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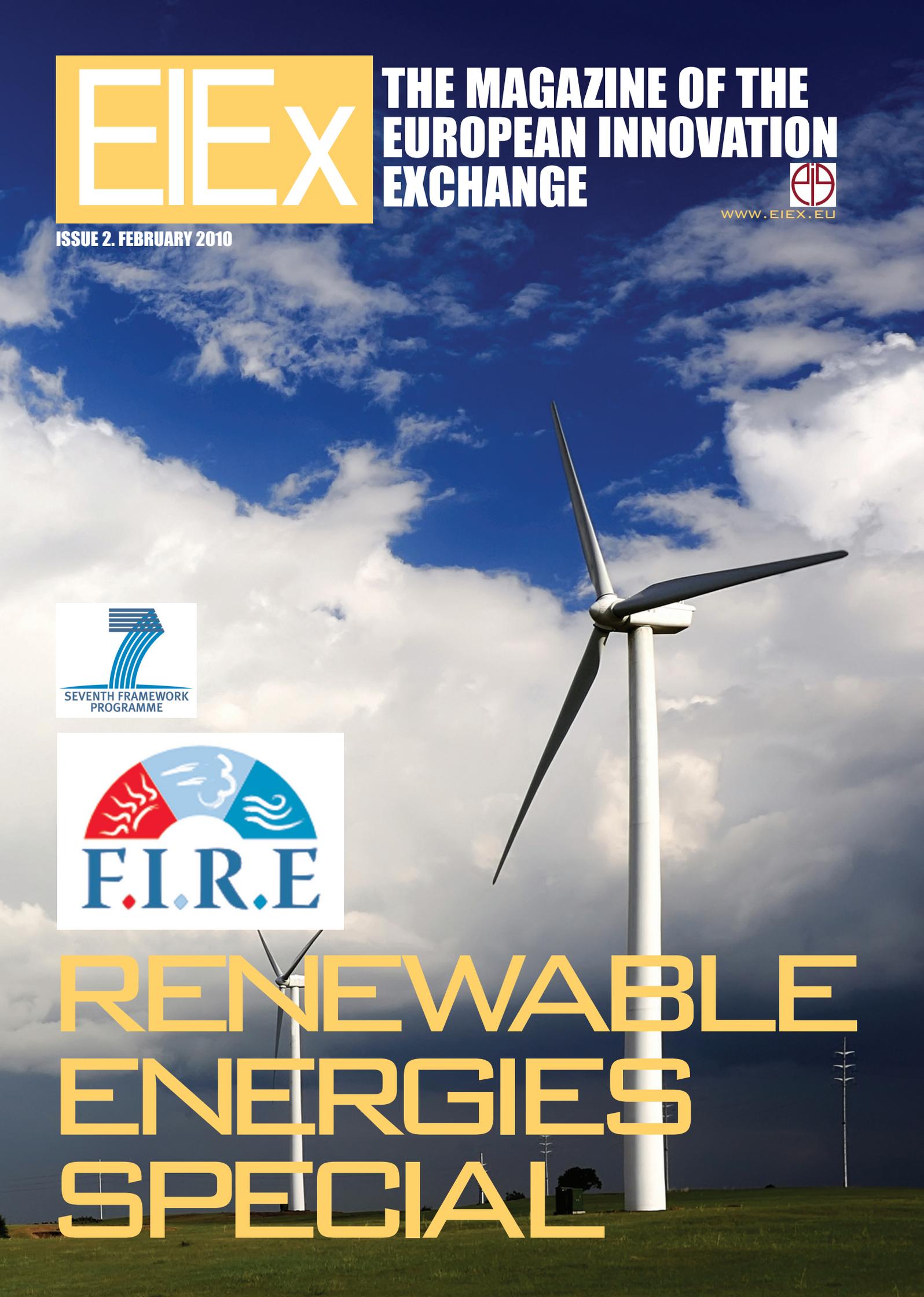


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RENEWABLE ENERGIES SPECIAL



Flying at the tip of success



Christian Hugues, French pilot, aeronautical teacher and inventor of MINIX drag reducer, talks to EIE

EIE: What is MINIX?

CH: MINIX, which stands for 'minimisation of i – induction and x – drag' is a device for reducing induced drag and vortex on wing or blade tips, consequently making them more efficient. MINIX technology can be applied to nearly all subsonic aircraft wing tips as well as UAVs, rudder and wind turbine blades, even hydroplanes, hydrofoils and the fins on submarines and Formula 1 cars.

EIE: Where does your story begin?

CH: Being an aeronautics teacher in Ile de France, a Paris suburb, I'd very often heard my pupils asking "why do we have planes that perform well in every domain without having found a solution to the major problem ... the induced drag, provoking the vortex?"

It was difficult to reply to this question, knowing that more than 400 patents on this topic already existed, unless I did the research myself! I was persuaded that we could decrease, or even remove this drag in the same way it was created, ie the pressures themselves. So, in 1998 I decided to test my idea. I made a 10 cm diameter cardboard cylinder, shaped at the tip like a

goose feather, 50 cm long with a spiral slit, all rigid with a composite layer, and fixed it to the end of a one meter long wing. To test it, I needed a wind tunnel, but the prices were too high. I did have a small open-top Fiat Fura though, so I fixed the whole prototype on my car, and added many strands of red wool to give me the flow direction. One July morning, at 4am when no one was around, I drove on the motorway at 100 km/hour. It was a good day, the weather was great, and all my pieces of red wool were behaving quite well! For an outside wind tunnel, it was a bit crude, but I reached my objectives and it worked!

EIE: How did you develop your idea?

CH: Over the next three years, dozens of prototypes were tested at the Eiffel wind tunnel in Paris and by the 22nd prototype, the vortex had nearly disappeared. I carried out tests (see results on www.minix.fr) and exhibited MINIX at the Paris Air Show in 2003. From 2003 to 2006, I carried out further tests with carbon-made MINIX prototypes on light planes, and at the Aberdeen Exhibition in 2007 started to get interest from experts from the wind turbine and water turbine industries and Formula 1. In 2008 research was carried out on the effects of MINIX on wind turbines and in 2009, I attended exhibitions in Paris, Aberdeen, Paris Air Show le Bourget, Green Luxembourg summit and last Eurocontrol in Brussels.

EIE: Where did you find the money to develop MINIX?

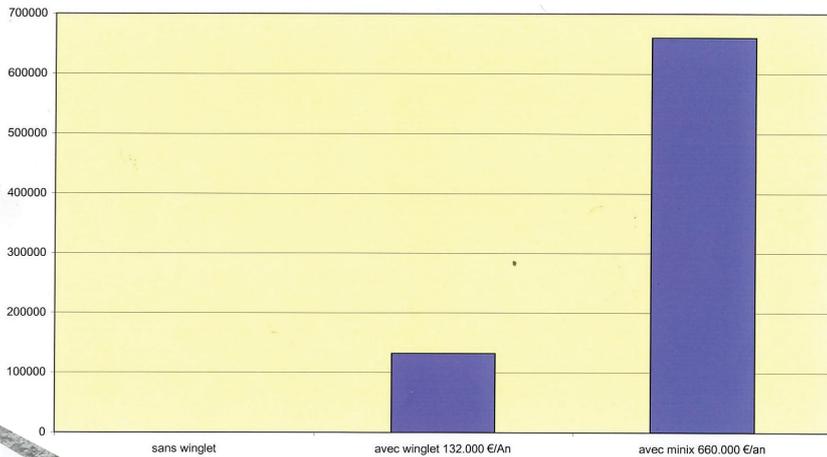
CH: From my own pocket! From the moment I saw the first results, I decided to go on with this adventure! And what an adventure! My life has been a little bit different with all this research – and it cost me a beautiful house near Paris to pay for all those days at the wind tunnel, the computer simulations and live tests. I funded 75 per cent of the costs and the rest was covered by national financial support and grants.

**MINIX Next Generation
Mach 0.8**



"I fixed the whole prototype on my car"

Estimated fuel savings for an Airbus A340 at Mach 0.8 (€/year)



EIEx: Can you say a little more about the device?

CH: MINIX takes the form of a cylindrical spiral cavity incorporating a helicoidal slot making it possible to reduce induced drag and marginal swirl (vortex) and increase wing or blade lift/drag ratio. Integrated with, or coupled to a wingtip, it can be adapted for all airfoils where lift or direction is used in triple axis (vertical, horizontal, and yaw) displacement. It can also be used in a reverse configuration (under surface/ upper surface) on high speed land vehicles or racing cars, and when secured to the tip of the wing, produces a result inversely proportional to speed. The faster the vehicle is travelling, the less drag it generates and the greater its ground adhesion.

EIEx: So, how can MINIX contribute towards a sustainable future?

CH: Aircraft wings generate about 33 per cent of the drag, the rest being caused by the fuselage, tail, etc. Minix technology, even in its early days has been seen to make a 6 per cent improvement in overall efficiency at Mach 0.8, the speed commonly used by aircraft. It's easy to see its potential for energy saving just considering the estimated 2.5 billion passengers planning to fly in 2010... that's a lot of CO2! MINIX can be easily attached to the top of a wing with very competitive retrofitting or new-build costs. The return on investment is clear – even a small percentage reduction in fuel

Benefits of MINIX on wind turbines

- Increases annual electrical output by 14%
- Can be retrofitted
- Adapts to all profiles
- Adapts to vertical wind turbines
- Fewer vibrations on the pylon
- Less mechanical wear
- Less vortex equals less noise
- Increases return per square meter
- Beneficial to onshore and offshore wind turbines

Benefits of MINIX on aircraft

- Fuel savings of 6%
- Increased range of 6%
- Net reduction of CO2 each trip
- Can be retrofitted
- Quick and lightweight
- adapts to all profiles
- Net increase in lift
- Reduction of the vortex and induced drag
- Less mechanical fatigue on three axis
- Implications for command twisted wings.

consumption equates to huge savings in a climate of rising fuel prices and new carbon taxation programmes, and the increased safety it brings is a bonus.

EIEx: Ok so that covers aircraft, can this be applied to other sectors?

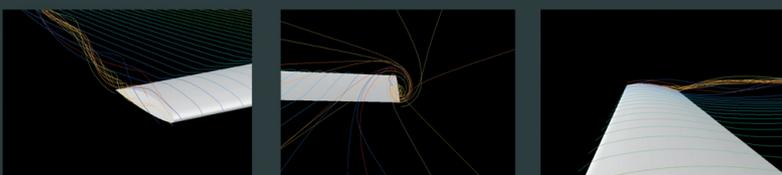
CH: Yes, if we take a look at MINIX in the field of renewable energies, eg wind turbines, where there are only blades, its potential becomes even more impressive. With the capability to increase the annual electrical energy output from a wind turbine by 14 per cent, it has rightly been described as a 'game-changer'. MINIX has the added advantage here, of operating without suffering the injury caused by different types of drag as on aircraft. MINIX can be adapted to fit the tips of wind turbine blades, either from the conceptual stage of design – adding value to new blade technology, or in retrofit – improving the efficiency of existing installations. Other additional benefits include reduced risk of damage and longer in-life service, extending significantly the five-year manufacturer's guarantee towards a potential 30-year operational life cycle.

The application of MINIX to the Wind energy sector presents many opportunities, not least to countries tasked with achieving a fixed percentage of wind power by 2020. The UK, for example has the target of achieving 15 per cent of energy from Renewables by 2020 which represents a seven-fold increase in its renewable energy consumption from 2008 levels. ■

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Contact:
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Without Minix



With Minix

