1st Project Periodic Report

Publishable summary

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SWIP – New innovative solutions, components and tools for the integration of wind energy in urban and peri-urban areas

Grant Agreement: 608554

From October 2013 to May 2017

www.swipproject.eu

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1. Publishable Summary

Project context

The Wind Energy Roadmap, which was published by the European Commission (EC) on October 7th, 2009, and was presented and discussed at the Strategic Energy Technology Plan (SET-Plan) workshop, will play a key role in fighting climate change and in helping EU Member States to meet the 2020 targets identified by the new RES Directive of December 2008, which sets the following goals for the wind energy sector:

A wind energy penetration level of 20% in 2020.

- Onshore wind power fully competitive in 2020.
- 250.000 new skilled jobs created in the EU by the wind energy sector in the 2010 – 2020 period.

Currently, the major application of wind power is electricity generation from large grid-connected wind farms. However, following the changing trend of the energy sector from a centralized energy system to a distributed one, small wind systems and its hybrid applications are expected to play an increasingly important role in the forthcoming years, meaning a higher share in the energy generation. With the support of the smart grid technology and fostered by the directives and regulation associated to the sector, small wind turbines (SWTs) can now be connected to the electrical grid from the consumer-end and, little by little, contribute to the stabilization of the electrical grid. Due to this fact, small-scale wind energy has now been applied in fields such as mobile communication base stations, offshore aquaculture, agricultural and farming and sea-water desalination, among others, in several countries. Besides this scenario, the integration of small wind energy in urban and peri-urban areas is being a challenge due to the barriers the technology has at this stage of development.

SWIP objectives

The **main objective** of the SWIP project is to develop and validate **innovative solutions for small and medium size wind turbines** to improve their **competitiveness**, enabling and facilitating the **integration** and deployment into **urban and peri-urban areas**.

The new and innovative solutions will address the current barriers (turbulence, noise, vibration, aesthetic aspect, cost of technology, wind resource assessment, wind market, user friendliness, social acceptance and safety) that delay the market uptake of this technology. These solutions will: **reduce the costs** of the electric generator of wind turbines, providing **two new concepts for energy generation**; **increase the Cp ratio of the blades**, so that the number of hours that the SWT is producing increases by 9%, highly **softening or even eliminating the mechanical and acoustic noise** they currently produce; **reduce the maintenance costs of the SWTs up to 40%** by including two innovative elements (SCADA for preventive maintenance and magnetic gearbox) in the SWTs and improving the **integration** of the wind turbines in **buildings and districts with more aesthetic solutions**.

The project will develop **three different prototypes** to be integrated in **three different scenarios** (new energy efficient building, shore-line and industrial area), to validate the solutions and goals aimed, providing scalable solutions for different applications, covering several user needs.

Moreover, the project will **improve the current methodologies for wind resource assessment** into urban and peri.urban areas, reducing the RMS error in wind speed estimation until 8%, minimizing the risk and the opportunity costs of the small and medium size wind turbines when they are integrated in these environments.

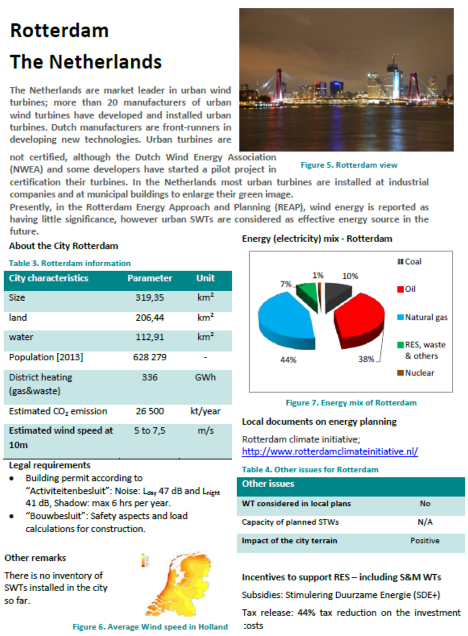
Work performed since the beginning of the Project

The work performed in the first project period convers a period where some preliminary works and studies have been developed. Preliminary tasks within WP1, WP3, WP4, WP5 and WP7 have been completed to set the basis for the further development of the works. All work has progressed aligned with the requirements from the DOW with minor deviations without greater impact within the progress of the work.

All work packages have run simultaneously in this period. A total number of 12 deliverables have been submitted.

Main results achieved so far

Within WP1, a benchmarking of small and mediums size wind turbine technologies has been developed, collecting, assessing and comparing the main technologies, both at market and at prototype level, concerning small wind turbines. Moreover, energy plans in EU cities and an analysis of three relevant European cities have been performed in order to determine the possibilities and space the SWTs have within the future concept of those cities and particular restrictions for the demo sites.



Rotterdam

The Netherlands

The Netherlands are market leader in urban wind turbines; more than 20 manufacturers of urban wind turbines have developed and installed urban turbines. Dutch manufacturers are front-runners in developing new technologies. Urban turbines are not certified, although the Dutch Wind Energy Association (NWEA) and some developers have started a pilot project in certification their turbines. In the Netherlands most urban turbines are installed at industrial companies and at municipal buildings to enlarge their green image.
Presently, in the Rotterdam Energy Approach and Planning (REAP), wind energy is reported as having little significance, however urban SWTs are considered as effective energy source in the future.

Figure 5. Rotterdam view

About the City Rotterdam

Table 3. Rotterdam information

City characteristics	Parameter	Unit
Size	319,35	km^2
land	206,44	km^2
water	112,91	km^2
Population [2013]	628 279	-
District heating (gas&waste)	336	GWh
Estimated CO_2 emission	26 500	kt/year
Estimated wind speed at 10m	5 to 7,5	m/s

Legal requirements

- Building permit according to "Activiteitenbesluit": Noise: L_{day} 47 dB and L_{night} 41 dB, Shadow: max 6 hrs per year.
- "Bouwbesluit": Safety aspects and load calculations for construction.

Other remarks

There is no inventory of SWTs installed in the city so far.

Figure 6. Average Wind speed in Holland

Energy (electricity) mix - Rotterdam

Figure 7. Energy mix of Rotterdam

Local documents on energy planning

Rotterdam climate initiative;
http://www.rotterdamclimateinitiative.nl/

Table 4. Other issues for Rotterdam

Other issues	
WT considered in local plans	No
Capacity of planned STWs	N/A
Impact of the city terrain	Positive

Incentives to support RES – including S&M WTs

Subsidies: Stimulering Duurzame Energie (SDE+)

Tax release: 44% tax reduction on the investment costs

Figure 1 Information sheet of the city of Rotterdam

Moreover, a design and performance evaluation methodology for permanent magnet synchronous generators to be used when designing optimal generators for small wind power applications in urban and peri.urban environments has been performed in WP3. The design method developed has been applied to design generators of 2, 4 and 20 kW, using real component characteristics and wind resource data.

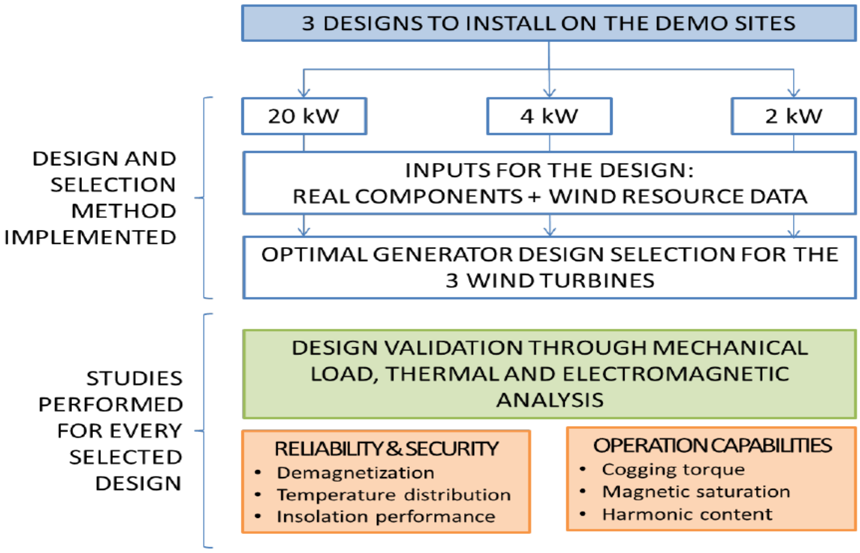


Figure 2 Methodology to design PM generators

A set of selection Guidelines (considerations and questions) for wind turbine and blade development such that they can more successfully be integrated into buildings, urban districts and other suitable areas is set out in WP4. The Guidelines address analysis protocols, decision making procedures and turbine/blade functionalities.

Within WP5, a selection of the most proper devices and tools for the Supervisory Control And Data Acquisition (SCADA) system is discussed. The new small and medium wind turbines, which will be developed in the project, have to bring along an economical and powerful SCADA system.

The electromagnetic compatibility requirements established by regulations emission and immunity requirements have been determined in WP7, collecting the reference standards where these requirements are set, and describing the test procedure which shall be performed in order to certificate the conformity of equipment under test. Furthermore, several electromagnetic disturbance mitigation methods which may be applied in case the equipment is not in accordance with the former electromagnetic requirements are approached.

The project's website (www.swipproject.eu) has been created and published, having a private space for the internal project management.

Finally, a questionnaire has been developed and distributed among the consortium and has been published in the webpage which aims at providing information to investigate the training needs that the society demands/needs in order to get acceptance on SWT.

Expected final results

SWIP project sets up a comprehensive **benchmark** that includes the most significant European legal and technical frameworks regarding small wind energy turbines regulations, the generation technologies and the energy plans for cities.

The project will deliver a **methodology for wind resource assessment in urban and peri-urban areas**, able to predict wind speed in urban location, without the need of performing a measuring campaign, and to implement such methodology in software. By means of that software the consortium will be able to assess and validate the accuracy of the model in the three locations in the project.

SWIP project has a clear orientation to small and medium wind power which involves:

- The design of **an innovative and low cost wind generator** (between 1 and 100 kW) which could be adapted to different types of wind turbines deployments depending on its final emplacement. Two configurations of permanent magnet generator will be developed, one for direct drive connection and a second one for a gearbox connection.
- The design and development of **cutting-edge technology wind blades**, which maximize the wind energy conversion in each type of final model, addressing small and medium size wind turbines and considering both vertical and horzontal axis for different use. The new blades will also contribute to the objectives of reducing vibration and noise coming from those elements, addressing the overall operation goals established in SWIP.
- The implementation of a **Supervisory Control And Data Acquisition (SCADA)** system that will allow a better performance of the wind generator, through improved operation and maintenance. This system will be used for the control of the turbine, safety issues, operation mode selection and reliability improvement through preventive maintenance. Converters will be able to work both in isolated grid and connected to the network. Furthermore, their control will satisfy "The Network Code on Requirements for Generators" which will be certified once they are installed in their final locations.

The SWIP project will also analyze the **structure and anchorage eleme**nts of small and medium size wind turbines for their installation into districts and buildings and it will develop best practices guidelines, for the aesthetic integration of these systems into urban and peri-urban settings. The project will also develop and implement solutions in order to mitigate and to absorb the noise and vibration produced by the wind turbine and to study the existing regulations regarding the safety issues in small wind turbine operation.

SWIP website

The Project website is www.swipproject.eu. The web page is regularly updated with information of the Project.