Energy efficiency; 15% reduction in consumption by 2020
- **Investment climate in Morocco is very favorable**
- **Some new Laws & regulatory framework about Renewables Energies & Energy Efficiency adopted by the Government**
- **Good contribution of GTZ experts for preparation of Laws & regulatory framework about Renewables Energies & Energy Efficiency**

Thank you for your Attention

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