Université Moulay Ismaïl
Ecole Nationale Supérieure d'Arts et Métiers

NATO SfP-982620 Follow up Meeting
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Energy Access and Small Wind Turbine Activities

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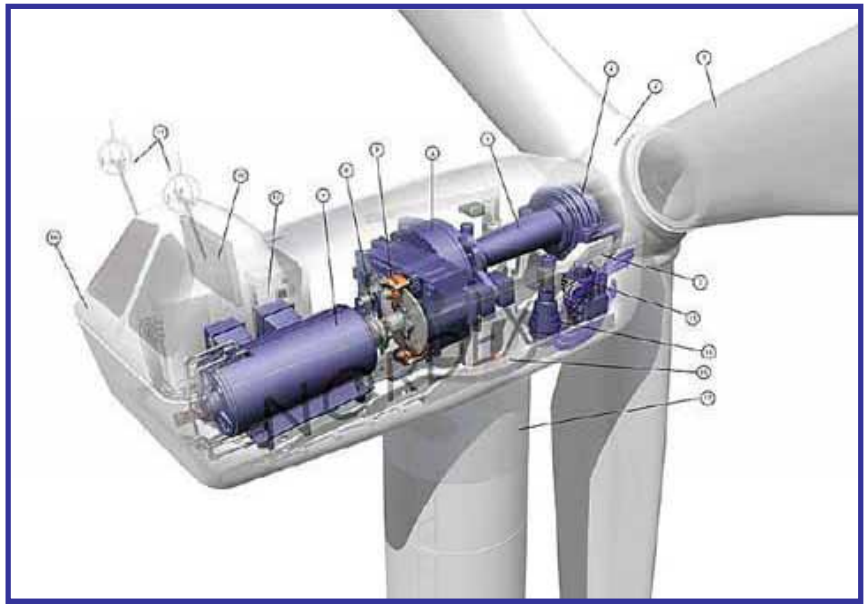
The Small Wind Turbine and these applications

According to the International standard IEC 61400-2
Swept area <200m^2
Rotor diameter <15m
Rated power <50kW

Category 1 **(40 m^2 < A < 200 m^2)**



Category 2 **(40 m^2 < A < 200 m^2)**

windy areas where weak grids can only accept small power inputs or where is no grid at all

The Small Wind Turbine and these applications

Off-Grid Power

Battery charging

PV/Wind system

Hybrid systems

On-Grid Power (Distributed Generation)

Grid connection

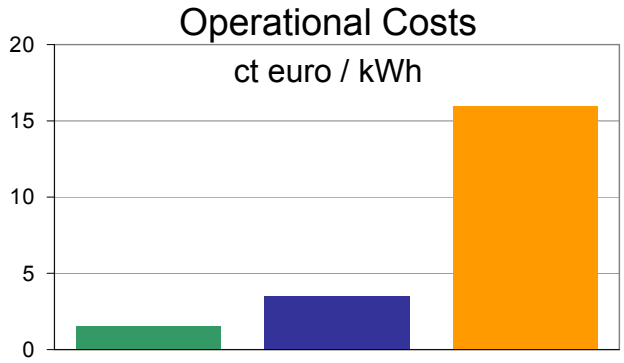
Source: www.acsaeolica.com

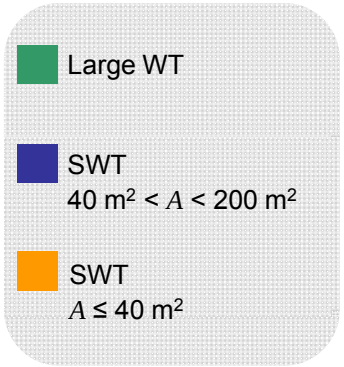
Diesel Mini-grid

The small wind turbine integration problem

Economics

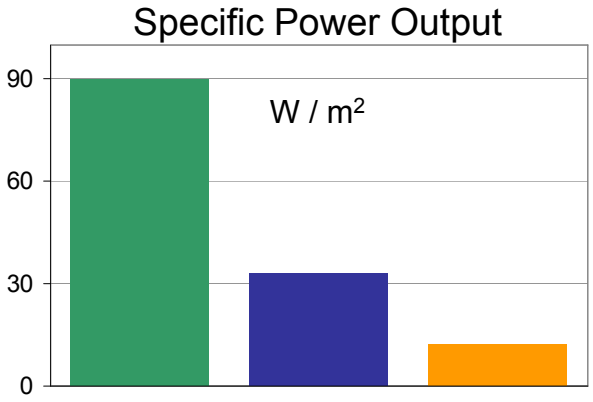
The small versus large wind turbine



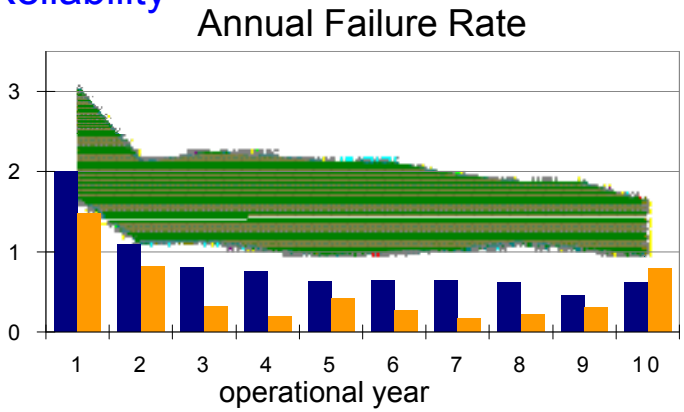


[1] Paul Kühn "Big Experience with Small Wind Turbines: 235 SWT and 15 Years of Operational Results", EWEC 2007- Milan, Italy, 9 May 2007

Energy Yields



Reliability



- Production of SWT in large quantities
- Maximizing SWT performance
- Good sitting and an adequate tower height.

The small wind turbine integration problem

In Morocco the SWT project is still in demonstration phase

1- Sidi Kaouki project (essaouira)

Hybrid Diesel/ Wind

CDER Projects

[2] Mustapha enzili, « l'energie eolienne au maroc », session de formation des acteurs de l'électrification rurale des pays africains francophones,CDER, du 19 au 28 novembre 2007

2- Morena project

Hybrid Diesel/ Wind/PV

- Absence of regional wind map
- Absence of national Legal rules
- Complex market and local manufacturing absence

Proposed actions to support the SWT Integration

Action 1

Decision support to the end user in the development of their SWT projects

Action 2

Local detail design and manufacturing process of small wind turbine

Action 3

Develop a Small Wind Test Branches (SWTB) to enable operational and performance tests to be carried out.

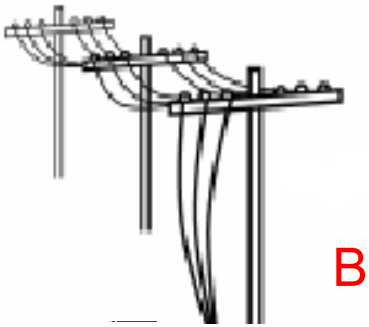
Action 1: Decision support to the end user in the development of their SWT projects

Conventional solutions

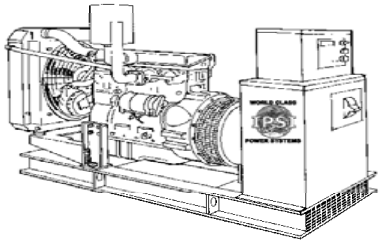
Renewable solutions

5 Hybrid system

1 Grid



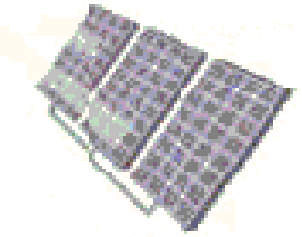
2 Diesel



Break even analysis

4 Wind system

3 PV system



Decision criteria and needs

Reliability requirements

Costs

Energy needs

Action 1: Decision support the end user in the development of their SWT projects

Grid characteristics

ONE

Energy needs

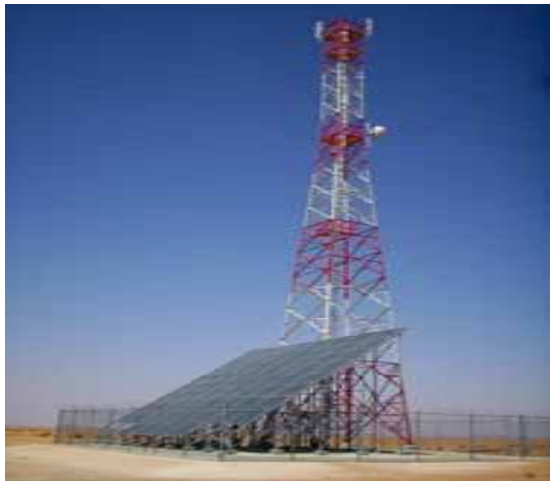
Maroc Telecom

Wind characteristics

Sahara Wind

Proposed case study

Break-even analysis and embodiment design of a PV/wind hybrid energy conversion system to supply power to telecommunication relay.



Source: http://sepsolar.com

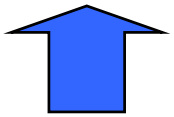
http://www.textually.org

Action 2: Local detail design and manufacturing process of SWT

Breaking technological barriers and propitiating the technological development in key areas for SWT sector

- Reliability and structural design.
- Aerodynamic and noise.
- Manufacture process and materials.
- Power electronics.

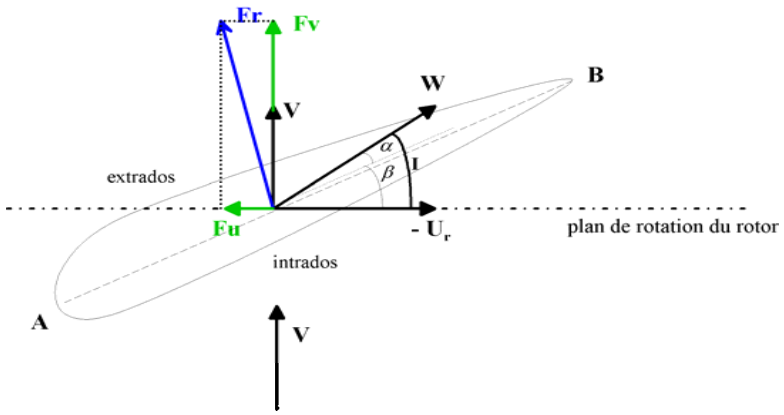
[2] Ignacio Cruz Cruz "Beyond barriers: A strategic R&D Plan for Small Wind Turbines development", EWEC 2007-Milan, Italy, 9 May 2007



The Use of Small Wind Turbines in Undergraduate Teaching and Research Projects

Action 2: Local detail design and manufacturing process of SWT

Aerodynamical and structural modelling of the small wind turbine blade.



- Estimation the energetic performance (starting behaviour and power curve).
- Estimation the blade loads.

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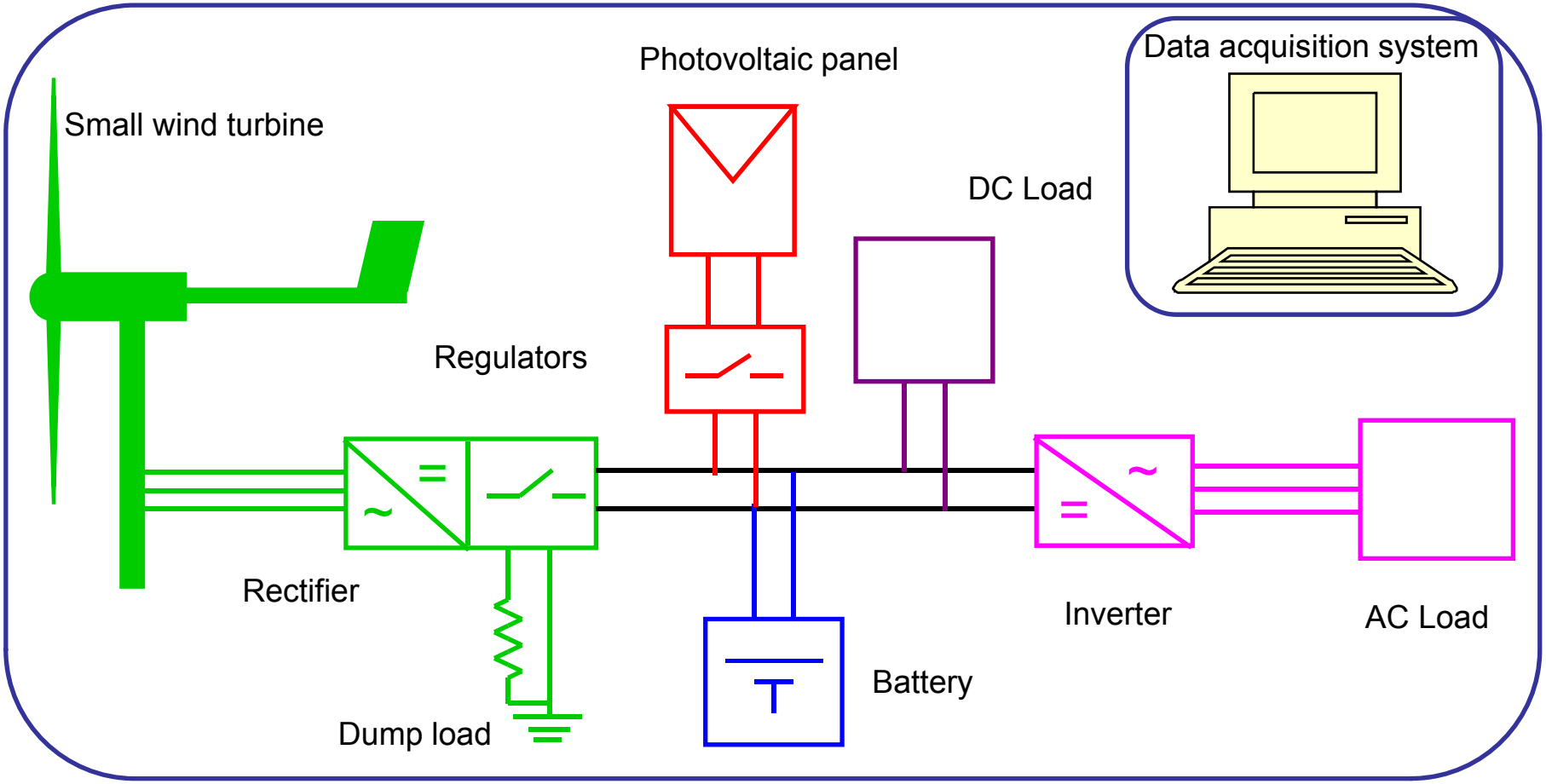
Optimal blade parameters

Action 3: Develop a Small Wind Turbine Test Branch (SWTTB)

Schematic diagram of a hybrid energy system test branch



The test results will be publicly available.
2 small wind turbines, will be under test at Al Akhawain University (Ifrane) and at ENSAM (Meknès).

Action 3: Develop a Small Wind Turbine Test Branch (SWTTB)

The intent of the SWTB is to test two small wind turbines over a sufficient period of time.

- Evaluate both the performance and the reliability of the tow units.
- Validate the simulation models.