

Introduction to the hybrid series of vertical axis wind turbines ¹



Hybrid wind turbines and Energy Mix & Save solutions



Hybrid turbine with vertical axis, where it is born



Etneo presents the vertical axis small wind turbines produced with its partner in Taiwan, nicknamed the typhoon country. Wind turbines manufactured in accordance with current regulations and tested in laboratories such as TUV NEL (UK), NREL (USA), WINDTEST KAISER (Germany), MIRDC (TAIWAN, institute for tests on micro wind turbines).

The active installations from almost 15 years guarantee an excellent production capacity, solving all the problems of horizontal turbines, from noise to vibrations to power losses due to the need to orient themselves to changes in wind direction.

Our turbines work on two principles:

Savonius or central part of the turbine with blades oriented on the 4 cardinal points to always capture the wind, essential for the start of the rotation of the turbine with weak winds.

Darrieus or external blades that allow the turbine to increase its production efficiency in situations of turbulence or very strong winds.





ASSESS THE QUALITY OF THE PRODUCTS



Classify turbine manufacturers:

The Supplier No. 1 (Hi_VAWT / Etneo Italia) releases a power measurement chart as in the image below, the result of tests at the prestigious laboratories such as TUV NEL in the UK or Intertek in the USA

The extrapolated data certainly can not be counterfeited or modified, are realistic as compared and validated with anemometric measurements in the test sites and not just in wind tunnel.

Supplier No. 2 releases a power measurement table provided by laboratories that are not known and certified

The extrapolated data can certainly be counterfeited and modified, but are not too far from reality.

Supplier No. 3 does not issue a power measurement chart but rather a simple power curve without any verification or certification.

It is therefore clear that:

It is essential to instruct the possible users of wind turbines to understand the importance of the power measurement table with respect to the power curve, which may be fake or only to the supplier's interpretation.

The CE certification is an important point but the data related to the IEC-61400 is dedicated to the verification of the wind turbine standard.



ASSESS THE QUALITY OF THE PRODUCTS



POWER MEASUREMENT TABLE (DS3000 measured at TUV in England)

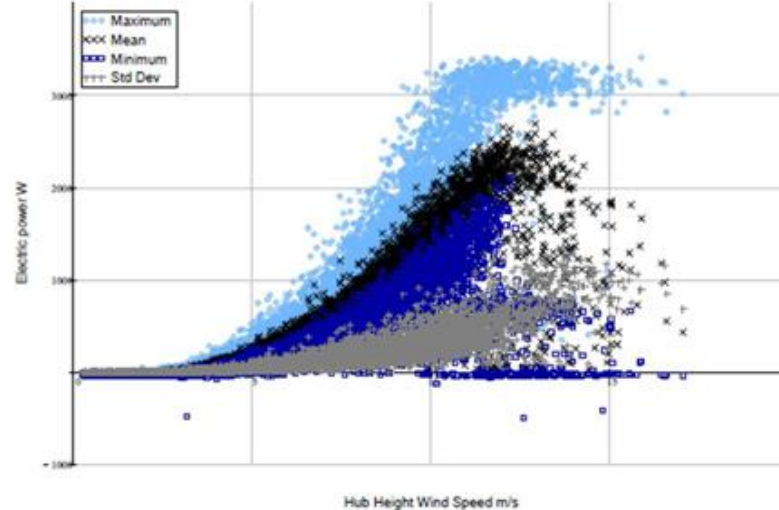


FIGURE 5 SCATTER PLOT OF POWER MEASUREMENTS AS A FUNCTION OF WIND SPEED (DATABASE B)



ASSESS THE QUALITY OF THE PRODUCTS



The strength of the mechanical parts

Hi-VAWT manufacturer of vertical axis turbines boasts installed experience of almost 15 years.

1 year of testing at the TUV NEL for the verification of strength and durability, according to BWEA in accordance with IEC-61400. A definitely positive result comes from the fact that in Taiwan (home of the parent company) there are many typhoons in the summer, the machines are tested in the field and not only with computer simulations.

The colored parts highlight the strength of the turbine near the blade connection, the curve of the blades on which the tension is distributed in a fluid and constant manner and the position of the generator underneath the blades for greater safety.



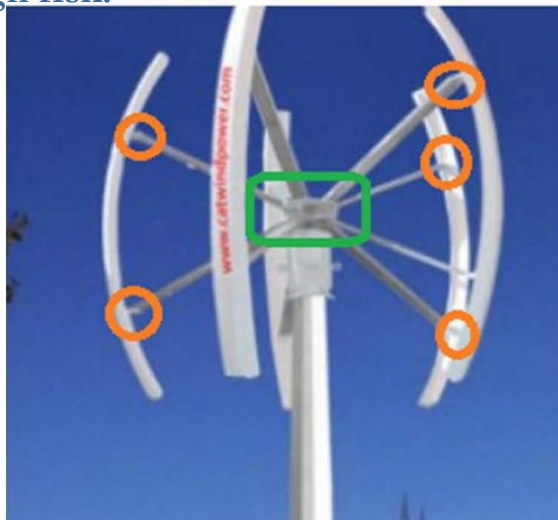


ASSESS THE QUALITY OF THE PRODUCTS



The strength of the mechanical parts

The same colored parts, below, show on two examples of vertical axis turbines the little sturdiness, in cases of gusts and very strong winds these parts are not very safe and subject to damage. The same generator "in green" is not protected as central compared to the delicate parts, in case of breakage of the blades also the generator is at high risk.





WHY CHOOSE THE ETNEO WIND TURBINE



To confirm our proposal the following is a list of the technical features of the DS300 turbine that the company Etneo Italia proposes for all the projects of hybrid street lamps and off-grid installations powered by renewable sources:

The DS300 is equipped, in the part under the generator, with a shock absorber (dumper), particularly of great importance for the vibrations of the rotating wind energy, especially when the speed is high.

The turbine has a permanent magnet generator suitable to withstand temperatures above 100 ° C, which is essential in the hot periods due to overheating of the generator, the most economical turbines hardly exceed 80 ° C of resistance, result: in one summer it is possible lose 80-90% of the magnetization with consequent malfunctioning and breakage of the generators.

The DS300 has IEC 61400-2 certification in South Korea, in addition to the CE mark and a CE-marked controller that is able to handle all the functions of the hybrid street lamp and above all the MPPT curve of the wind turbine. Almost no manufacturer or perhaps no manufacturer has IEC61400-2 certification on turbines below 1kW power.

The DS300 has CP efficiency of 25-26%, the other Savonius generators are all between 13 and 15% maximum; Savonius generators work well only with weak winds, the DS300 starts with weak winds and works well with medium and strong winds and with turbulence

The poles must be made based on the reference data of the installation site, or wind gusts lasting 3 seconds (Sicily Catania) at 38.9m/s or 10 minutes at 27.7m/s, this is an integral part of the legislation UNI EN 40-3-1. Most competitors consider only 10 minutes at 27.7m/s and therefore do not really guarantee the safety of the turbine and the whole system

The turbines have been installed in radio towers, have IEC 61400-2 certification for 300W turbine and 3000W turbine in Japan for obtaining the incentive tariffs resulting from the connection in the network, to date only two producers have obtained this certification for generators of small size in Japan and we are one of two.



D300 MODEL: AIR EXTRACTION SOLUTIONS



The D300 model has been designed specifically for being able to offer solutions in cases of air extraction (air exhaust, air ventilation or similar). This wind turbine is only Darrieus system because we will never face the low wind in air extractions solutions, we always face with wind from 8 to 15mt/s.

The bigger advantage of air extraction: turbine works almost every day and all year with constant wind, so we can count on a very constant and high energy generation.

Considering a working air extraction system for 12 hours per day and 365 days per year:

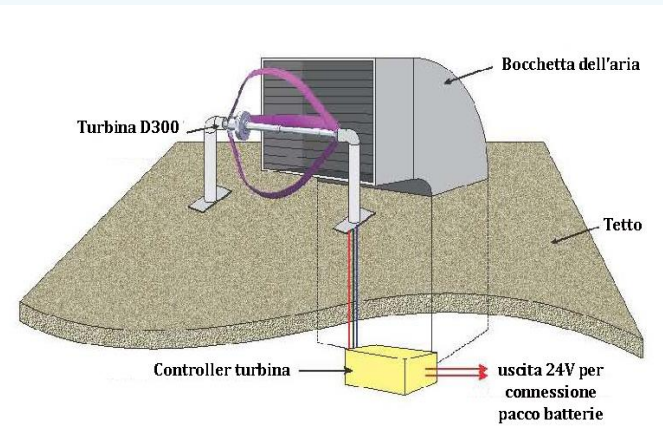
With constant wind speed of 10mt/s for 12 hours per day the turbine could generate 1,70 kwh (that are 51kwh/month and 612kwh/year).

With constant wind speed of 12mt/s for 12 hours per day the turbine could generate 2,89 kwh (that are 86,7 kwh/month and 1040,4 kwh/year).

With constant wind speed of 14mt/s for 12 hours per day the turbine could generate 4,34 kwh (that are 130,2 kwh/month and 1562,4 kwh/year).

Dimensions of air ventilation out must be around 1mt or little bit higher, but never smaller.

Wind speed checked 60cm distance from the exhaust. Machines working for at least 12 hours per day and 365 days per year.

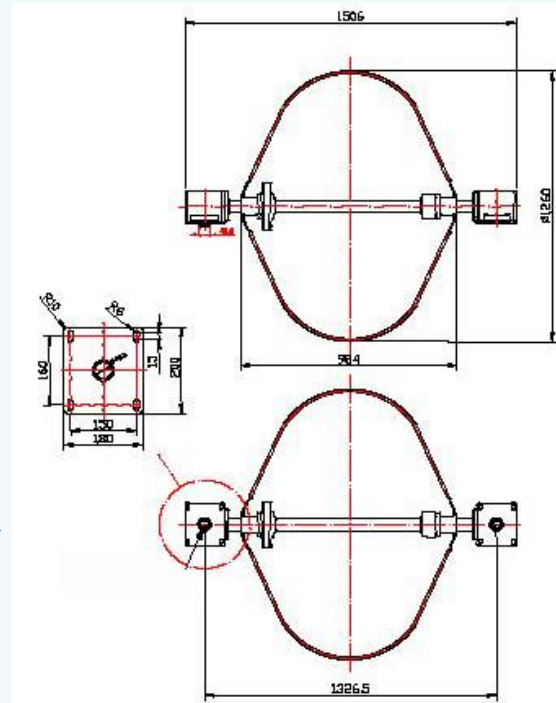




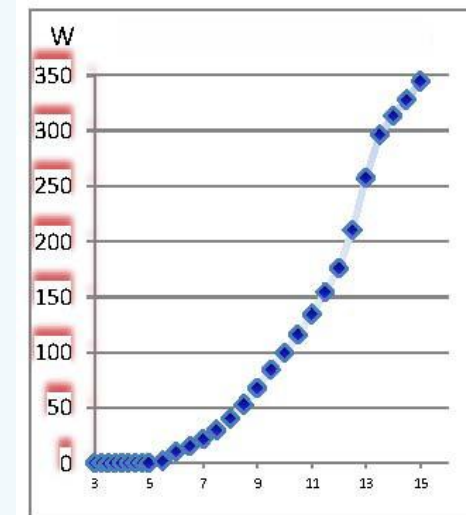
D300 MODEL: AIR EXTRACTION SOLUTIONS



Turbine drawing



Power curve



Technical specifications

Blades diameter:	1245mm
Total width:	1143mm
Number of blades:	3
Blades material:	Aluminum
Axis material:	SS400
Cut-in wind speed:	5mt/s
Rated wind speed:	13,5mt/s
Cut-out wind speed:	15,5mt/s
Weight:	30kg
Generator type:	Synchronism PMG
Nominal power:	300W
Braking system:	3-phase short circuit braking optional
Manual braking system:	optional



INSTALLATION EXAMPLES



Installation of turbines for
air extraction at AU
**Optronics corp. AUO in
Taiwan**





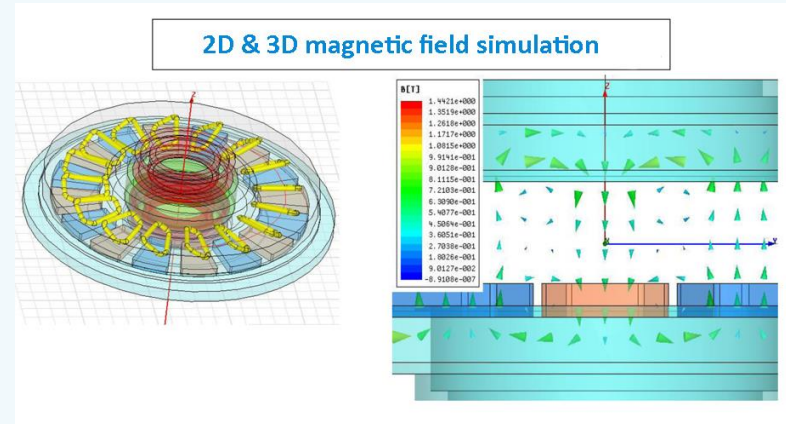
DS300 MODEL: OFF-GRID INSTALLATIONS



Wind turbine DS300 is a 300-500W power vertical axis small wind turbine that combines in its structure a dual system consisting of Darrius blades that guarantee high efficiency and Savonius blades, which enable the system to be activated with very low winds. This technology mix makes the Hi-VAWT turbine a highly innovative product: equipped with controllers capable of managing the maximum battery power and direct magnet drive generator. These turbines are built according to the IEC 61400-2 certification, a very important factor for small power generators. Very small dimensions, weighing only 25Kg, quietness, are the features that make this wind turbine the perfect solution for integration with residential photovoltaic systems with 24V battery storage technology.



The DS300 small wind generator distinguishes itself from the many cheap Chinese products, the numerous turbines made in the laboratory and never tested in open field, thanks to the double rotor, the dumper, the materials used, the Certifications obtained.

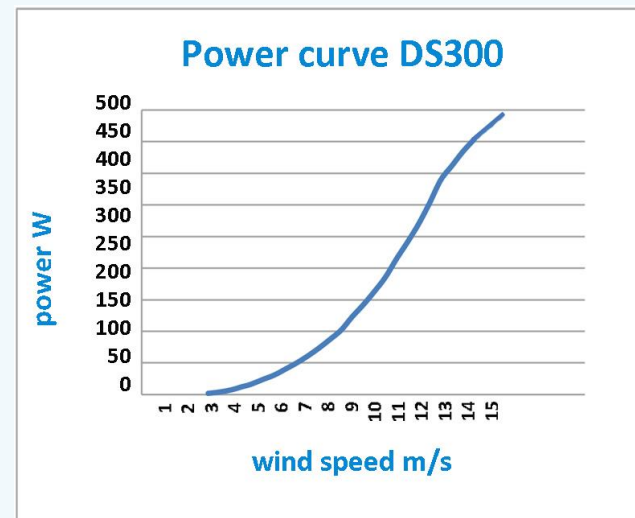
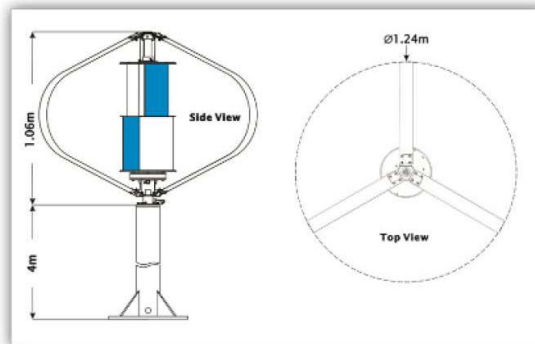




DS300 MODEL: OFF-GRID INSTALLATIONS



General Specifications			
Rated Power	300W	Wind Speed max. power	15 m/s
Maximum Power	500W	Cut in Wind Speed	<3 m/s
Cut out Wind Speed	15.5 m/s	Survival Wind Speed	60 m/s
Dimensions/Weight			
Rotor Diameter	1.24 m		
Rotor Height	1.06 m		
Tower Height	4.00 m (minimum)		
Total Height	5.06 m (minimum)		
Turbine Weight	25.5 kg w/o tower		
Rotor Specifications			
External Darrieus	3 blades		
Internal Savonius	2 layers		
Blades Material	Anodized aluminum		
Axis Material	Galvanized steel SS400		

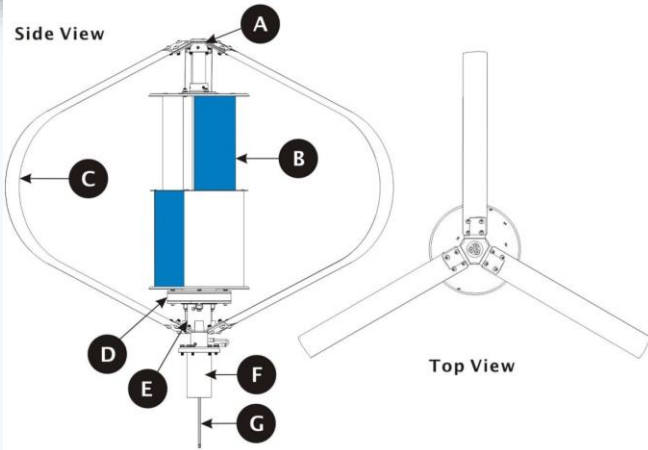




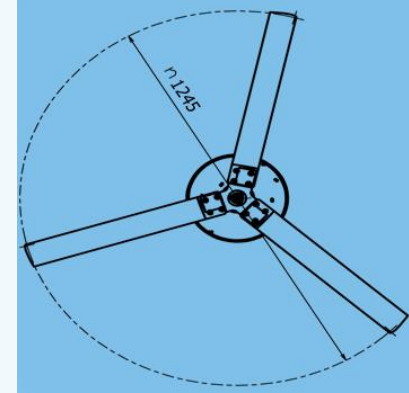
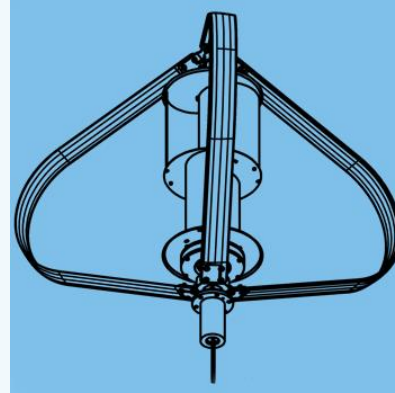
DS300 MODEL: OFF-GRID INSTALLATIONS



Side View



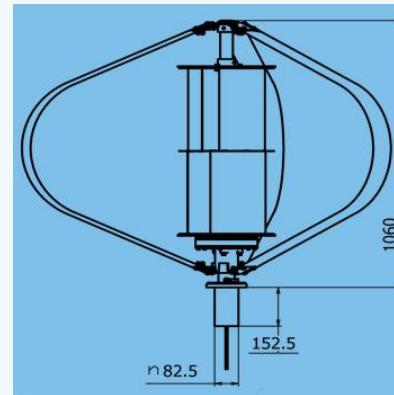
Top View



25,5Kg WEIGHT

1,24m DIAMETER

Parts	Description
A	Upper Darrieus Blades Connector.
B	S-Type Savonius.
C	3 Darrieus blades with built-in airfoil.
D	3-Phase, Direct Drive, Weather Sealed, Mechanically Integrated Permanent Magnet Generator.
E	Lower Darrieus Blades Connector.
F	Damper.
G	3-Phase R-S-T Generator Wires.



1,06m HEIGHT



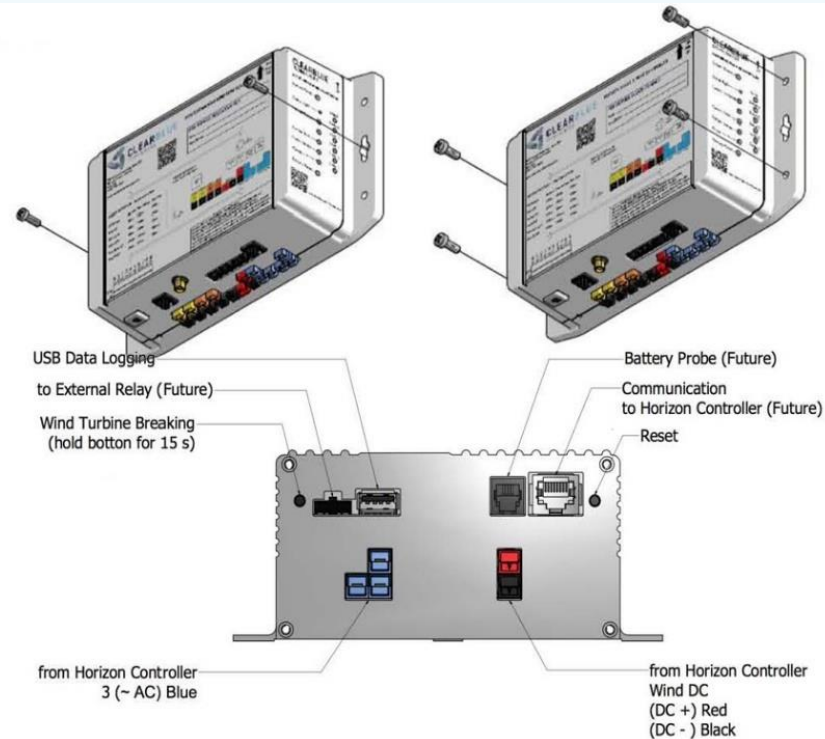
DS300 MODEL: OFF-GRID INSTALLATIONS



main controller



wind controller





Hybrid street lamps totally off the grid



The public administrations of the whole world are today in the moment of turning for the energy saving, the simple solution of the replacement of the old lamps with the new led systems leads to a benefit that could still be implemented with the total elimination of the use of the electricity grid.



Lighting, but above all the resulting costs, can become a fundamental factor for the development of small energy microgeneration stations.

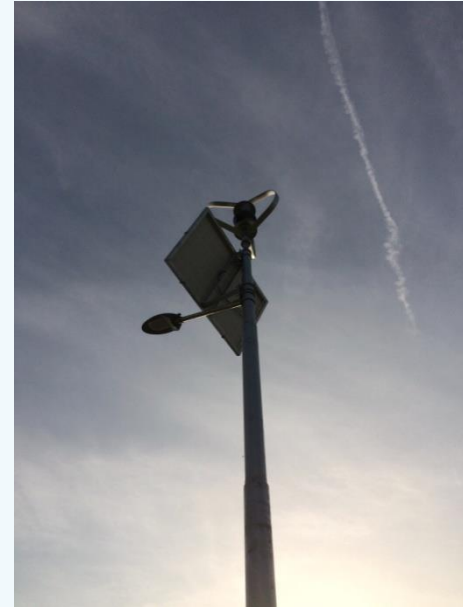
These so-called "microstations" are nothing more than hybrid street lamps powered by solar sources, a wind source and the storage of energy produced in batteries.



INSTALLATION EXAMPLES



Hybrid wind-
solar street lamps
at the **Fiat Sata**
plant in Melfi,
production site
of the new Fiat
Jeep





INSTALLATION EXAMPLES



Hybrid wind-solar street lamps at the **Fiat Sata plant in Melfi**, production site of the new Fiat Jeep





INSTALLATION EXAMPLES



Hybrid wind-solar
streetlights 1000pcs.
Installed along the
**Qingcaosha
Shanghai Water
Reserve**





INSTALLATION EXAMPLES



Hybrid wind-solar
streetlights 1000pcs.
Installed along the
Qingcaosha
Shanghai Water
Reserve





INSTALLATION EXAMPLES



Hybrid wind-solar
streetlights 1000pcs.
Installed along the
Qingcaosha
Shanghai Water
Reserve





INSTALLATION EXAMPLES



Hybrid wind-photovoltaic
street lamps with innovative
controller with remote
monitoring and cloud
management in **Canada**





INSTALLATION EXAMPLES



Wind street lights installed in **Turkey**
with connection to the network



INSTALLATION EXAMPLES



TURBINA 300W PROGETTO DIDATTICO
ISTITUTO TECNICO ARCHIMEDE DI CATANIA



300W turbine installed for educational didactic purposes at the **Archimedes Technical Institute of Catania**





INSTALLATION EXAMPLES



300W turbine installed at the **port of Ravenna** thanks to the European Powered project





INSTALLATION EXAMPLES



300W turbine installed at the **South Pole** for scientific research project





INSTALLATION EXAMPLES



300W turbine installed in **Augusta (Sicily)** on a completely off-grid marine buoy for sea water monitoring





INSTALLATION EXAMPLES



300W turbine installed at **Botel 2.0**
Porto Ceresio (Varese), reception
of future floating hotel structure
totally off grid.





DS700 MODEL: OFF-GRID INSTALLATIONS



Wind turbine DS700 is a 700W nominal power (1kW maximum power) vertical axis small wind turbine that combines in its structure a dual system consisting of Darrieus blades that guarantee high efficiency and Savonius blades, which enable the system to be activated with very low winds. This technology mix makes the Hi-VAWT turbine a highly innovative product: equipped with controllers capable of managing the maximum battery power and direct magnet drive generator. These turbines are built according to the IEC 61400-2 certification, a very important factor for small power generators. Very small dimensions, weighing only 60Kg, quietness, are the features that make this wind turbine the perfect solution for integration with residential photovoltaic systems with 48V battery storage technology.



The DS700 small wind generator suits perfectly on flat roof especially with container cases. The real advantage of the medium/big containerized solutions is that are easy to move and install and keep inside all the accessories needed in the hybrid installations.

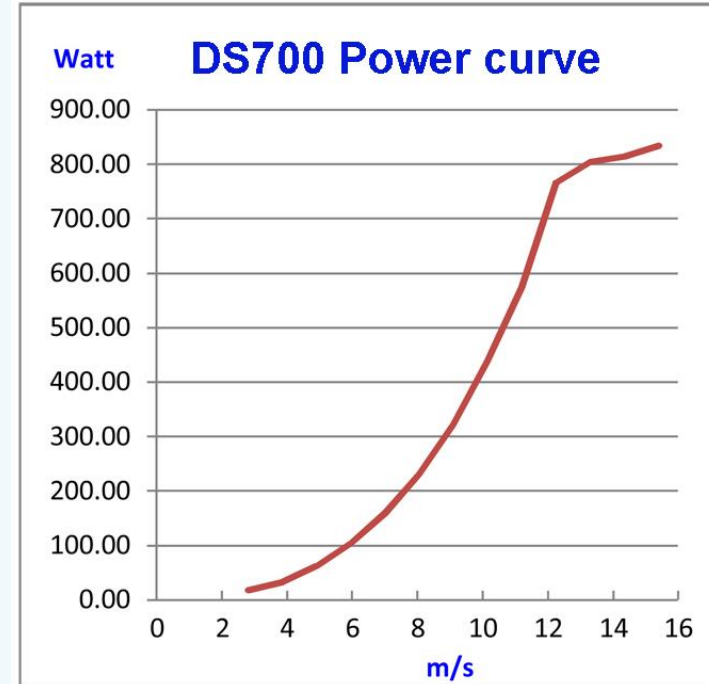




DS700 MODEL: OFF-GRID INSTALLATIONS



General Specification					
Rated Power	700w	Rated wind speed	12 m/s		
Rated rpm	405 rpm	Cut-in wind speed	<3m/s		
Cut-out	15m/s	Survivor wind speed	60m/s		
Wind turbine specification					
Rotor Diameter(A)	1.930m				
Total Height (B)	1.597m				
Tower Height (Option)	3 meter height minimum recommended				
Turbine Weight	60kg				
External Darrieus	3 blades				
Internal Savonius	2 layer				
Blades material	Anodized Aluminum				
Rotor Axis material	Anodized Aluminum				
Generator Specification					
Type	AC, 3phase, Synchronism PMG				
Rated power	1000W				





DS700 MODEL: OFF-GRID INSTALLATIONS



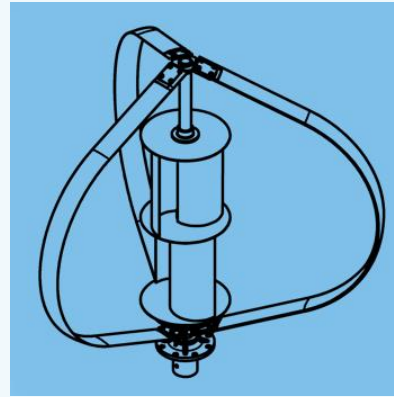
HYBRID CONTROLLER



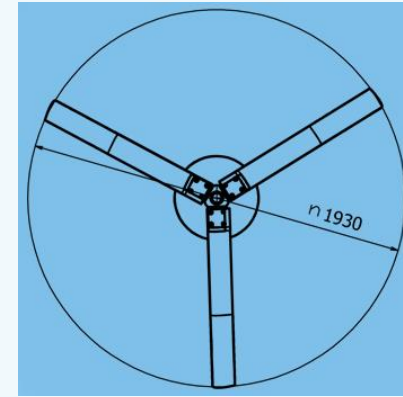
The hybrid controller is able to manage the wind source in total autonomy through the turbine MPPT curve management function.

The advanced technology allows an accurate control over all the generated values, the speed of the turbine, the output power, the accumulated energy capacity.

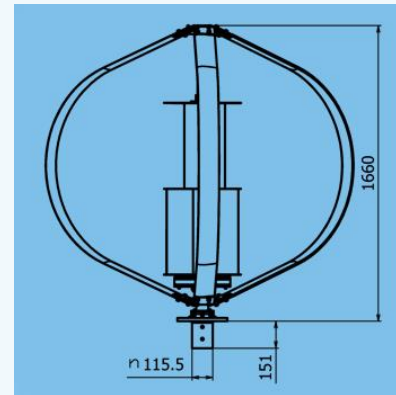
The product is also equipped with all the protections for short-circuit, overcurrent or voltage, manageable via proprietary software on a computer via RS485-USB.



60Kg WEIGHT



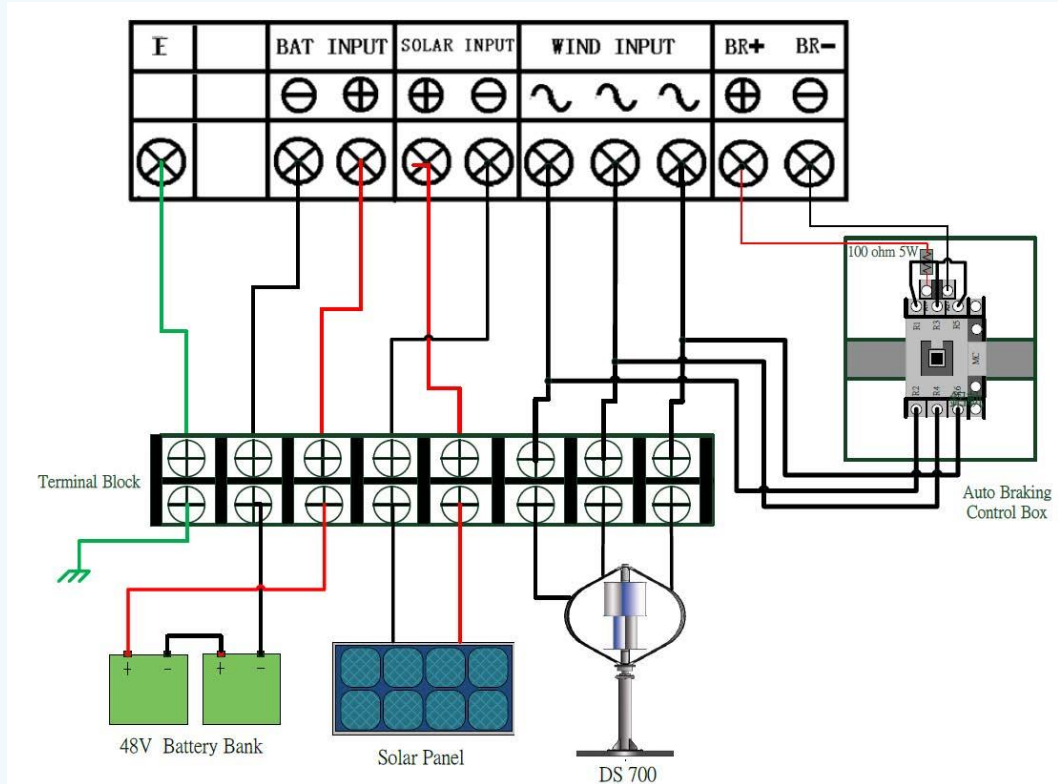
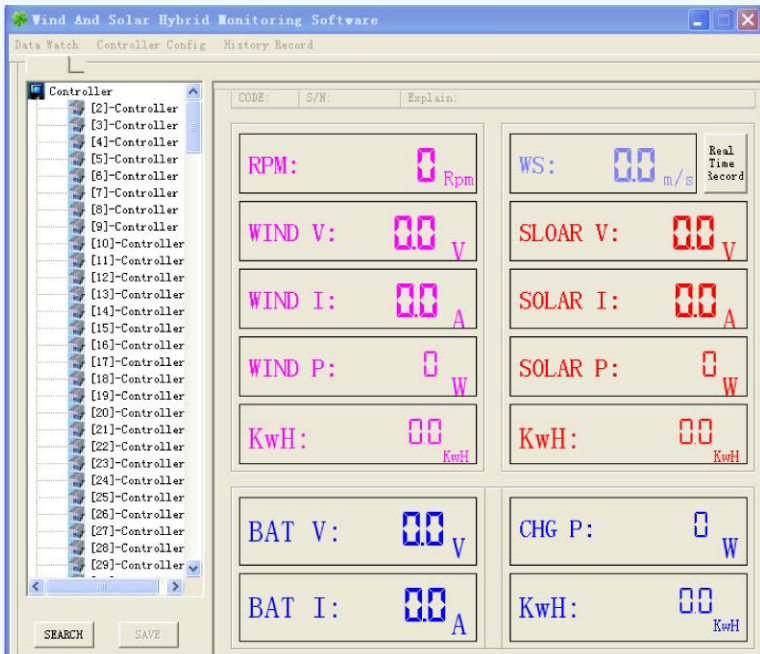
1,93m DIAMETER



1,59m HEIGHT



DS700 MODEL: OFF-GRID INSTALLATIONS





INSTALLATION EXAMPLES



Hybrid installation for **China Telecom**





INSTALLATION EXAMPLES



Hybrid installation on rooftop





INSTALLATION EXAMPLES



Wind installation on **Politecnico di Torino Energy Center**





DS3000 MODEL: ON-GRID INSTALLATIONS



The DS3000 turbine is a 3kW power vertical axis wind turbine, these turbines are built according to the IEC 61400-2 certification, a very important factor for small power generators. The size of the product perfectly reflects the technology of a vertical axis capable of generating 3000W of wind power at 12m/s, and cumulating from 20 to 40kWh per day with winds between 9 and 12m/s

The DS3000 small wind generator has been updated in the last two years with the following improvements:

- 2.1. **Mechanical drum brake:** before the turbine used a manually activated mechanical drum brake for turbine maintenance management. The drum brake has been designed with braking capacity greater than the torque generated by the rotor when the machine is at a standstill. The mechanical operation of the drum brake is not convenient for the user: if the turbine is installed in a rural area with a high tower, the manual mechanism to activate the mechanical drum brake is too high for access or in case of contraction it becomes too accessible which can be damaged by strangers.
- 2.2. **Rotor lock:** the rotor lock is designed to operate automatically always immediately after the activation of the short-circuit brake and the turbine is substantially stationary. The automatic system is set when the three-phase short-circuit brake is activated, 20 seconds later (it takes 15 seconds to stop the rotor), the rotor lock will be activated automatically. On the contrary, when the rotor should start working again, the rotor lock will go to the release position immediately before releasing the three-phase short-circuit brake. In addition to automatic operation, the manual switch for the activation of the short-circuit brake in the DS3000 design is present, but the rotor lock is designed to follow immediately after the short-circuiting of the brake.
- 2.3. **Tilt sensor:** the idea is that the vertical wind turbine can act similarly to a "spinning top" during its operating regime. It will therefore produce a small angle of inclination (θ) which varies according to the speed and the rotation time. This angle of inclination could contribute to an additional load (the moment) and interfere with safety (low cycle fatigue phenomena) when it reaches 10 degrees or more.



DS3000 MODEL: ON-GRID INSTALLATIONS



General Specifications

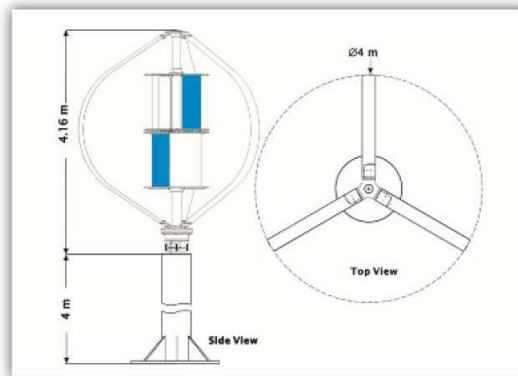
Rated Power	3kW	Rated Wind Speed	12 m/s
Rated Speed	230 rpm	Cut in Wind Speed	<3 m/s
Cut out Wind Speed	15 m/s	Survival Wind Speed	60 m/s

Dimensions/Weight

Rotor Diameter	4m
Rotor Height	4.2m
Tower Height	4 m (minimum)
Total Height	8.2m (minimum)
Turbine Weight	680kg w/o tower

Rotor Specifications

External Darrieus	3 blades
Internal Savonius	2 layers
Blades Material	Anodized aluminum
Axis Material	Galvanized steel SS400



Generator Specifications

Generator Type	AC, 3phase, Synchronism PMG
Rated Output	3kW

Braking System

Automatic	Automatic dump-load and 3-phase short circuit braking system
Manual	Mechanical drum brake

Operation Conditions

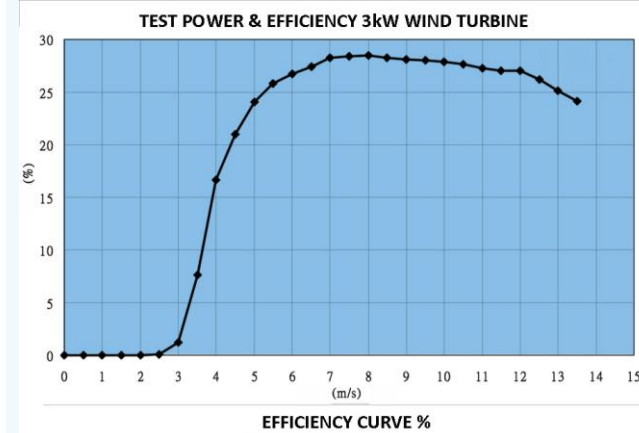
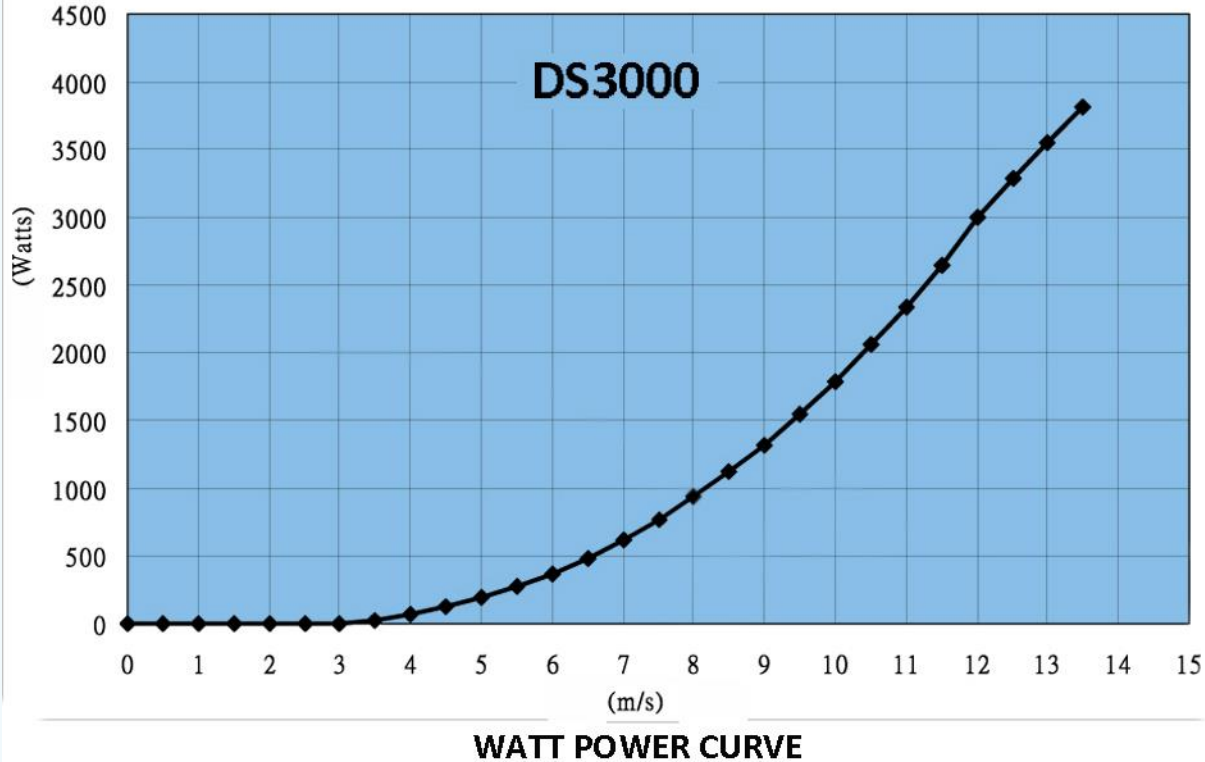
Ambient Temperature	-10~40°C
Ambient Humidity	95% max.



DS3000 MODEL: ON-GRID INSTALLATIONS

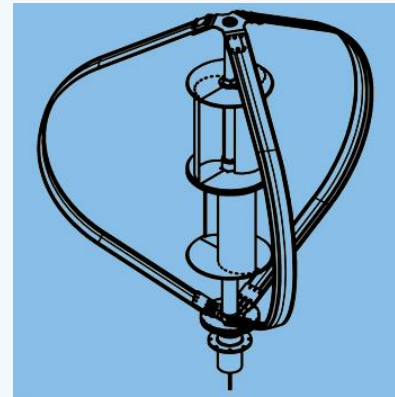
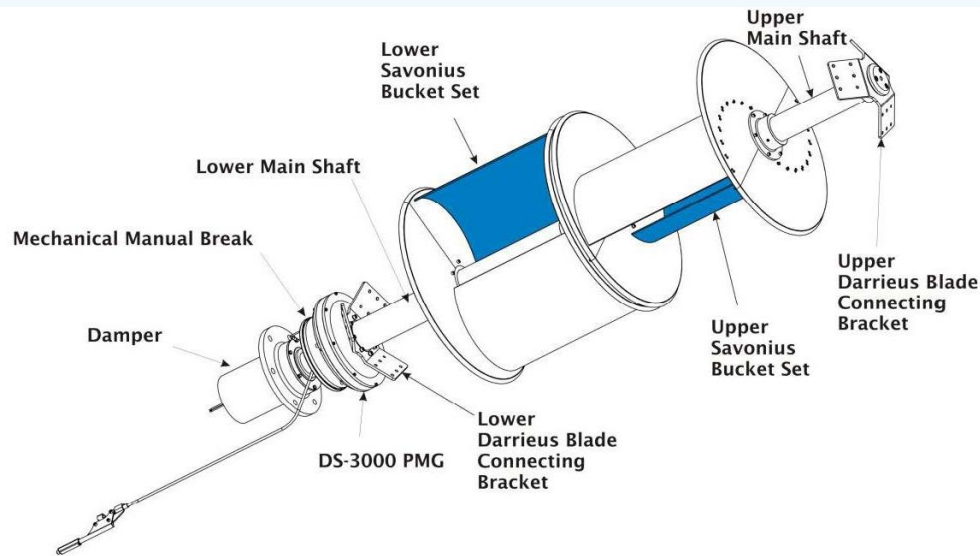


TEST POWER & EFFICIENCY 3kW WIND TURBINE

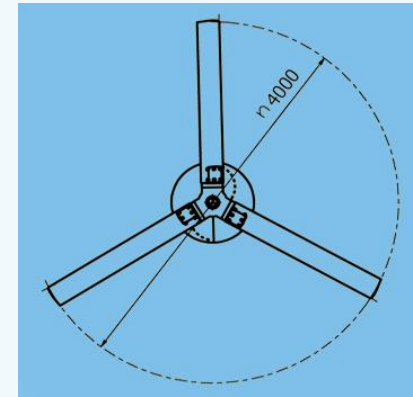




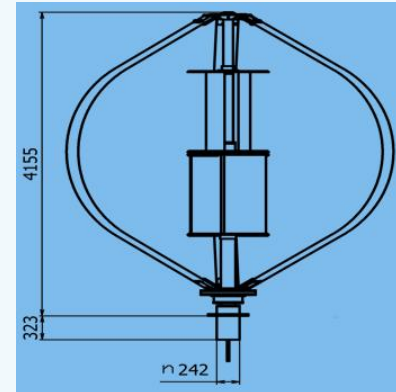
DS3000 MODEL: ON-GRID INSTALLATIONS



680Kg WEIGHT



4m DIAMETER



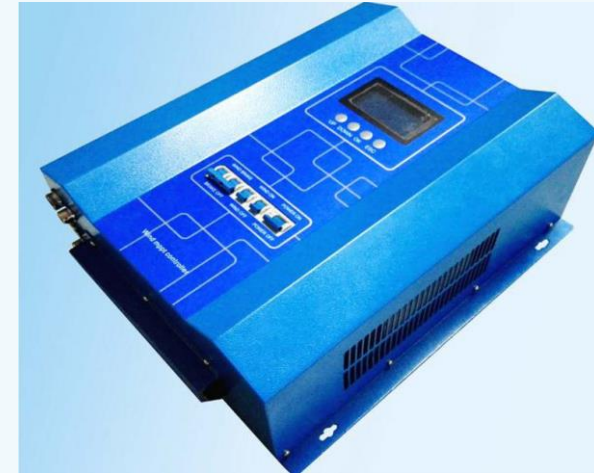
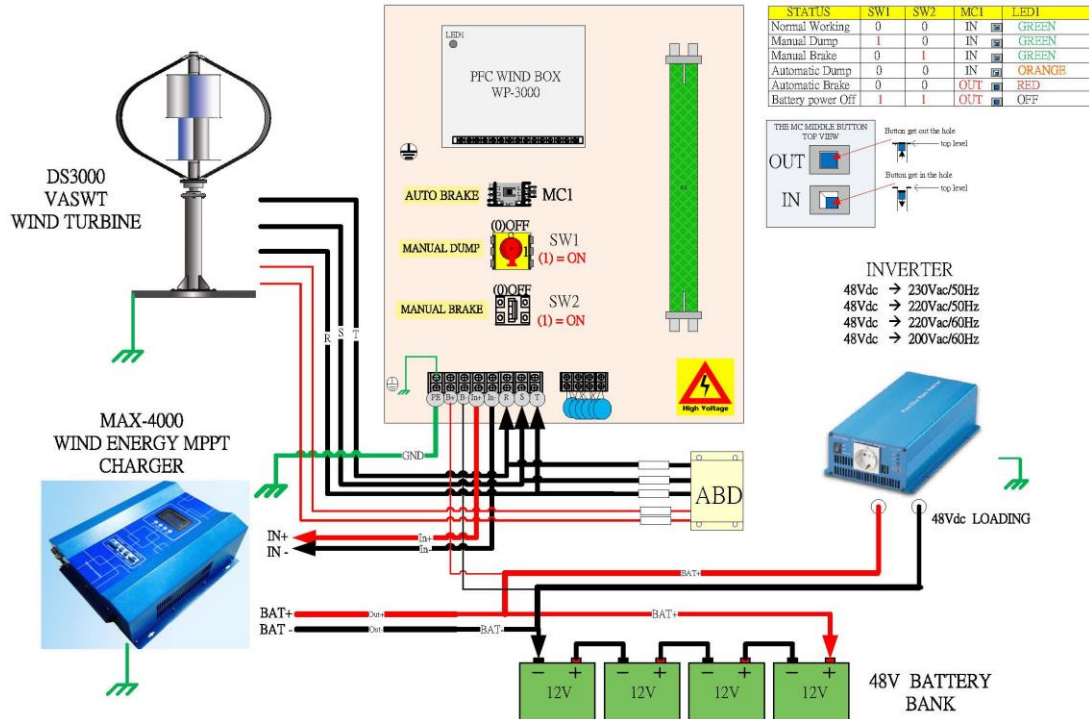
4,1m HEIGHT



DS3000 MODEL: OFF-GRID INSTALLATIONS



DS3000 OFF GRID SYSTEM WIRING



HYBRID CONTROLLER



INSTALLATION EXAMPLES



Installation in **Taiwan** made
by 432 turbines 3kW each,
total power of 1,2MW





INSTALLATION EXAMPLES



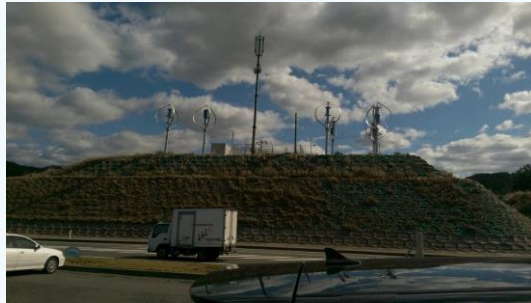
Installation in **Taiwan** made by 432 turbines
3kW each, total power of 1,2MW



PRODUCTION ANALISYS OF DS3000



Mini wind farm No. 1



1. Power generated real data:

Row 1 of 4 generators from 400 to 500kWh (n ° 1-4)

Row 2 of 2 generators from 200 to 300kWh (n ° 5-6)

The difference between the two rows is reasonable due to the turbulence created by the obstacle of the front turbines compared to the rear ones

2. Installation conditions:

The distance between the turbines is about 5-6m

The generators are installed on the top of the hill

The height of the posts is 4m

No.	1-1	1-2	1-3	1-4	1-5	1-6
(KWH)	469.6	156.5	490.5	506.1	279.2	242.4

2016-02-05



2135.4 kwh



469.6 kwh



156.5 kwh



490.5 kwh



506.1 kwh



279.2 kwh



242.4 kwh



PRODUCTION ANALISYS OF DS3000



Mini wind farm No. 2



1. Power generated real data:

About 1100 kWh

The production capacity of the individual turbines is almost identical

The total energy generated is twice that of the wind farm generators No. 1

2. Installation conditions:

The height of the posts is 7m

The distance between the turbines is about 5-6m

There is only one row of generators and it is placed facing the sea

The generators are installed on the top of the hill

No.	2-1	2-2	2-3	2-4	2-5	2-6
(KWH)	1101	1127	1091	1133	1051	761.1

2016-02-05



6237.2 kwh



1101 kwh



1127 kwh



1091 kwh



1133 kwh



1051 kwh



761.1 kwh



PRODUCTION ANALISYS OF DS3000



Mini wind farm No. 3



1. Power generated real data:

Production of 600-1100kWh for generators n° 1-4

Production of 250-400kWh for generators n° 5-6

2. Installation conditions:

The height of the posts is 4m

The distance between the turbines is only 5-6m

The generators n° 5 and 6 are placed behind the 1st row

The generators are installed on the top of the hill

No.	3-1	3-2	3-3	3-4	3-5	3-6
(KWH)	1077	1037	842.6	625.2	394.9	249.2

2016-02-05



4230.5 kWh



1077 kWh



1037 kWh



842.6 kWh



625.2 kWh



394.9 kWh



249.2 kWh



PRODUCTION ANALYSIS OF DS3000



CONCLUSIONS AND CONSIDERATIONS

Most of the 3kW turbines generated around 1100kWh in 30 days, except for those that suffered turbulence, with an estimated average wind speed of 4.4 and 4.6 m/s.

Surely the 4m high poles are less suitable as they suffer the negative effects of turbulence, the height of 7m confirms an optimized production. It is not confirmed but probable that the distance between the generators of only 5-6m has negatively influenced the yield, therefore we recommend a distance almost double.





INSTALLATION EXAMPLES



1st project in **Japan in Hokkaido** mini wind farm, private, with 3kW Turbines connected in the network





INSTALLATION EXAMPLES



Hybrid installations for **SKT Telecom Korea**



THANKS FOR THE ATTENCTION

49



Etneo Italia srl, via Giovanni Bovio n°6, 28100 Novara, Italy, phone: +39 0321.697200,
mail: alexdrappo@etneo.com - <http://www.etneo.com/en/hybrid-energy/>