MINIX TECHNOLOGY

Reduction device for induced drag and vortex

PROTOTYPES

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Called “MINIX” (minimum of “i” and “x”), this invention based on the dynamic of gaseous fluids and liquid, with specific design, is a breakdown innovation with 18 applications listed at this day. .

It is aimed principally to current environmental constraints by a significant reduction of fuel and CO2 in aeronautical and an increase of electrical production at 2 figures into wind turbines vertical, horizontal, onshore/offshore, this what permit compensate for the end of guaranty and maintenance problems, very expensive into this field. .

This technology is protected by patents into a lot of countries .

- Christian HUGUES is the inventor and the owner of the brand MINIX.
- 1998, biginning of the research with more of 28 prototypes tested at the EIFFEL wind tunnel.

  Many numerical simulation for MINIX1 and MINIX2 since 2006 until now and real tests aeronautical with MINIX2 in 2012.

- Breakdown innovation, that in origin, has been developed for the aerospace to reduce the induced drag and the vortex of the wings aircrafts.
- Real testing on aircraft with success.
- A dispositif that give wind turbines more efficiency.

Wingtip vortices (vortex)

= Drag (decrease speed)

MINIX APPLICATIONS

AIR

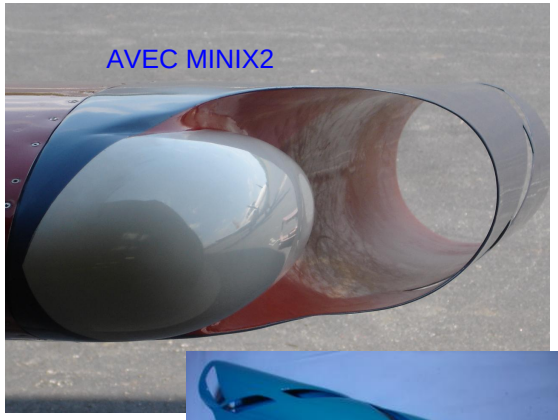
- · Aircrafts wings
- · Racers wings
- · Gliders wings
- · ULMs wings
- · UAVs wings
- · Helicopter blades

MER

- · Rudder blade
- · Stabilising wing of boats
- · Rotor Lipp wings
- · Submarines fins
- · Hydrofoils wings
- · Hydrofoils wings
- · Tide powers wings
- · Horne sails, etc

TERRE

- · Spoilers racers wings, F1
- · On-shore wind turbines blades
- · Off-shore wind turbines blades



Example of fixation MINIX carbon on aircraft wing

MINIX 2 – How it works ?

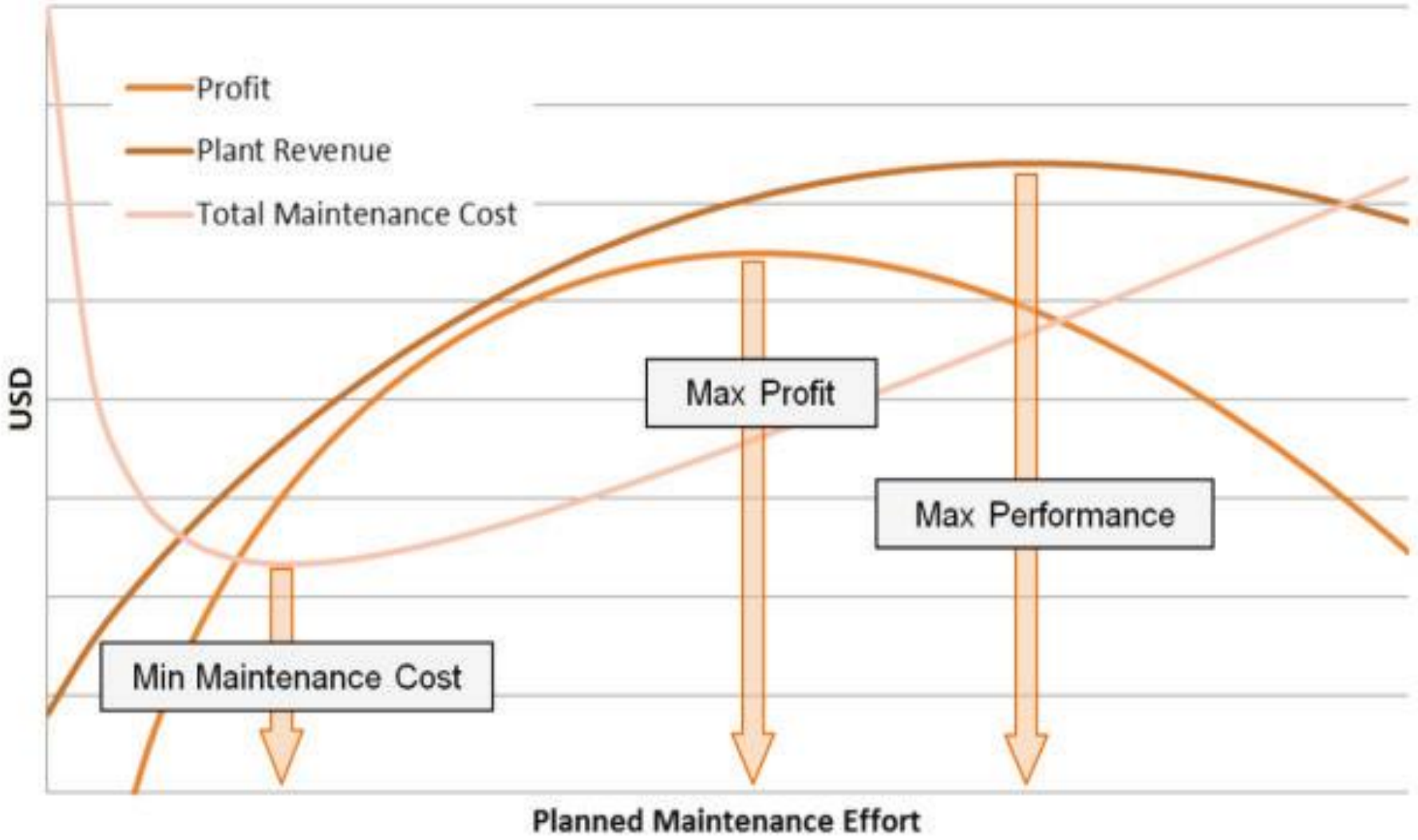
Prototypes MINIX carbon, tested on an aircraft to 360 km/h

- MINIX 2 is easily attached to each wing tip. Its design in goose cut with an excrescence in drop of water (white area) in the leading edge, allows it to recover the relative wind on all the incidences of conventional flight and rush it into the cylinder (red zone), this is the first "COANDA" effect.
- Above the wing this relative wind will accelerate on all the convex portion of the profile and cause depression..
- As under the wing, often flat, this relative wind will become high pressure.
- As nature abhors a vacuum, the high pressure flow wants to get to the low pressure flow, but a part of it will be deflected, **second effect «COANDA»** (white area), and add it at the first frontal effect «COANDA» before to rush it inwardly of the cylinder (red zone).
- On entering the cylinder, these two flows that add, become low pressure and suck the high pressure flow that wraps around the cylinder (blue area) with a helical slot 180° .
- Everything is blown at the end of the cylinder, resulting in a third "COANDA" effect of the wing trailing edge a part of the mini vortex wake.
- Since 2012 it is possible to make molds and prototypes of all sizes with a CAD.

THE WIND TURBINE

CURRENTLY

Profit Maximising Maintenance



• INSURANCE OF WIND TURBINES

- The wind industry currently focuses on the blades of wind turbine onshore and offshore and the damage only on the blades account for 41.4% of the reported insurance claims, either an average of € 177,662 per claim.
- The percentage of claims represents:
- 1/ Poor maintenance for 24.5%, 2 / Lightning for 23.4%, 3 / design flaws for 11.5%. 4 / the Wear for 9.3%. 5 / mechanical defects for 6.2%.

• WARRANTY MANUFACTURER WIND TURBINE

- The manufacturer warranty (which generally runs from 2 to 5 years at the start of operation of the wind farm), do not necessarily cover all the points, regular visits by the manufacturer, replacement of parts which abnormal wear will have been detected
- The warranty on the external breakage covers the replacement of parts whose wear is abnormal in relation to the time during which a wind turbine should work.

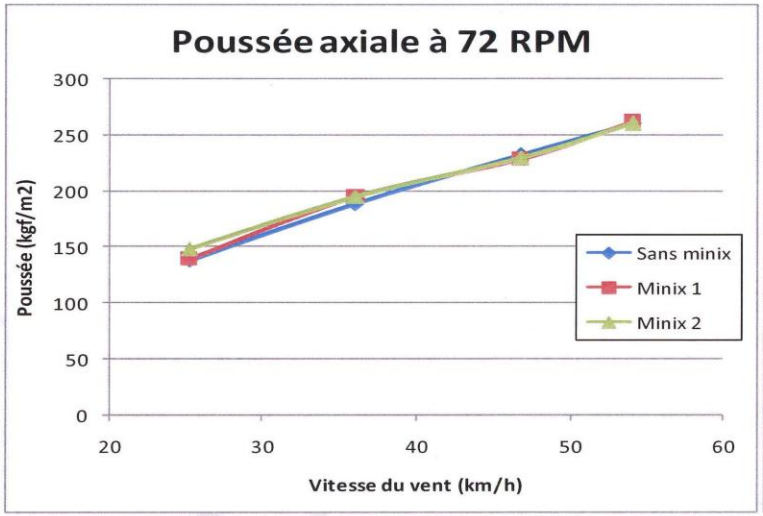
- **WIND TURBINES IN THE USA**
- **END OF WARRANTY 2013 AND FORECAST 2014**

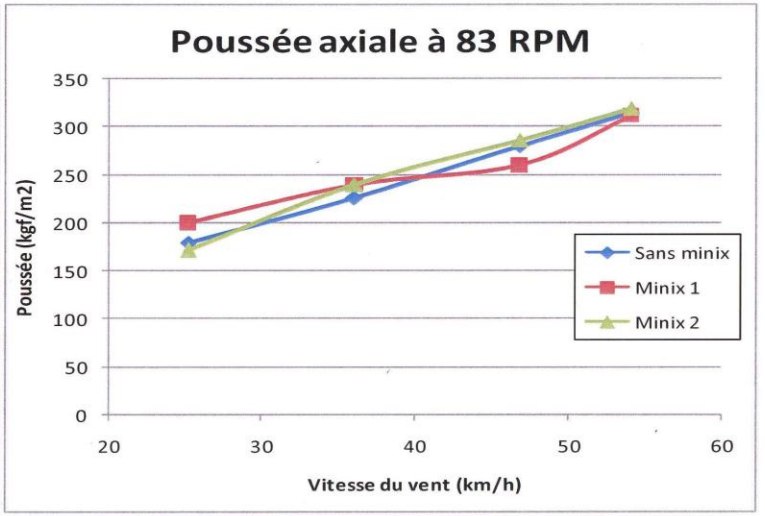
- - More than $ 40 billion in wind turbines value, aren't guaranteed since 2013, placing the assets managers and O & M directors under pressure to develop a financial strategy and of design O & M end of warranty. The 5th annual summit of wind turbines O & M (9-10 April 2013, Dallas) is returned with a program exclusively for owners of wind turbines, / asset operators who lose their warranty period. Essential summit for the asset managers seeking to develop a strategy after the warranty, maximize efficiency and reduce operating costs.
- - The United States have the largest amount of wind energy used over 29 GW of which 8.4GW are provided by the Texas. The location in Dallas is at the heart of the capital of wind energy and attracts the participation of all major industries in this area that you may encounter.
- - In 2025, the potential market size 0 & M (Operation and Maintenance) is estimated at about $ 6 billion per year - since 2009 the WEU (wind energy sector - Wind Energy Unit) represented operators who collectively invested over $ 65 billion dollars of spending on O & M.
- - In 2025, the installed capacity of wind turbines is estimated at 131 508 GW, representing a growth of 279% - The O & M top represente 75% of the operator's market, this is the time to build relationships and share lessons learned.
- - 73% of U.S. wind turbines farms reach the end of their warranty period in the next 3 years.

RESEARCHES

OF WIND TURBINES GAINS WITH MINIX

Poussée axiale

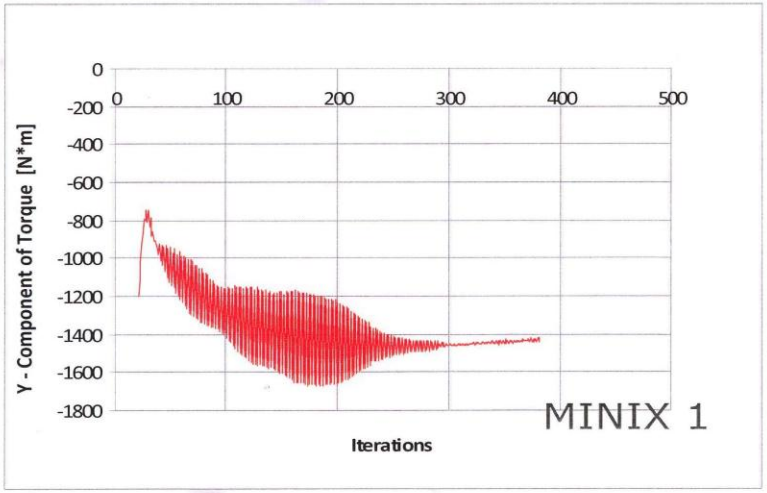


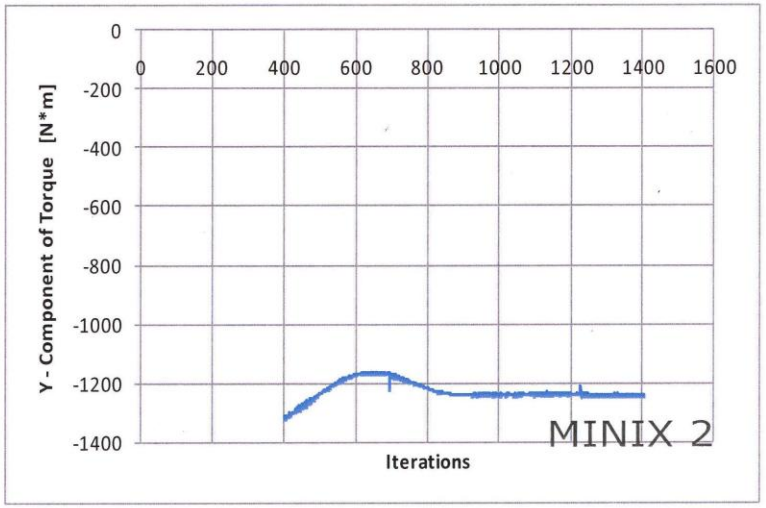


- On constate que le MINIX ne modifie pas significativement la valeur de la poussée axiale sur l'éolienne.

Fluctuations des puissances

- Avec le MINIX 1, nous avions observé des fluctuations de la puissance traduisant un comportement instable de l'éolienne
- Avec le Minix 2, ces fluctuations sont réduites à moins de 1% de la valeur de la puissance

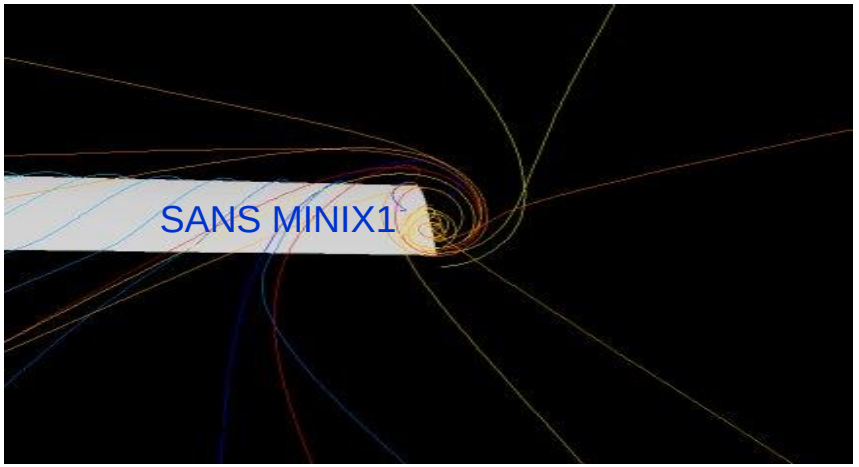


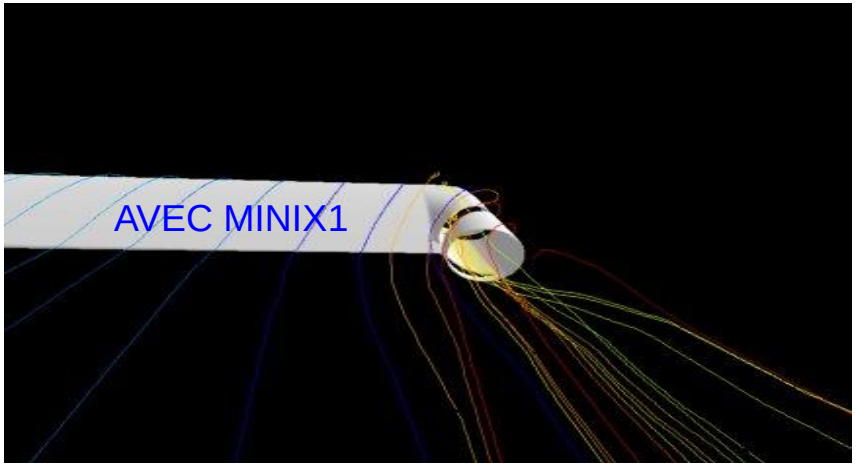


Minix©®

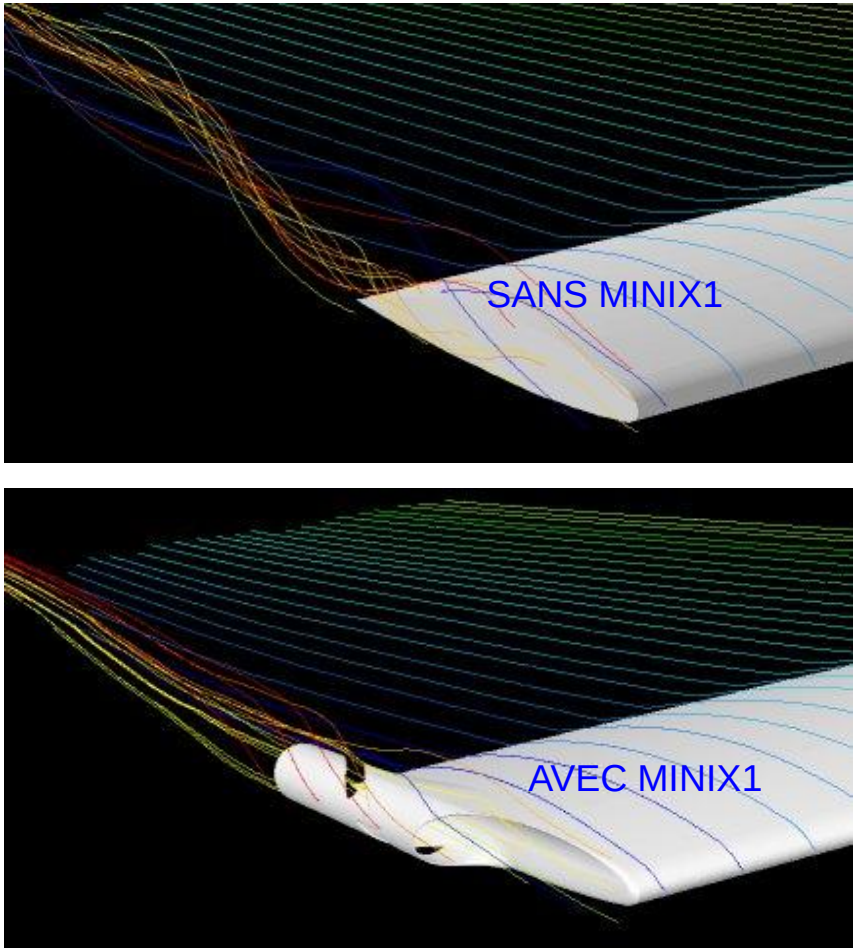
Dispositif de réduction de vortex et de traînée induite

- MINIX 2 outperforms MINIX 1 and significantly reduces the fluctuation of power of a wind turbine blade.
- Current numerical simulations give a result 14% of additional production of electrical energy annual average with an MINIX2.
- This is a method to increase the profitability of the energy output of a wind turbine.
- An alternative to reduce mechanical wear.

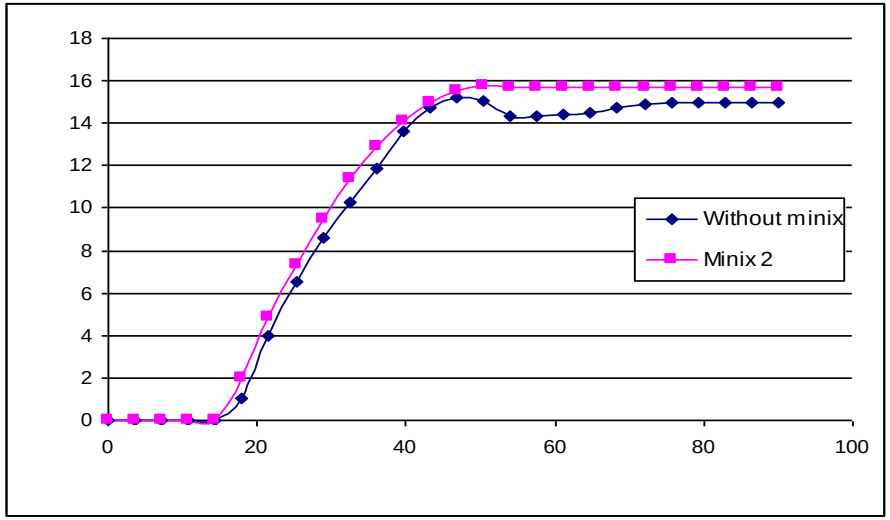




- Capable of reducing the noises and the vibrations on tower (mechanical and environmental impact).
- Can increase the efficiency per square meter for wind farms.
- The wind turbine starts earlier with a lower wind speed.



Test: Wing turbine result Minix 2



Power/Speed

RESULTS			
Calculated production of electricity	Without Minix	Minix 2	
Average power output	3,5	4,0	kW
Daily production	84,9	96,9	kW.h
Monthly production	2 582	2 948	kW.h
Annual production	30 987	35 379	kW.h
Gain		14%	

Start speed	5	m/s
Cut out speed	25	m/s

Wind turbine power curve

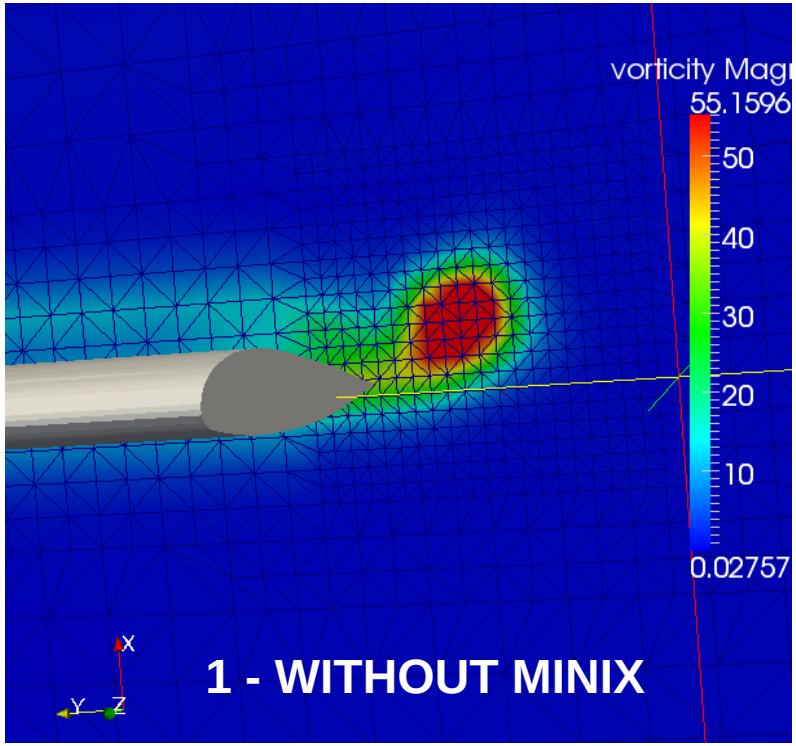
Wind Turbine Power Curve :

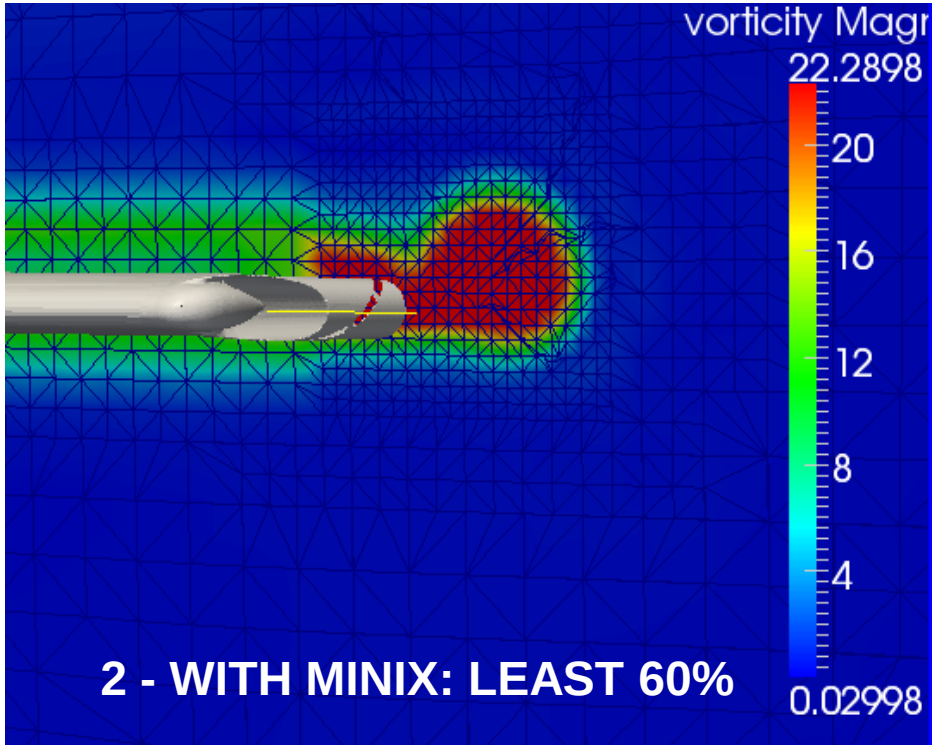
Speed m/s	Speed km/h	Power		Production	
		Without minix	Minix 2	Without minix	Minix 2
0	0	0	0	0	0
1	3,6	0	0	0	0
2	7,2	0	0	0	0
3	10,8	0	0	0	0
4	14,4	0	0	0	0
5	18	1	1,9855	0,139	0,275
6	21,6	4	4,8216	0,491	0,591
7	25,2	6,5	7,3309	0,648	0,731
8	28,8	8,6	9,5134	0,646	0,715
9	32,4	10,3	11,3691	0,543	0,599
10	36	11,9	12,898	0,411	0,446
11	39,6	13,62	14,1001	0,289	0,299
12	43,2	14,72	14,9754	0,180	0,183
13	46,8	15,2	15,5239	0,100	0,103
14	50,4	15,06	15,7456	0,051	0,053
15	54	14,3	15,7	0,023	0,025
16	57,6	14,3	15,7	0,010	0,011
17	61,2	14,4	15,7	0,004	0,005
18	64,8	14,5	15,7	0,002	0,002
19	68,4	14,7	15,7	0,001	0,001
20	72	14,9	15,7	0,000	0,000
21	75,6	15	15,7	0,000	0,000
22	79,2	15	15,7	0,000	0,000
23	82,8	15	15,7	0,000	0,000
24	86,4	15	15,7	0,000	0,000
25	90	15	15,7	0,000	0,000

Rédaction		
Alain FRYDMAN	TECHNI PROCESS	visa

ESI GROUP SIMULATIONS

HELICAL FLOW VELOCITY



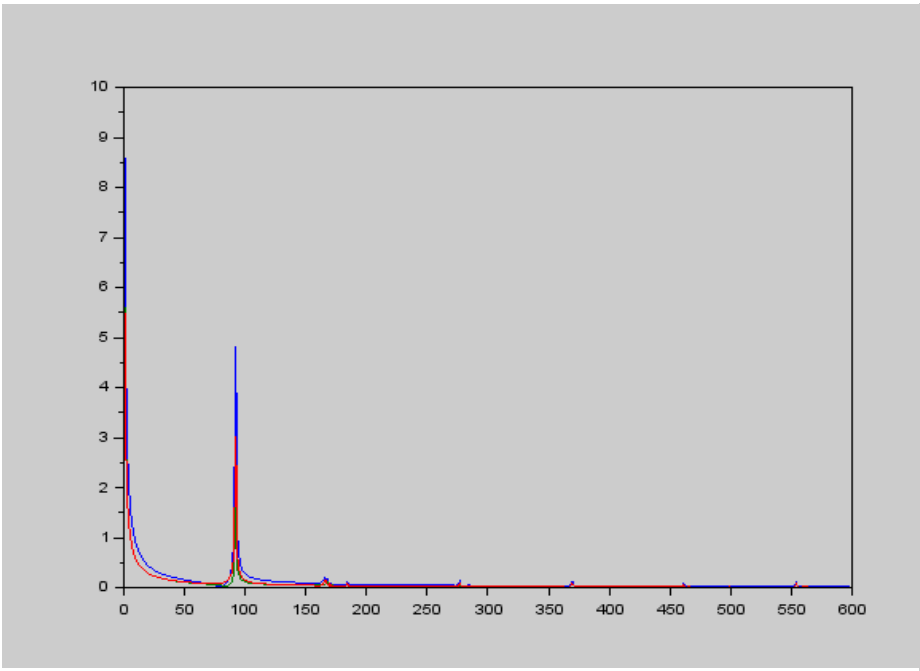


These two images with and without Minix show a obtained flow around a wing creating a depression zone above the wing and a over-pressure zone below it. These two contrary pressures show a wake turbulence and a vorticity at the tip, behind the wing.
In the first figure without Minix we can observe the concentration of vortex reaching a speed greater than 55m / s-
In the second figure with Minix the wing tip shows a exhaust more surface that explains a relaxing of vorticity and a velocity of 22m /s, meaning 60%less . This helical flow velocity reduction always corresponds to a noise reduction.

ESI GROUP SIMULATIONS

ACOUSTIC SOURCE WITHOUT and WITH MINIX

ACOUSTIC SOURCE WITHOUT MINIX = → 4.9



ACOUSTIC SOURCE WITH MINIX = 2 → LEAST 57%

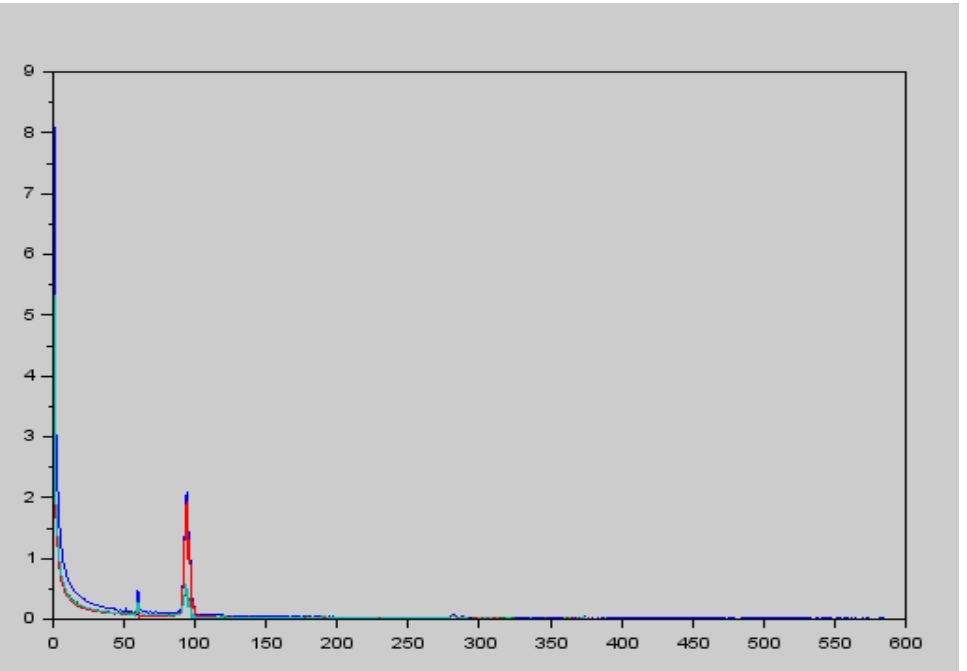
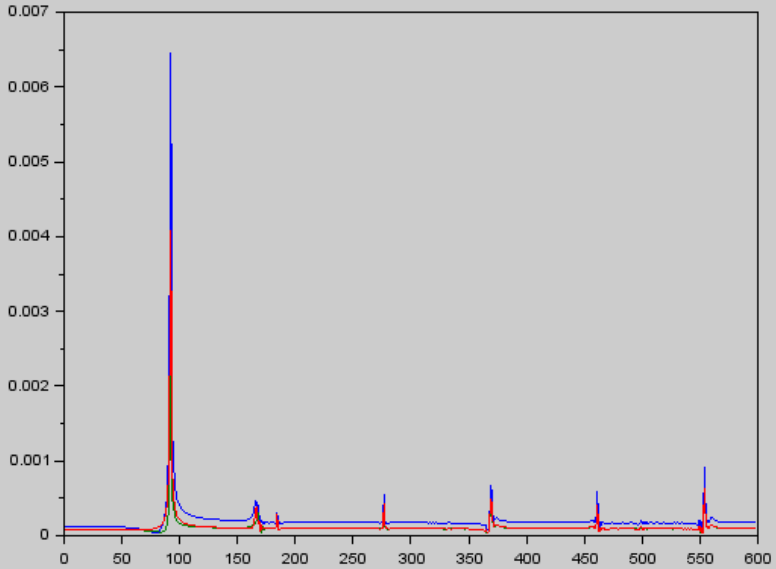


Figure 20: sound spectra at source without Minix (left) and with Minix (right) (ordinate in Pa and abscissa in Hz) Directly from sound spectras at the source we see that Minix allows a strong reduction of noise . Indeed radiated noise depends on the intensity of the force on the surface, or the noise peak (at 50 Hz) visible on the two spectra with and without Minix is halved on the spectrum of the simulation with Minix

ESI GROUP SIMULATIONS

RADIATED PRESSURE WITHOUT AND WITH MINIX

RADIATED PRESSURE WITHOUT MINIX = → 0.0065



RADIATED PRESSURE WITH MINIX = 0.0029 → LEAST 55%

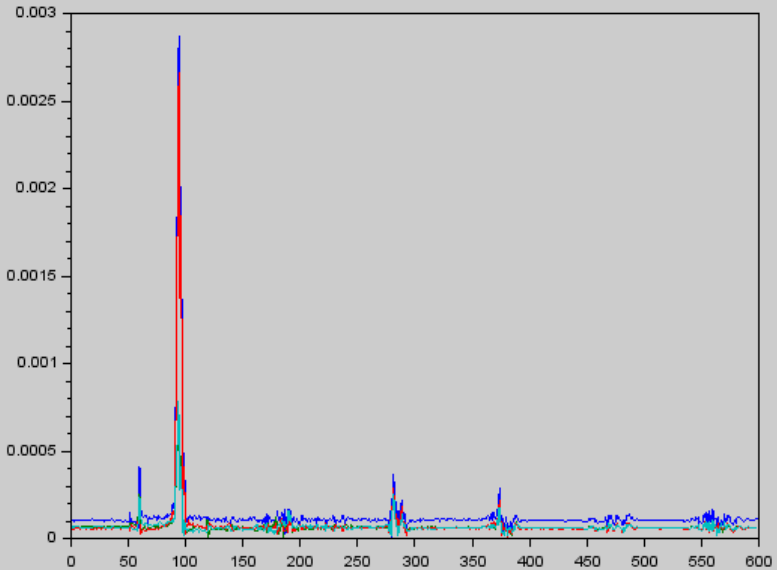


Figure 21: sound spectra at the clew (ordered in Pa and abcissa in-Hz)
The first visible results on the spectra at source is confirmed when the spread at the clew performed. The simulation shows Minix with a halving of the intensity of the peaks relative to the simulation without Minix.

• FIXING OF MINIX ON WIND TURBINE BLADES

BLADE OF HORIZONTALE WIND TURBINE

The fixing of MINIX on the blades of horizontale wind turbines is quite simple, on the large wind turbines of course, it is simply necessary to be equipped with a cradle to be able to work in good conditions.

Shut the blade down by a rope fixed at ground,

Place above the blade tip, a jig "bell" whose rim, will determine the distance of cut from the tip,,

Draw the section around the blade tip, to respect the same weight,/ centrifugal force, of all the blades of the wind turbine,

Cut the blade tip (it should be noted that the section is done before the arrester),

Position the water discharger toward the trailing edge,

Fixing the MINIX with resin or with an adequate glue for long term bad weather.

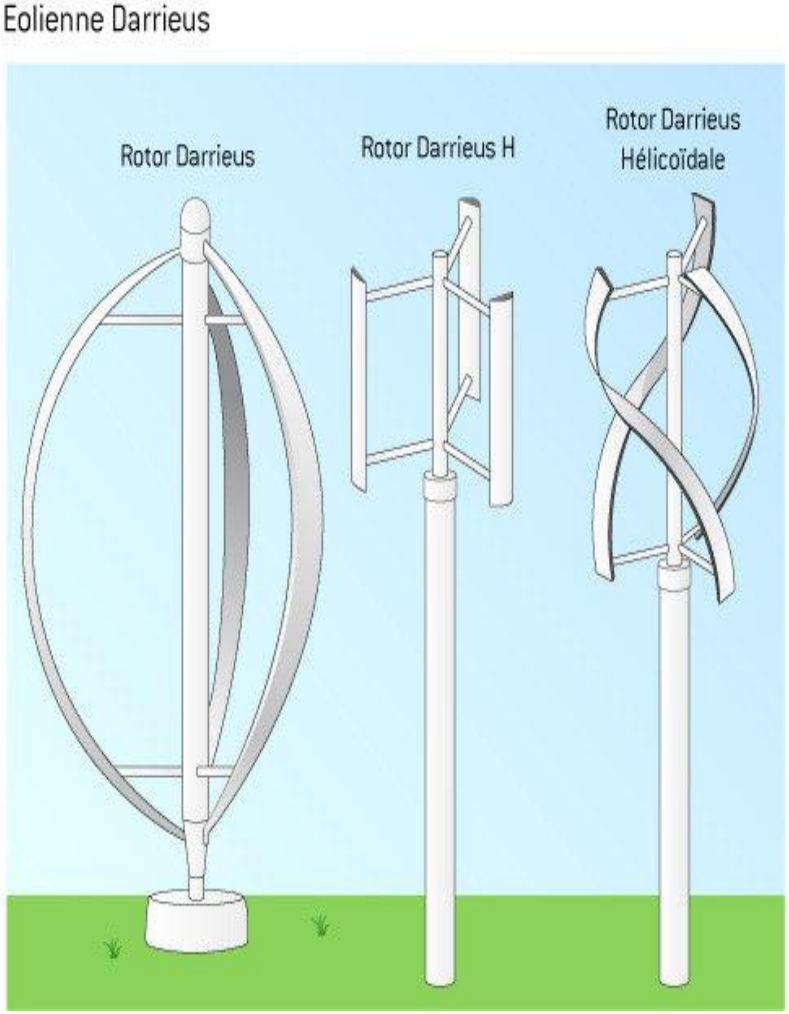
BLADE OF VERTICAL WIND TURBINE

The most common vertical wind turbines are those with the Savonius and Darrieus rotors.

MINIX only work on wind turbine kind **Darrieus H** and **helical Darrieus** (see following)

On wind turbines Darrieus-H and helical Darrieus, each blades tip will be equipped of MINIX (6 instead of 3

On these wind turbines there is no specific preparation, the MINIX is sticked or fixed over the blade tip..



CONCLUSIONS

Who is affected by this technology ?

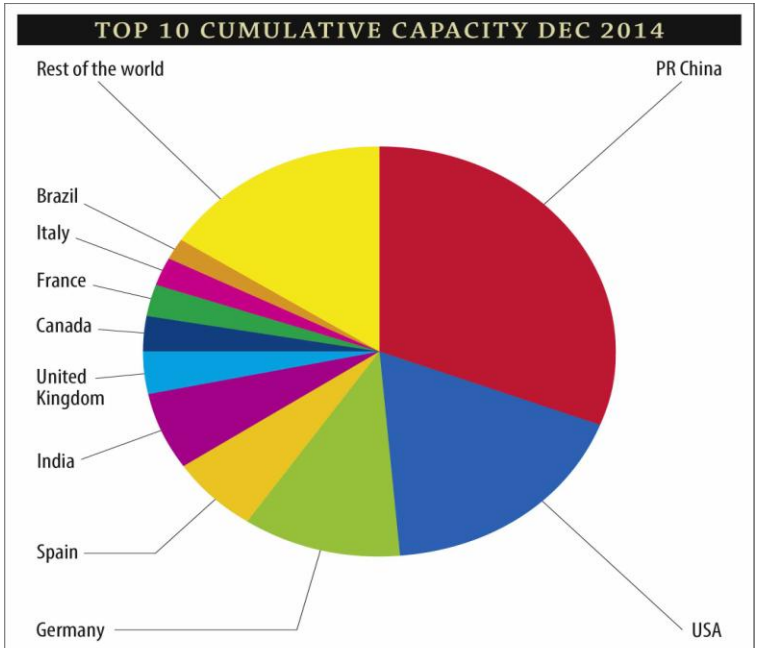
- Operators and users of wind power (on-shore and off-shore vertical and horizontal),
- The wind turbine manufacturers confronted to growing demand,
- Wind farm project managers to obtain a competitive edge,
- Wind turbine engineers and designers,
- Government authorities confronted to a renewable energy targets,
- Technology strategy advisors in renewable energy sector,
- Financial backers and investment companies looking for quicker return on investment.

- The MINIX device is compact, lightweight and rigid and easily manufactured.

- Easily fitted by gluing or others technical in accord with the wind turbine.

- Adapted and put in retrofit for all profiles of blade tip, on site.

- Renewable energy is doing a good giant with massive investment over the planet.
- Obligations of Governments to achieve CO2 reduction targets and setting up of wind turbines.
- The current demand exceeds the manufacturing capacity.
- Observation of the danger of nuclear energy, and of the fossil fuel emissions, which amounted to nearly 40 billion tons of CO2 in 2014.



Country	MW	% SHARE
PR China*	114,763	31.0
USA	65,879	17.8
Germany	39,165	10.6
Spain	22,987	6.2
India	22,465	6.1
United Kingdom	12,440	3.4
Canada	9,694	2.6
France	9,285	2.5
Italy	8,663	2.3
Brazil**	5,939	1.6
Rest of the world	58,275	15.8
Total TOP 10	**311,279**	**84.2**
World Total	**369,553**	**100**

Source: GWEC

ADVANTAGES of MINIX 2

MINIX 2 operates on aircraft wings with a reduction of 6% fuel and 3 times less C02,
MINIX 2 operates on wind turbine blades with an additional gain of 14% of electrical energy,
MINIX 2 gets a big decrease in the curve of power fluctuations,
MINIX 2 does not change the axial thrust and therefore does not alter the mechanical dimensions of the mast and anchors on the wind turbine,
MINIX 2 reduced by 60% the speed of the vortex, by 57% the acoustic to the source and reduces by 55% the faraway radiated noise.

These gains are reflected in:

- A blade manufacturing the material economy (greater lift and finesse with less elongation)
- A MINIX installation can be done directly in the manufacture of the blade or "retrofit" on site,
- A start with lower wind
- A decrease in the vortex noise and noise impact of all onshore and offshore wind load.
- A constant efficiency all year in proportion to the gain generated.

Gains on long-term wear: the blade tip vortex is responsible for many problems such as noise, wear blades, wear of bearings, caused by vibrations.

Unprecedented gains on noise ensuring a better life in the vicinity of onshore wind turbines and in the world of cetaceans for the offshore.

A very quick return on investment: these additional gains allow owners to address the expired warranty issues, minimize mechanical wear, to negotiate insurance rates, reduce maintenance frequency and invest in new wind turbines or increase the area of their farm.

CONTACT

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