



# Small Wind Power (SWP) as a Renewable Energy Source in Morocco

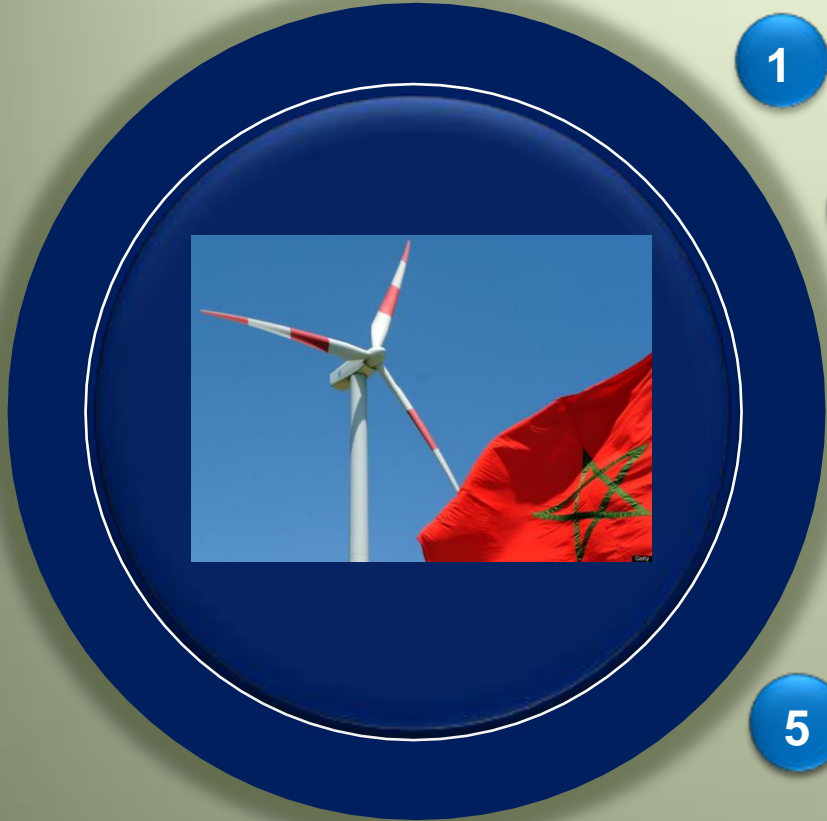
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Small wind turbine

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- 1** *Main objectives*
  - 2** *RE Institutional Framework in Morocco*
  - 3** *Common Barriers in developing countries (DCs): Case of Morocco*
  - 4** *Manufacturing a HWT for Domestic Application in Morocco*
  - 5** *Conclusion*



# Main objectives

The present work had two main objectives:

- (1) to identify the causes behind the low penetration of SWP in Morocco, and
- (2) to study the design of a horizontal axis wind turbine for domestic applications in the Moroccan context by following the design requirements of the international standard of small wind turbines IEC 61400-2.



# RE Institutional Framework in Morocco

Under the Kyoto Protocol, Morocco has not been bound by any reduction in the emissions of dioxide carbon and other greenhouse gases. Morocco has, however, voluntarily implemented several measures to reduce its dependence on external energy sources as well as to participate in the global climate change mitigation efforts in various economic sectors (energy/electricity; transportation; construction /housing ; etc.). A complete system of organizations has been established to oversee and develop the sector of renewable energies (RE). Although these organizations perform seemingly diverse activities, they share the same goal as to mobilize the national renewable energy potential.

The main RE organizations are :

- MEMDD
- Morocco's ministry of energy, mines and sustainable development
- ONEE – Morocco's electricity and water utility public company
- AMEE – Morocco's agency for energy efficiency
- MASEN – Morocco's agency for sustainable energy
- SIE – Morocco's energy investments company
- IRESEN - Morocco's renewable and new energies research institute

## ***Common Barriers in developing countries (DCs): Case of Morocco***

The limited exploitation of the small wind energy is not only unique to Morocco but common to developing countries (DCs). Developed countries also share the same dissatisfaction at their national levels of SWP deployment. The factors behind the low global diffusion of SWP in developing countries (DCs) fall within four 'barrier categories', briefly summarized as follows:

### **1. Awareness & information barriers:**

Little information available about SWP to energy decision-makers and potential developers of SWTs in DCs.  
Fragmented nature of the SWP international market (little contact opportunities).

### **2. Technical & technological barriers:**

Lack of a complete & reliable dataset characterizing the wind resource available.  
Limited financial resources to gather data.

### **3. Market, economic & financial barriers:**

High initial investment costs for SWP system acquisition and installation.  
Governmental subsidies (GSs) to conventional energies.  
Market failure to consider 'external costs'

### **4. Institutional, policy & regulatory barriers:**

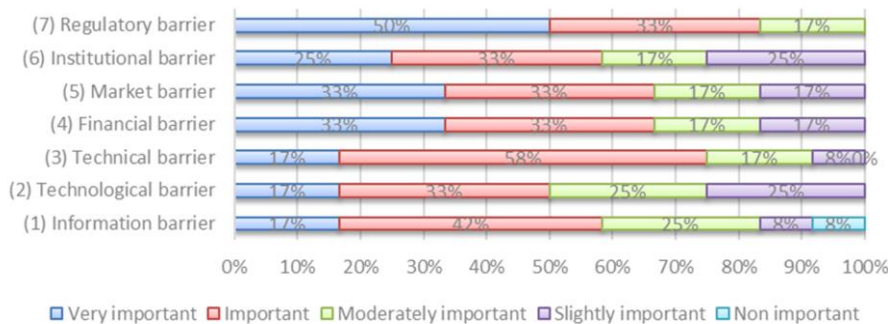
Multiplicity of governmental agencies and organizations intervening in the REs sector, resulting in duplication, overlapping and coordination problems in the implementation of SWP projects.  
Centralized planning process, sometimes opposing the 'decentralized' nature of some SWP projects.  
Bureaucratic approach to project implementation, resulting in rigidity in instructions and unnecessary delays.

## Qualitative Survey:

- 12 respondent experts in major RE institutions provide inputs based either on their experience when they have direct connection with the SWP industry or based on their expertise.
- Answers collected from the experts give credibility to the exploratory nature of the study. No statistical inference is drawn from the answers.
- The number of respondents is adequate as Leedy and Ormrod (2001) recommend that the number of informants be comprised between 5 and 25.

## Results:

Not all the barriers were found to be equally important in explaining the low diffusion of SWP systems in Morocco.



The most relevant barriers are:

- Regulatory barrier (with an 'aggregate relevance score' (ARS) of 100%).
- Technical barrier (with an ARS of 92%).
- Financial & market barrier (with an ARS of 83%).



## *Manufacturing a HWT for Domestic Application in Morocco*

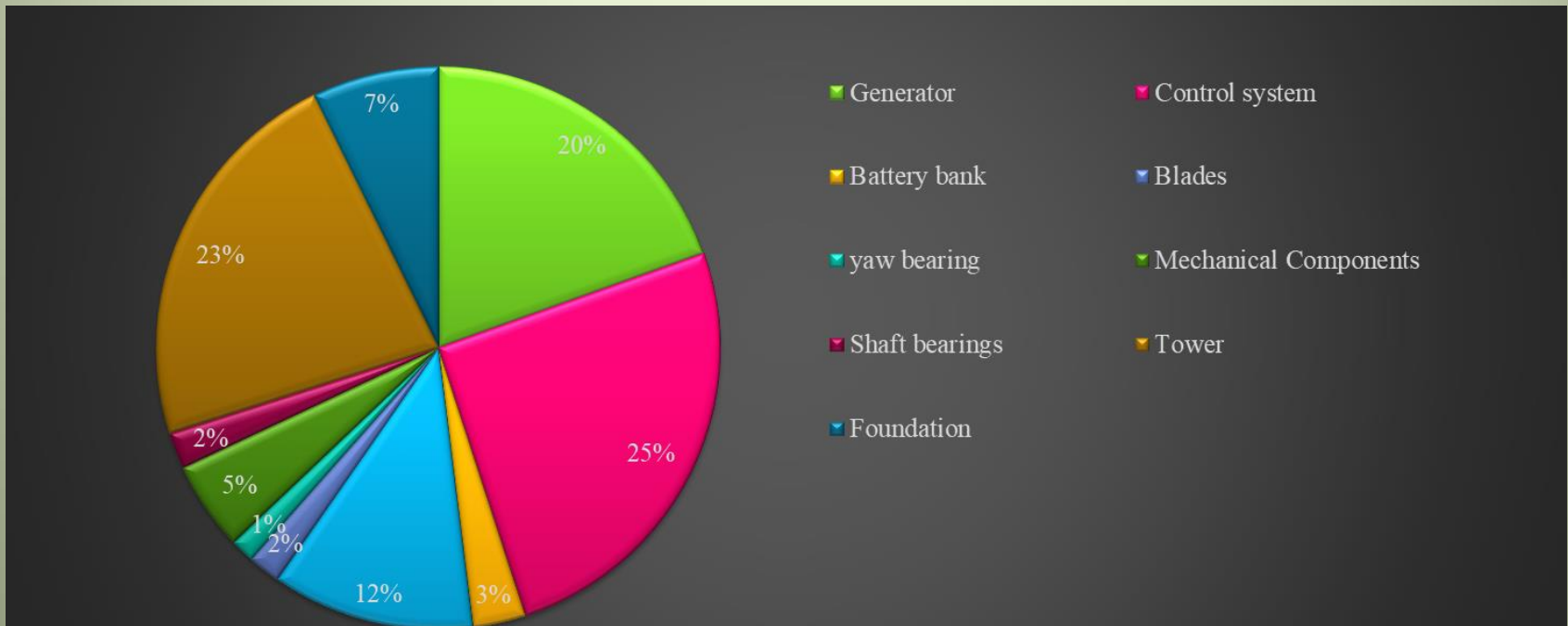
- Small wind turbine rated power output

Based on the average daily consumption of a typical rural household in Morocco of 103 kWh and by using an annual mean wind speed of 7.5 m/s (which corresponds to a design wind speed of 10.5 m/s according to the IEC 61400-2 standard), a rated power output of 11 kW is found to be a power that would be the most in demand.

- Technical barriers towards local implementation

Locally manufactured components are limited to the rotor, main shaft, nacelle cover and main-frame, tower and foundation. The costs associated with other components that cannot be manufactured locally (the drive-train system, the braking system, the electric generator, and the control and safety system) remain the highest.

- Locally manufactured components are limited to the rotor, main shaft, nacelle cover and chassis, tower and foundation. The costs associated with other components that cannot be manufactured locally (the drive and steering system, the braking system, the electric generator, and the control and safety system) remain the highest. This is how the industrial integration rate associated with this prototype does not exceed 30% !



Component costs expressed as a percentage of total machine cost.

***The constraint of designing the final product's economic viability ('low cost') can therefore only be fully satisfied if the local manufacture of all components is considered.***



# Conclusion

This work investigated the limited diffusion of SWP in Morocco.

- In the first stage, we use a survey to identify the relevant factors that are preventing the development of SWP.
- Three main factors are recognized as the most important ones namely regulatory barriers, technical barriers, and financial & market barriers.
- We perform a design of a 11 kW SWT to better define the technical barrier. The reliability and the efficiency requirements based on the IEC guidelines constrain the selection process of high-quality components which affect the production cost.
- The economic viability of a SWP project can only be fully satisfied if a local manufacturing process of all components is implemented.
- Potential participants can pursue various business activities: sourcing of raw materials, partial or full fabrication of SWT components, SWT component/system testing, logistics, installation/commissioning, financial, technical and project management consulting, loan granting etc.



THANK YOU  
FOR YOUR  
ATTENTION!

