



<u>Small Wind Turbines Optimization and</u> <u>Market Promotion</u>



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SWTOMP

- The main objective of the SWTOMP project is the promotion, development and implementation of the utilization of small and medium size wind turbines for isolated applications and for connection to weak grids, including the optimization of small/medium-scale wind turbines to meet local wind regimes and regional infrastructure requirements
- Total duration of the project is three years (2016 2019)

SWTOMP

- It is a project organized under the umbrella of the ERANET_LAC European Program that was approved in November 2016
 - Each partner has its own national funding
 - Each partner has a different time schedule
 - ➤ Total estimated cost: 1.14 M€ (0.64 M€ requested funding)

SWTOMP

The main expected results are:

•Closer inter-regional links between R&D institutions, wind turbine manufacturers, policy makers and end-users.

 Increased awareness of small/medium-scale wind turbines

• Development of new wind turbines designed specifically for tropical and cool environments

SWTOMP – Consortium members

The following institutions participate in the project:

- CIEMAT Spain Coordinator
- INEEL (Instituto Nacional de Electricidad y Energías Límpias) Mexico
- •INTEC (Instituto Tecnológico de Santo Domingo Dominican Republic
- •INTI (Instituto Nacional de Tecnología Industrial) Neuquén Argentina
- •IZTECH (Izmir Institute of Technology) Turkey
- •UdelaR (Universidad de la República) Uruguay
- •UTCN Universitatea Tehnica din Cluj-Napoa) Romania
- •VTT (Technical Research Centre of Finland Ltd) -Finland











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Working Packages structure

WP Number	Work Package Title	TASK Number	Task Name
WP0	Project Management	Task 0.1	Management of the Project
		Task 1.1	Analysis of the market of SMWT
WP1	Promotion of SWI Market	Task 1.2	Workshops for Market Promotion
	Market	Task 1.3	Preparation of material for education
\\\/D2	Wind Resources for	Task 2.1	Assessment of the wind resources in six locations
VVFZ	SWT	Task 2.2	Methodology for easy assessment of local resources
		Task 3.1	Selection of SWTs to be optimised
		Task 3.2	Redesing of the SWT
WP3	Wind Turbines	task 3.3	Manufacture and installation of prototypes
	optimization	Task 3.4	Testing and Certification of SWT
		Task 3.5	Analysis of results
\W/D/	Standard for SNA/T	Task 4.1	Identification of standards improvements
VV 24	Stanuaru ior SWT	Task 4.2	Proposal for IEC 61400/2 Modification

Gantt Diagram

WP Number	Work Package Title	TASK	Task Name		YEA	R 1			YEA	AR 2			YE	AR 3	
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WP0	Project Management	Task 0.1	Management of the Project												
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	Standard for SM/T	Task 4.1	Identification of standards improvements												
vvP4	Stanuard for SWI	Task 4.2	Proposal for IEC 61400/2 Modification												









IZTECH

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WPO. Project Management

WP Leader: CIEMAT

The WPO is related with the general financial and scientific issues of project management including aspects concerning the cooperation between ERANET_LAC officers and the project consortium.

Main Deliverables:

Web creation: <u>http://swtomp.ciemat.es/</u>
Annual Progress Reports
Final Report



WP Leader: CIEMAT

The objective is the promotion, development and implementation of the utilization of small and medium size wind turbines

- Task 1.1 Analysis of the market
- Task 1.2 Workshops
- Task 1.3 Preparation of material for education of researches, technical and users

Task 1.1 Analysis of the market To analyze the present situation of the small and medium size wind turbine markets in the participating countries. Deliverable 1: Sample survey form

 Five scopes have been identified in relation to the characterization of the market of SWT:

- the market deployment assessment,
- \circ the market suitability assessment,
- the practical aspects of SWT market,
- $\,\circ\,$ the social aspects of SWT market and
- $\,\circ\,$ the regulatory issues of SWT market.
- SWTOMP: not one, but several sample survey forms (INTI, INEEL, CIEMAT)



Task 1.1 Analysis of the market

Deliverable 2: Sample survey results

- Different results coming out from different survey forms
 - Different levels of detail
 - México and Argentina, detailed
 - Spain, Dominican Republic, more general
 - Different levels of deployment:
 - Uruguay, very low
 - Argentina, quite high
 - Different level of accomplishment
 - México and Argentina, finished
 - Spain, on-going

Task 1.2 Workshops In order to promote the increase of awareness of the potential of small/medium wind turbines, four workshops will be organized giving information of the benefits of the use of SWT. Deliverables: Workshops for information

6/2018: Huatulco, Mexico http://projects.ciemat.es/web/swtomp/cont_dest4



10/2018: Soria, Spain, in REGEDIS week http://projects.ciemat.es/web/swtomp/cont_dest5



Task 1.3 Preparation of material for education of researches,

technical and users Tutorial material will be developed in English and Spanish and will be distributed to several centers for the education of potential researchers, industrial technicians and installers.

Deliverable: Educational material edition

- Different materials for different target audiences
 - Available resources mapping
 - Elaboration of a guide to navigate through these resources
 - New educational material: technically oriented

WP2. Development of methodology for evaluation of wind resources for SWT

WP Leader: IZTECH

The objective is to develop a methodology for easy assessment of the wind resources in potential locations for the use of SWT

Task 2.1 Use of existing codes for assessment of the wind resources in four locations and verification of the results

Task 2.2 Description of the methodology for easy assessment of local resources using the available information (data bases, etc.)

WP2. Development of methodology for evaluation of wind resources for SWT

- Spatial borders: participating countries
- Turbine sizes: up to 1 MW
- Atlases to be used: Global
- Product type: reporting Webapp
- A fence modelling experiment (Uruguay)
- A building integrated experiment (Spain)



WP3. Optimization of SWT

WP Leaders: INEEL and INTI Neuquén The objective is the optimization of two small turbines to meet local wind regimes and regional infrastructure requirements

Task 3.1 Selection of the SWTs to be optimized for cool sites and tropical sites

Task3.2 Redesign of the SWT

Task3.3 Manufacture and installation of the prototypes

Task 3.4 Testing and certification of the SWT

WP3. Optimization of SWT. SWTs to be optimized for cool sites Eolocal Wind Turbine

- Argentinian manufacturer
- Leader: CIEMAT
- Based on Hugh Piggot's design
- 1000 W
- Battery charging model tested at INTI
- Interest in grid tied model:
 - PV Grid Inverter (1kW)
 - Chinese made
 - Matching to the SWT





WP3. Optimization of SWT. SWTs to be optimized for tropical sites Aeroluz Wind Turbine

- Mexican manufacturer
- Tower:
 - 18 meters
 - 3 sections
 - Galvanized steel
- Grid Inverter (6kW)
 - Range input operating: 50-580 V
 - Max. Input Current 36 A
 - Input voltage at full power: 200-580
 - Max. Continuous output power: 6000W@ 50°C
 - Frequency range: 59.3-60.5 Hz
 - Power factor: >0.995
 - Nominal output voltage: 277 V/240 V/208 V





WP3. Optimization of SWT. SWTs to be optimized for tropical sites Aeroluz Wind Turbine

- Leader: INEEL (México)
- Components under study:
- 1. Electric Generator (INEEL)
 - New design
 - Patent application (Dec 18, 2018)
 - Vibration analysis study
- 2. Blades (UNISTMO)
- 3. Control system (CENIDET)
- 4. Tower (INEEL)

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WP Leader: CIEMAT The objective is to improve the existing standards for design of SWT

Task 4.1 Identification of Standards Improvement.

Task 4.2 Proposal for IEC 61400/2 Modification.

Deliverables: Summary of the improvements identified / Proposal for IEC 61400/2 Modification

Design evaluation

External Conditions

- Environmental and electrical conditions may affect the loading, durability and operation of small wind turbines.
- The **environmental**, **electrical and soil parameters** shall be taken into account in the design and shall be explicitly stated in the design documentation.
- Environmental conditions:
- Wind conditions (Affect to the structural integrity of the SWT).
- Other environmental conditions. (Affect to the control systems function, durability, corrosion, etc.)
- Electrical conditions:
- network conditions
- local electrical conditions like batteries, hybrid systems or local grid.
- Soil conditions
- Design of SWT foundations.
- Each type of external condition may be subdivided into a **normal external** condition and an extreme external condition.
- The normal external conditions generally concern long-term structural loading and operating conditions, while the extreme external conditions represent the rare but potentially critical external design conditions.

Other Environmental Conditions

• Environmental (climatic) conditions other than wind can affect the integrity and safety of the SWT, by thermal, photochemical, corrosive, mechanical, electrical or other physical action.

- Moreover, combinations of the climatic parameters given may increase their effect.
- The following **other environmental conditions** shall be taken into account:
 - temperature;
 - humidity; (High humidity)
 - air density;
 - solar radiation; (High Solar Radiation)
 - rain, hail, **snow and ice**;
 - chemically active substances;
 - mechanically active particles (e.g. sand and dust particles);
 - lightning;
 - earthquakes; and
 - marine environment corrosion.

* Climatic conditions for the design shall be defined in terms of representative values or by the limits of the variable conditions. The probability of simultaneous occurrence of the climatic conditions shall be taken into account when the design values are selected.

Other normal environmental conditions

- The other normal environmental condition values, which shall be taken into account are:
- normal system operation ambient temperature
 range of -10 °C to +40 °C;
- relative humidity of up to 95 %;
- atmospheric content equivalent to that of a **nonpolluted**
- inland atmosphere (see IEC 60721-2-1);
- solar radiation intensity of 1000 W/m²; and,
- air density of 1,225 kg/m³.

Additional external condition parameters

- When the designer specifies additional external condition parameters, these parameters and their values shall be stated in the design documentation and shall conform to the requirements of IEC 60721-2-1:
- IEC 60721-2-1 Classification of environmental conditions Part 2-1: Environmental conditions appearing in nature Temperature and humidity

Temperature

The design values for the extreme temperature range shall be at least -20 °C to +50
 °C for the standard SWT classes.

Lightning

• The provisions of lightning protection required in clause 9.5 may be considered as adequate for wind turbines in the standard SWT classes.

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• No ice requirements are given for the standard SWT classes.

In case the manufacturer wants to include ice loading in their design load estimation, a minimum of 30 mm layer of ice with a density of 900 kg/m3 on all exposed areas is recommended. This static ice load would then be combined with the drag loads on the parked turbine system at 3*Vave. Ice loads on the support structure including guy wires should be considered in the design loads of the support structure.



Thank you!