

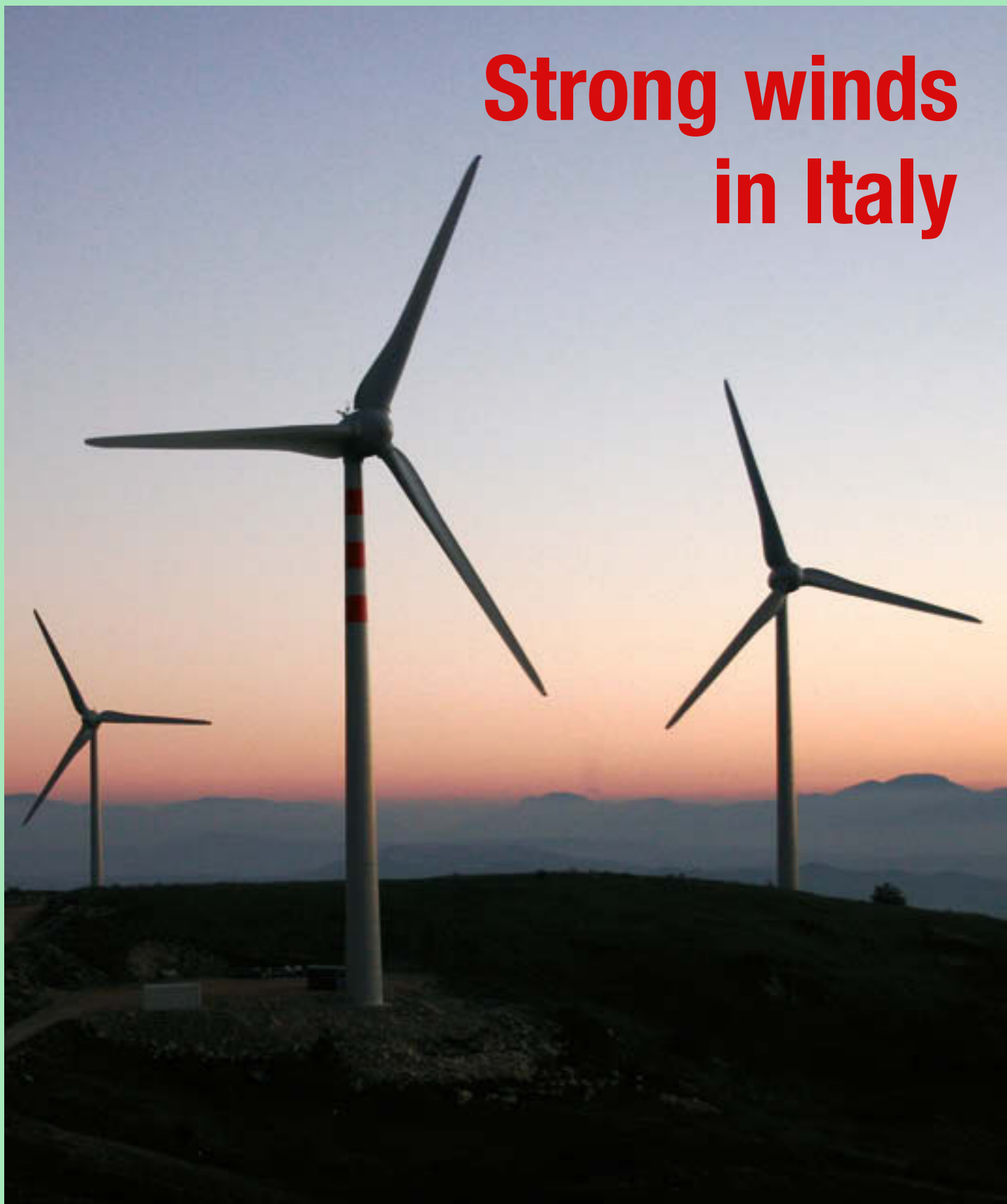
Issue 1 / February 2006

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WIND BLATT

ENERCON MAGAZINE for wind energy

**Strong winds
in Italy**



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At the end of 2004 there were only four wind energy converters in operation in Hungary. Currently applications for a total of 1800 MW wind power are being processed. But, very few will have access to the weak 20 kV grid. Due to ENERCON highly-developed system, Hungary's by far largest wind farm made up of five E-70 turbines was recently connected to the grid.

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The solution is ingenious: The transformer is integrated in the wind turbine. Classical oil-cooled transformers are usually too big and do not fit through the tower entrance. In cooperation with ENERCON the Belgian transformer manufacturer Pauwels developed a silicone cooled compact transformer.

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Three new E-112 wind turbines with 6 MW rated power were connected to the grid just in time for the end of 2005. Eight of these huge WECs are momentarily turning in Germany. This makes ENERCON the leader for the installation of large wind energy converters.

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Editorial

More output for a sound future

Energy is the motivating force to achieve top performance. Because energy is so important, we need to ensure that a sufficient amount is available for tomorrow's world. Since fossil fuels are finite resources, renewable energies can no longer be set aside for a sustainable energy concept.

Renewable sources therefore face a big challenge as they play a decisive role for the development of a sustainable energy supply. ENERCON has identified this important position and aims at creating sophisticated technologies and highly efficient wind turbines. The company has used the year 2005 to further increase the output of its various wind turbine types so that today's yield at inland locations does not have to be necessarily lower than in windy coastal areas.

A direct comparison of the first E-66 / 1.5 MW WEC from 1995 with the new E-82 / 2 MW wind turbine from 2006 shows that ENERCON has been able to increase the energy yield for typical inland winds by up to 70 %. This has considerably reduced the costs per kilowatt hour of generated wind energy and has made inland sites with weaker wind conditions much more attractive. The first E-82 prototype was set into operation shortly before the end of 2005.

Furthermore we have been able to increase the output of our largest wind turbine, the E-112, from 4.5 MW to 6 MW. Three of these 6 MW types, the most efficient turbines worldwide, were put into operation last December. Eight E-112 WECs are currently generating a total power of 40.5 MW and thus prevent 80,000 tons of climate damaging CO₂ per year.

Both examples prove: The better the wind energy technology, the more cost-effective the kilowatt hour of wind-generated electricity. Another scenario however arises for conventionally produced energy: Natural resources starting to run out will cause enormous price increases in the medium run. For this reason we can look forward to a near future in which renewable wind energy does not only assure a clean climate, but also stable electricity prices. This way it will become a significant part of the energy mix – accepted and appreciated by everyone.



Aloys Wobben
Managing Director ENERCON GmbH

Unusual presents for ENERCON personnel

Trees as a mark of recognition

Klaus Peters, Managing Director of the Mechanic Anlagenbau GmbH in Aurich, awarded unusual presents to his employees: All staff members who have been working for the company for ten years or longer – so almost half of the personnel – received a fruit tree. Already at the

Managing Director Klaus Peters (right) awarding a fruit tree to long-term employees.



beginning of 2003 Klaus Peters had this idea in mind: "Our gift represents the company's principles. A tree is a symbol for reliability and sustainable growth." On 12 November 2005 his idea was finally put into effect: The Managing Director welcomed the guests of honour on an

orchard meadow and in the name of the company awarded a tree to

each of them. Graduate geographer Katrin Koch accompanied this project for ENERCON. She was, amongst others, responsible for taking care of ecological buffer zones. "All wind farm owners are obliged to create buffer zones. This can even be orchard meadows", explains Katrin Koch. Together with the local group of East Frisians from the German environmental organisation BUND she developed a concept for ENERCON's personnel orchard meadow: "We purposely chose old East Frisian fruit tree species." Klaus Peters' pilot project was so successful that the two ENERCON Managing Directors Aloys Wobben and Hans-Dieter Kettwig have handed over gift certificates for the next tree planting event in 2006 to 80 ENERCON GmbH staff members, who have been part of the company for more than ten years as well.

Expectations fulfilled for 2005

1.5 GW newly installed

The year 2005 terminated on a highly positive note and completely fulfilled ENERCON's expectations. ENERCON was able to install 961 new wind turbines with a total power of 1.5 GW worldwide, last year – an increase of 12 % in comparison to the year before.

Taking only export markets into consideration, ENERCON raised the number of new installations abroad from 489 MW in 2004 to 747 MW in 2005 – an increase of 53 %. Thus ENERCON's export share of newly installed wind energy power nearly achieved the 50% mark in 2005. ENERCON expects their international projects to further increase in 2006.

Project managers and construction supervisors at ENERCON had a lot of

work to do in 2005: On average, 80 wind turbines were built worldwide every month and there of about 36 WECs in Germany. A total of 430 new ENERCON installations with a rated power of 753 MW were connected to the grid in Germany enabling ENERCON to further improve its position in the German market.

By the end of 2005 ENERCON had already installed 8,786 wind turbines worldwide with a total power of 8.67 GW – this corresponds to a rated power of about six nuclear power plants. In comparison to power plants operating with fossil fuels the operation of all ENERCON wind turbines reduces the amount of climate damaging CO₂ by approximately 445 million tons per year.

Special design for medium wind speeds

E-82 prototype in operation

It was a race against time, but ENERCON project manager Nicole Kleiner and the installation-, grid connection and serviceteam won. The first E-82 wind turbine was put into operation in the last hours of 2005. The prototype was connected to the grid in Simonswolde, part of the German community Ihlow.

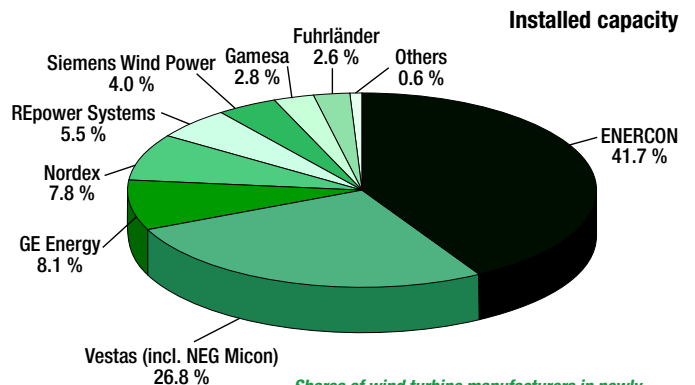
But despite this success ENERCON construction supervisors Karl Ihmels and Thomas Brauer encountered some initial problems as the construction soil conditions were not easy: "The construction soil consisted of peat till a depth of up to 5 metres. Pile foundations were therefore necessary for the tower, the crane pad and the transformer." For this purpose complex bored piles were used instead of the regular rammed piles to avoid shocks on an asbestos cement water pipe installed in the immediate vicinity of the foundation.

All challenges were mastered successfully – and the first E-82 wind turbine started generating electricity at the beginning of this year. With its large rotor diameter of 82 metres and an efficient rotor blade geometry this turbine guarantees excellent output values at inland locations as it is specially designed for medium wind speeds. A yield of 5,332 kWh/a is forecast for a 98.3 m hub height at an average wind speed of 6.4 m/s. A direct comparison of the first



E-66 / 15.66 WEC from 1995 with the new E-82 wind turbine dated 2006 shows that ENERCON has been able to increase energy yield by up to 70 % and in return decrease costs per generated kilowatt hour of wind energy.

A second E-82 wind turbine is currently being installed on the Steinkopfsinsel in Magdeburg-Rothensee opposite the ENERCON rotor blade factory. It is planned to be put it into operation this month. "Since wind speeds in the Magdeburger Börde are low, the E-82 turbine is more suitable for this region as is our E-70 WEC", explains Jürgen Helms, ENERCON project developer in Magdeburg. With the E-82 system ENERCON has improved the efficiency of inland wind turbines so that also locations with low to medium wind speeds become more attractive. ENERCON has already received numerous orders for this turbine type – even from abroad.



Survey

Opinion on wind energy extremely polarised

According to a survey carried out by the German polling institute – FORSA, wind energy plays a decisive role for seven out of ten German citizens. However, there are often intense and sometimes even emotional conflicts concerning the installation of new wind turbines. The European Union is currently supporting a project called Wind-TechKnow (www.wintechknow.net) which aims at rendering public discussion more objective and identifying deficits and problems during planning stages of wind energy projects. In Germany, regional planning office: Havelland-Fläming, is taking part in this project with a comprehensive analysis concerning citizens' opinions and knowledge level. 1,900 directly affected people in 57 districts were asked their opinion on wind energy. First survey results:

- The opinion on wind energy is extremely polarised. Half the interviewees are in favour of wind energy.
- However, disadvantages of wind energy are mentioned more often than possible advantages.
- Citizens think they are not sufficiently informed about planned wind energy projects.
- The answer to whether wind energy projects are sensible in their immediate vicinity was mainly the importance of the economic aspect.

Within the context of WindTechKnow, experts from Estonia, Greece, Portugal, Sweden, Wales and Germany recently discussed how public opinion about wind energy is developing. According to Harald Knauer, who participated as the head of the planning office Havelland-Fläming at a meeting in

Kleinmachnow (Germany), Germany would be putting its top position in wind energy technology at stake "if on the one hand prejudices hinder current planning phases and on the other hand wind turbine manufacturers do not consider public opinion and try to achieve their goals irrespective of other arguments." For this reason Harald Knauer would like to support communication between the various parties. Behind the motto "Our wind farm" he wants to give citizens an understanding of wind energy and plans to install information boards, carry out guided tours, tower visits and "wind parties" and make wind farm data publicly available via the internet.

In the region Havelland-Fläming 350 wind turbines are producing about 850 GWh of electrical energy per year. Further wind farms are in the planning stages.

Prefab concrete towers

New production plant inaugurated in Emden

ENERCON recently built a new plant in Emden (Germany) to manufacture and stock prefabricated concrete towers. The mayor of Emden inaugurated this 90,000 m² plant near the Jarßumer harbour at the end of January. ENERCON invested several millions in the new production plant. 35 employees have already been engaged and up to 100 new positions are planned for this year.

The prefabricated parts for the E-70, E-82 and E-112 concrete towers are cast in the 75 m wide and 300 m long production hall. The first concrete half shells were manufactured last year in October and plans are to produce 90 towers for the E-70 and E-82 wind turbines as well as two towers for the E-112 this year. A loading harbour will be built next to the new plant in the first four

months of this year to transport tower parts with barges or ocean going vessels to other European countries.

ENERCON has been manufacturing prefabricated concrete towers in Magdeburg (Germany) and India for some years now. But the production capacities in Emden are twice as big as in Magdeburg. This makes it possible for ENERCON to produce considerably higher amounts of concrete tower parts. Prefabricated concrete towers have several advantages than in-situ concrete towers: Irrespective of the weather conditions series production enables ENERCON to manufacture large tower quantities with consistent quality. Complex production steps are automated in the factory. Furthermore the transformer station and the cables are inserted into the first tower segment which avoids time-consuming retrofitting work at the construction site.

**ENERCON on fairs****European Wind Energy Conference**

(Athens/Greece)

27. 02. – 02. 03. 2006

Stand No. 380

Int. conference and exhibition of the European Wind Energy

Association

www.ewea.org**Renewable Energy**

(Böblingen/Germany)

10. 03. – 12. 03. 2006

Int. conference and exhibition www.erneuerbareenergien.com**Hanover Trade Fair 2006**

(Hanover/Germany)

24. 04. – 28. 04. 2006

The world's most important technology exhibition

www.hannovermesse.de**Power Expo**

(Zaragoza/Spain)

20. 09. – 22. 09. 2006

Int. exhibition of efficient and sustainable energy

www.feriazaragoza.com**Eolica Expo Mediterranean**

(Rome/Italy)

28. 09. – 30. 09. 2006

The main event for wind power in the mediterranean

www.eolicaexpo.com**Canadian Wind Energy**

Conference

(Winnipeg/Canada)

22. 10. – 26. 10. 2006

Int. conference and exhibition of the Canadian Wind Energy

Association (CanWEA)

www.canwea.ca



Big developers rely on ENERCON

Strong winds in Italy

Eleven ENERCON E-70/2 MW turbines were connected to the grid in San Chirico. They are the first 2 MW turbines to produce clean power at altitudes over 800 metres in Italian mountain range

If one has a look at the “Atlante Eolico dell’Italia”, a sort of atlas for wind energy in Italy, it is obvious that the wind is strongest along the coast of Sardinia, Sicily, the southeastern tip of the mainland, the region around Apulia and along the hilly countrysides of the Campania and Molise regions in southern Italy. These regions with strong winds and turbulences are in the Wind Class I category.

The same is true in San Chirico in Val Fortore which lies 830 meters above sea level. This region is named after the Fortore River, the natural boundary between the windy regions of Campania, Molise and Apulia. Last September ENERCON installed eleven E-70 wind turbines in the region for wind farm operators: Fortore Energia S.p.A. This is the first time that turbines in the 2 MW category were put into operation in Italy at altitudes over 800 meters.

The challenge: Turbines with multimegawatt power on impassable territory

Fortore Energia, also named after the Fortore River, is one of the largest wind project developers in Italy. The operators were looking for a manufacturer able to install turbines with a rated power of 2 megawatts in a mountainous region with the highest wind category. They did not have to look long: Fortore Energia signed a contract for thirty E-70 wind turbines back in May 2004. The first 11 were recently connected to the grid in San Chirico. This year 10 more will be added in Rochetta and another nine in Spina. The biggest challenge for all of these projects is transporting the huge E-70 tower sections and other components up the serpentine roads to the top of the mountains. Sometimes the

track just ends in the middle of nowhere. “Up until now, we’ve always been able to master this complicated task with our transport team”, explains Diodoro Carrera, ENERCON’s installation manager in Italy. “First we take a really close look at each road and then we decide on the appropriate measures.”

Upwind in Italy

Thanks to lucrative power purchase prices the Italian wind market has been growing especially since strong winds at altitudes above 800 meters in the southern regions promise high yield. Thomas Barkmann, ENERCON’s sales manager for Italy sees great potential in the Italian wind market. “Due to a combination of especially windy sites and an exceptional power purchase price system for electricity from renewable energy sources, Italy is a particularly attractive market for investors. With “green certificate” sales (duration 8 years at approx. 8 cents per kWh) added to guaranteed power purchase over the entire operational period (approx. 5 cents per kWh), Italy is currently one of the most lucrative markets.

However, there are some obstacles to overcome: Authorisation procedures are complicated and the processing procedure varies from one region to the next. In addition, the number of hurdles connected with grid access regulations is constantly increasing (see insert). “Italian grid operator, GRTN, constantly demands new requirements for grid connection”, says Stefan Wachtel explaining the strict regulations. Wachtel is responsible for international grid connection at ENERCON: “ENERCON is constantly improving its grid connection technology so that turbines



ENERCON wind turbines in San Chirico: Operators in Italy are assured dependable support and security, a fact that the Italian bank Banca Verde definitely appreciates.

disconnect Italy from the UCTE system entirely – with of course serious consequences. After all, Italy imports 17% of its required electricity from neighbouring countries. This was the cause for the major blackout in September 2003. With this in mind, the technical stipulations for connecting wind farms to Italian high voltage transmission networks are currently being revised (see insert).

“Lucrative power purchase prices, but authorisation procedures are complicated”

Not only Fortore Energia, but also Edison and Daunia Wind who manage larger wind farms are convinced by ENERCON's technology. Edison, Italy's second largest power supply company alone has almost four hundred E-40 wind energy converters (500 and 600 kW) connected to the grid. This year Edison will be connecting 13 more turbines. Daunia Wind also has plans to install another eighteen E-70 turbines in Troia on Mount Calvello.

fulfil grid access conditions worldwide. Our technology also works as a stabiliser for weak grid systems."

New regulations should stabilise the public grids

That is one of the reasons why large Italian developers such as Fortore Energia, Daunia Wind and Edison trust ENERCON technology. Italy's power supply system has been in a critical state for a number of years now. Italy depends on a bottleneck in the European transmission grid UCTE. A failure in just one transmission line is sufficient to trigger a chain reaction which could

Big developers rely on ENERCON

ENERCON's grid technology fulfils the new regulations. ENERCON wind turbines "ride through" grid failures: Instead of disconnecting from the grid as most turbines would do, they continue to feed electricity into the grid. The advantage of this technology is that it not only improves yield but at the same time has a stabilising effect on the grid. Using an "intelligent" control system, ENERCON wind farms can be directly controlled by grid operators to be integrated in Italy's required bottleneck management system.

Nicole Kleiner, project manager for Italy, has her hands full. "Over the next few years, we are planning to install several hundred megawatts of output capacity in Italy. This also includes the new E-82, which guarantees excellent yield in less windy regions."

New sales office in Italy

Last October, ENERCON opened up a new sales office in Frascati, 40 km south of Rom, in order to provide better customer service on location. Office manager Benedetto Gallina: "We want to support our customers in all aspects - especially for complicated building permit procedures

San Chirico in Val Fortore which lies 830 meters above sea level. Last September ENERCON erected eleven E-70 wind turbines in the region for wind farm operators: Fortore Energia S.p.A.





*ENERCON Engineer Stefan Wachtel:
"Our technology works as a stabiliser
for weak grid systems."*

and environmental impact verification, in order to avoid turbine installation delays as much as possible."

ENERCON also offers highly professional service for turbines already in operation. Within the scope of ENERCON's Partner Konzept contract, ENERCON Service Italy takes care of maintenance and service and guarantees 97 % technical availability over a period of up to 12 years. Operators in Italy are assured dependable support and security, a fact that the Italian bank Banca Verde definitely appreciates.

Banca Verde is specialised in financing renewable energies. "We have full confidence in ENERCON technology and the ENERCON Partner Konzept. This plays an important role when financing a wind project," according to a spokesperson at Banca Verde. This is one reason why Fortore Energia was able to successfully carry through its most recent ENERCON wind farm project in San Chirico entirely financed by Banca Verde.

*With 256 megawatts
ENERCON is represented in the Italian
wind market in second place.
Italy's developers like Fortore Energia,
Daunia Wind or Edison
rely on ENERCON.*

Critical Grid Management

The Italian electrical grid is particularly susceptible to failures. Italy's topology and geographical situation means that its transmission network is connected to Western Europe's grid by only a few high voltage lines in Northern Italy. A considerable portion of the energy consumed passes through this bottleneck, in particular nuclear power imported from France's state utility, EDF.

Further bottlenecks inside Italy also aggravate transmission to consumers in Southern Italy. All these factors add to increasing the risk of blackouts, similar to the major power failure experienced in September 2003. Triggered by a grid failure in Switzerland, Italy's entire national grid was cut-off from the UCTE network. At the time, power supply was not re-established until several hours later.

ENERCON's Grid Management System enables turbines to "ride through" grid failures

This event has incited Italy's national grid GRTN to revise requirements to hook up to Italy's high voltage grid. On top of gathering conclusive experience from other countries, circumstances in Italy are being closely analysed. ENERCON's wind turbines can easily be connected to any grid worldwide due to their power plant properties. Instead of disconnecting and shutting down, ENERCON's Grid Management System specially designed for transmission grids enables turbines to "ride through" grid failures (ENERCON UVRT – undervoltage ride-through) and at the same time has a stabilising effect on the grid system while continuing to feed power. ENERCON UVRT has been tried and tested in large scale field trials worldwide. Together with ENERCON's SCADA – remote monitoring feature, wind farms can easily be integrated into any grid management systems – an especially challenging task considering Italy's particularly weak power network. Turbines with ENERCON's grid management feature not only produce clean electricity but also make a major contribution to stability and security within Italy's national grid system.



Hungary's largest wind power plant connected to grid:
New power purchase price provides momentum

The race is on!

At the end of 2004 there were only four wind energy converters in operation in Hungary. Out of the four, three were ENERCON E-40 turbines each with a 600 kW power capacity. However, the winds of change are blowing strongly and currently applications for a total of 1,800 MW wind power are being processed. But, very few will have access to the weak 20 kV grid and this is where ENERCON grid management technology has its advantages. Recently, Hungary's by far largest wind farm made up of five E-70 turbines as connected to the grid.

Hungary also has its wind energy explorer: Balazs Stelczer. Stelczer had the first noteworthy wind turbine installed in Hungary, an ENERCON E-40 with a 600 kW capacity. This turbine has been providing electricity in Kulcs on the Danube river located 30 km southwest of Budapest since 2001. Except for a small 250 kW turbine, only two further wind turbines were installed in all of Hungary up until the end of 2004: Two E-40 turbines in Mosonszolnok (Northwest Hungary) – also initiated by Stelczer. Both projects were realised in cooperation with E.ON Hungary.

Attractive power purchase prices since September 2005

Until two years ago wind energy, with just four turbines, only held a small market niche in the ten-million-resident country.

The main reason for this was the power purchase price for wind energy. Compared to most Western European countries this price was about half of that paid for electricity produced by conventional power plants.

However, since Hungary joined the European Union on 1 May 2004, it has committed to reducing its greenhouse gas emissions by 6 percent by the year 2012 and to increasing the proportion of renewable energies considerably – from 3 % in 2003 to 6 % in 2010. On a long-term basis, Hungary is aiming for the EU average which is approx. 12 %. In order to attain this ambitious goal, Hungary introduced a feed law for renewable energies and raised the power purchase price in September 2005 to 23 Forint per kWh (approx. 9.2 Eurocents). Also new is the fact that this high purchase price is also valid for weak load periods. This new feed law has significantly increased interest in wind energy investments. "Numerous operators have submitted applications to build wind turbines in Hungary with an overall capacity of approx. 1,800 MW", says Michael Richter, ENERCON's project manager for Hungary commenting on the drastic increase.

Stiff competition for grid access

However, Hungary's wind pioneer Balazs Stelczer is cautious about the expectations. "Only a few of these turbines have obtained building permits and even fewer have the possibility to feed power into the extremely weak public grid. László Pál, General Director of the state utility Magyar Villamos Művek (MVM) assumes that the Hungarian Energy Agency "will authorise grid connection for a maximum of 200 MW" by the year 2010. At the moment, competition for the best sites with good grid accessibility is stiff.

The European Union is encouraging new members of the Union to construct wind energy turbines by offering additional funding within the framework of the so-called Phare-CBC program. Financial support for investment in infrastructure and environmental protection

is being especially provided for border regions (CBC = Cross-Border-Cooperation). Here, environment and renewable energy are the focal points.

"The race is on for the best sites in Hungary."

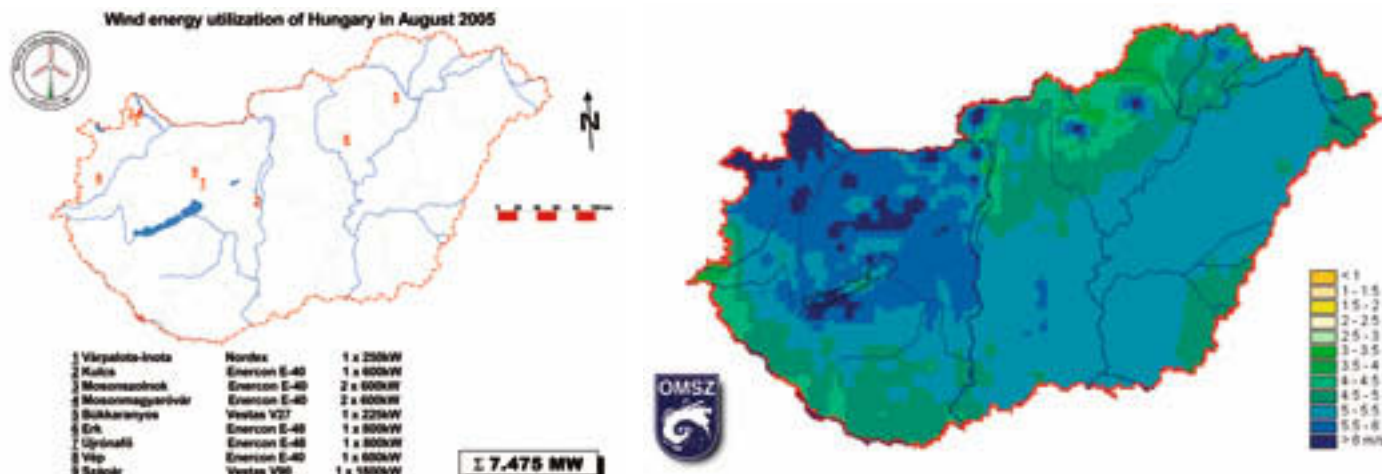
Minister of the Environment praises ENERCON Project

Last June two turbines were connected to the grid near the Austrian border – an E-48 (800 kW) in Ujrónafő and an E-40 (600 kW) in Vép. Since both turbines received EU funding the operators had to make an open call for tender. On both accounts ENERCON was awarded the contract. This came as no surprise to Balazs Stelczer, who planned the E-48 in Ujrónafő for LÉG-ÁRAM Alapítvány. "Our project planning office "Winfo" solicits bids for each wind energy project. When evaluating the documents we not only look at the price but also the technology and investment risk. ENERCON almost always submits the best offer."

Hungary's Minister of the Environment Miklos Persanyi praised the Ujrónafő project at the inauguration ceremony. The operators of the E-40 in Vép, Szélerő Vép Energiatermelő Kft. also rely on ENERCON.



Hungary's Minister of the Environment Miklos Persanyi (left) praised the Ujrónafő project at the inauguration ceremony and started the E-48 turbine. Balazs Stelczer (right) planned the E-48 in Ujrónafő for LÉG-ÁRAM Alapítvány.



Last August in Hungary there were only wind energy converters with an overall capacity of 7.5 MW in operation

Wind speed at 75 metres height. A precise new wind atlas will definitely facilitate determining the best sites for future wind farms in Hungary.

Their project manager Rudolf Piller wants to install one more E-48 and two E-70 in Vép. “ENERCON is a dependable experienced partner able to provide us with turn-key installations - including grid connection and commissioning. And that is a huge assurance when planning and calculating.”

New wind atlas for Hungary

Although continental, Hungary does have favourable conditions for the use of wind energy. The Scientific Association for Wind Energy at the Szent István University in Gödöllő and the Hungarian Meteorological Service recently compiled a detailed wind atlas indicating regions where the mean

wind speed significantly exceeds 6 m/s at 50 to 100 metres hub height. This precise new wind atlas will definitely facilitate determining the best sites for future wind farms in Hungary. The vast Hungarian lowlands and Northwestern Hungary, especially the Parndorfer Plateau, are cited as being particularly good sites for wind turbines. The race is on for the best sites in Hungary.

Hungary’s largest wind power plant

Since competition for these sites is up and authorisation processes in Hungary are long, less regions in Hungary remain attractive. Plans this year are to connect the first E-82 to the grid in Sarbogard in Central Hungary. ENERCON project manager Michael Richter sees special potential for the new E-82 in Hungary: “The E-82 has all the new features for optimised output in continental regions with weaker wind conditions (Wind Class II). With this turbine, operation at sites such as these can be just as profitable as at those currently in demand in Hungary.”

“Operation at sites with weaker wind conditions can be profitable.”

Last year ENERCON installed five E-70 turbines (2 MW rated power – hub height 113 metres) for five different customers

in Mosonmagyaróvár near the Parndorfer Plateau. All five WECs have been operational since the end of 2005 – by far the largest in Hungary with the highest performance. Karoly Banfalvi from Netpoint Bt one of the five operators in charge of this project: “Authorisation for our wind farm in Mosonmagyaróvár was a drawn out process but thanks to ENERCON’s professional project coordination we were able to hook up all five E-70s to the grid before the end of 2005.”

Hungary’s wind pioneer Stelczer is also aiming at bigger projects. Just 15 km from Hungary’s first wind turbine (E-40 in Kulcs), Hungary’s most well-known wind project planner “Winfo” is planning a wind farm with a rated power of 24 MW for E.ON Hungaria. Managing director, Balázs Stelczer, who is the heart and soul of Winfo, sees himself as the first Hungarian wind energy fan. “Five years ago, I always drove to Regensburg for the company I worked for. I noticed the German wind turbines and asked myself: Why don’t we have these?”, he remembers. And today he says: “This year the race is on in Hungary.”



Sun and wind and an E-48 in Ujvárfő: Hungary has committed to reducing its greenhouse gas emissions by 6 percent by the year 2012

Silicone cooled transformers are very compact

Tower integrated transformers

The solution is ingenious: The transformer is integrated in the wind turbine – an external transformer station is no longer required. Classical oil-cooled transformers are usually too big and do not fit through the tower entrance. In cooperation with ENERCON the Belgian transformer manufacturer – Pauwels – developed a silicone cooled compact transformer.

Wind turbines starting at a rated power of approx. 300 kW are connected to high voltage grids. Since wind turbines produce energy at the low voltage level they require transformers with appropriate transformation capacities.

Due to their size, standard transformers have to be installed in transformer housings outside the tower. This, however, can be costly. Furthermore, transformer stations spoil the appearance of the turbine.

Many wind turbine manufacturers use dry type transformers such as cast resin transformers when the transformer is integrated in the tower. ENERCON, however, prefers using three-phase hermetically sealed transformers with silicone fluid as a coolant together with heat-resistant Nomex fibre insulation. These transformers, manufactured by Pauwels International N.V., are just as compact as dry type transformers. This new generation of transformers was especially developed by Pauwels according to ENERCON specifications.

The following gives insight into some aspects of this development:



Both transformers and towers were designed to accelerate any necessary transformer replacements. Transformers can easily be replaced within just a few hours.

Electrical Properties

Dry type transformers cannot dissipate heat in the rated load range as effectively as oil-cooled transformers and are quite sensitive to overload. Rapid load variations can cause fine cracks to form in the cast resin which in turn cause localised partial discharge which could damage dry type transformers in the long run. Oil transformers are different: The inner flow of oil can minimise or rectify this type of fault. Oil analyses can disclose information about the current condition of the transformer; gradual damage is detected at an early stage and can then be repaired. In addition there is also the economical factor: No-load losses for oil transformers are considerably lower than for comparable dry type transformers. Since wind turbines constantly have no-load losses, oil transformers are considerable cost-savers over the service period.

„Conventional transformers are not well-suited for wind turbines.“

Fire Safety

The oil transformer's metal housing is grounded and all ENERCON connections are insulated. With regard to thermal loads, silicone transformers behave similar to dry type transformers. Silicone fluid has a high burning point (360 °C) and virtually extinguishes itself. The risk of fire hazards

Completely assembled transformers are delivered on site and installed directly in the tower base. The towers are then lowered over the transformer stations.



ENERCON-Transformers by Pauwels International, Belgium

Quality teamwork

For wind turbines whose transformers are installed in transformer stations, ENERCON has a large choice of suppliers who can provide conventional mineral-oil transformers. However, in many cases the customers prefer tower-integrated transformers. With conventional mineral oil transformers problems occur as turbine output capacities increase:

- Conventional transformers are often too big, do not fit through the tower entrance and reduce the necessary service space in the tower basement.
- When sized down to more suitable dimensions, mineral oil transformers over-heat because surface cooling is too low.

Slim and compact: Although Pauwels silicone-filled "SLIM" transformers employed in ENERCON turbines are compact their thermal capacities are excellent

Photo: Pauwels



Over one thousand transformer in work

So in 2000 ENERCON approached Pauwels and asked them to develop a suitable oil cooled transformer. The Belgian firm based in Mechelen is specialised in manufacturing transformers. Pauwels has the same outstanding technological competence and high quality standards as ENERCON. Both companies distinguish themselves from their competitors by using alternative technologies. The two firms have been cooperating since 1996.

It did not take long to achieve results: Pauwels developed a very compact oil-cooled trans-

former with excellent thermal performance. Special insulating material made of heat-resistant Nomex fibre and the use of a class "K" cooling agent made this possible.

ENERCON has been using the newly developed compact transformer since 2001 – in the E-70 and the E-112. The thousandth transformer of this type was delivered in the second quarter of 2005.

Not one single transformer has broken down.

Of course Pauwels also supplies conventional transformer types. Due to their convincing quality, ENERCON also deals with Pauwels on many foreign projects (Australia, Japan, Taiwan and Brazil). So far not one single transformer has broken down. Pauwels is flexible when it comes to unforeseeable short

notice supply. This summer Pauwels even offered to fly twenty transformers down to Australia due to a delivery delay. (Each transformer weighs 6 tons!) Fortunately, this expense was able to be avoided at the last minute.

Technical pioneers

ENERCON not only works closely with Pauwels for materials management and planning production capacities but also in developing transformers for new wind turbines. The Belgian transformer manufacturers do not just wait until ENERCON makes a suggestion. They

have also come up with their own ideas for improvement such as the recent proposal to use an even more environmentally friendly organic oil in compact transformers.

Ergo: Both firms, Pauwels and ENERCON, are technical pioneers in their field and know that conventional transformers are not well-suited for wind turbines.

For further information: Pauwels International, 2800 Mechelen, Belgium, www.pauwels.com

with oil transformers is extremely low since the tanks are gas insulated. Oxygen can only penetrate if the tank is severely damaged. Transformers installed by ENERCON have a protection system comprising overcurrent-time protection, temperature monitoring, and a pressure guard which in case of fault would prevent the transformer tank from being destroyed.

Oil transformers are very dependable

Silicone-filled transformers are sealed so they can operate in harsh environments without special housings. They are highly resistant to humidity, salt fog and chemical gases. Oil transformers are also more resistant to mechanical stress. Jolts and shocks during transport, installation or operation have very little effect on them.

Silicone oil: Environmentally friendly

The silicone liquid used in Pauwels compact transformers fulfils Clean Water Standard 1, does not deprive the environment of oxygen and is non-toxic. Since the material is stable material it can be easily recycled. A metal pan designed to collect the entire oil content is always placed directly under the transformer. These drip pans are guaranteed leak-proof.

Summary

By converting from mineral to silicone oil as well as further developing insulation materials Pauwels and ENERCON were able to develop extremely compact oil transformers designated for tower integration. Since they are compact they fit through the door opening which facilitates replacement. ENERCON took this fact into consideration during the development stages of both towers and transformers. These transformers can be replaced within only a few hours.

Of course, ENERCON will still continue to supply external transformer stations on customer demand. Transformer stations with either silicone or mineral oil transformers are usually installed just beside the wind turbine.



Three further E-112
windturbines with 6 MW
rated power connected to grid

Majesties in the Wind

Three new E-112 wind turbines, one in Cuxhaven and two in Emden (both Germany), were connected to the grid just in time at the end of 2005. Eight of these huge WECs are currently running in Germany, making ENERCON the leader in the multi-megawatt wind energy converter sector. These three installations are the first wind turbines able to provide 6 MW rated power. They are thus the most efficient WECs worldwide.

Germany, Cuxhaven, 17 December at 11.30 am at the German Wind Energy Institute DEWI offshore test site: "Everything OK", says ENERCON construction supervisor Jörg Zimmermann proudly looking up at the turbine together with his installation team. The reason for his satisfaction: The eighth completely assembled E-112 wind turbine went into operation as planned at the end of 2005.

Excellent finish in Cuxhaven

The day before, stormy conditions prevented the installation team from fitting the huge rotor (Ø 114 metre!) to the almost completely assembled wind turbine. But in the wee hours of the morning the wind suddenly dropped and Jörg Zimmermann confidently fired the starting gun at 6:30 am. His 15-member team did not hesitate a moment: With his 144 metre crawler crane the crane operator slowly lifted the pre-assembled rotor carefully to a height of approximately 50 metre and set the 100 ton ring upright with the aid of two rope winches. Two further winches were used to stabilise the hub in position. When the erected rotor hub reached the tip of the 115 metre high steel tower, the ENERCON technicians were ready to fit the hub element to the nacelle. 250 bolts were sufficient and at 11 am everything was

completely assembled accompanied by brilliant sunshine.

A 850 ton steel tower manufactured at ENERCON's steel tower factory EWP in Malmö (Sweden) supports the 500 ton nacelle. These enormous weights and dimensions really pay off: The operator, EWE AG in Oldenburg, expects an annual energy output of 15 million kWh. This is sufficient to supply 4,500 households with electricity.

Air-conditioned machine house

The offshore test site in Cuxhaven belongs to DEWI OCC (Offshore and Certification Centre). This area located directly behind a dyke on the North Sea coast is used to gain



*Loading one tower segment:
The complete tower consists of
four segments and weighs 741 tons.*



*The eighth E-112 wind turbine is
completely assembled and could
be put into operation as planned by
the end of 2005.*
Photo Jens Hadel



experience in operating wind turbines under offshore weather conditions. Five locations are planned for the development and testing of offshore WECs. With the E-112, ENERCON is the first manufacturer to start test runs on wind turbines of this size. This installation is specially equipped for offshore conditions, its machine house is air conditioned and all relevant components are continuously monitored by an electronic system. Offshore maintenance and repair work requires a lot of effort and is considerably more expensive than onshore.

two foundations into the ground in April last year, to commissioning in the middle of December 2005", explains ENERCON Sales representative Frauke Reimers with satisfaction. In contrast to the E-112 wind turbine in Cuxhaven, the towers in Emden were made of prestressed concrete on site. The operator, Stadtwerke Emden, expects an annual energy output of 17 million kWh for each wind turbine with a 124 metre hub height. This would supply around 5,000 households with electricity.

Leader in large wind turbine sector

ENERCON installation teams can also be proud of the Larrelter Polder wind farm in Emden: Before the WEC was put into operation in Cuxhaven, the first two E-112 wind turbines in the 6 MW class had been started up at this site. "We were able to perform all installation operations as planned – from ramming the piles for the

Eight E-112 wind turbines have already been put into operation with a total output power of 40.5 MW. ENERCON is thus the leader for the installation of large wind energy converters. The first prototype with an output of 4.5 MW was erected in Egeln in 2002. "Innovations and increasing experience with this type of wind turbine have enabled us to further develop to reach a rated power of 6 MW", according to Reimers. Good for the environment: Operation of only one single E-112 WEC reduces the amount of climate damaging CO₂ emissions by about 10,000 tons per year.

*Special transporter with 22 axles
for the 212 tons generator of the E-112*



*Setting up a tower section of the
115 meters high steel tube tower on
the DEWI OCC test field in Cuxhaven.*
Photo Jens Hadel



ENERCON Service Germany certified according to DIN EN ISO 14001

Spotlight on environment

ENERCON still attaches great importance to environmental management. After the production plants were successfully certified in 2004, Germanischer Lloyd has now assigned a DIN EN ISO 14001 certificate to ENERCON Service, too.

As an environmental engineering company, ENERCON aims at saving resources and manufacturing its products in an environmentally friendly way. Since this guideline does not only concern production

ENERCON Service, which guarantees maximum technical availability for 5,743 wind turbines in Germany (as at 10 January 2006), is subdivided into several decentralised areas. Since the Service centres are continuously being geared to customer needs, not only travel distance to sites has been reduced but also environmental pollution.

Optimised processes

Service has also been able to considerably decrease its paper consumption. Every year Service teams submitted approximately 183,000 report papers. But today, in order to accelerate workflow,

Service teams use Pentops so that paper consumption has been decreased. Last year consumption dropped to almost zero. Service was also able to improve material flow from the stores to the technicians. These now receive material packs within defined supply intervals making material supply more reliable and reducing transport costs and pollutant emission.

Waste identification

When servicing wind turbines, it is unfortunately not possible to completely avoid waste or even hazardous materials such as grease. In order to obtain an overview of waste quantities and types, all relevant data is collected and centrally assessed for the various Service teams. "We have

analysed the processes and sensitised our employees. We've considerably reduced the amount of hazardous waste", says Volker Kendziorra proudly. However, he is also aware that oil and grease are always required during maintenance work. "Unfortunately we cannot completely avoid such waste", explains the head of the Service Department. Nevertheless "prevention is much more important than reduction". So if possible, supplier company packaging should be switched from non-returnable to returnable systems. "We now use a stretch wrap machine which requires less foil to tightly pack materials to be sent to technicians", explains Kendziorra as an example.

Strict handling of hazardous materials

Although Service only uses small amounts of hazardous materials, ENERCON has developed special guidelines for all offices and Service stations to further reduce possible environmental risks. These regulations meet the legal requirements to store, treat and dispose of hazardous materials.

Continuous improvements

All members of the Service Department continuously take part in improving ENERCON's environmental protection philosophy. A special key code system, which considers certain environmental aspects, supports them during their work. "Our service teams have already accomplished a lot with the certification of the environmental and quality management systems!" explains Managing Director Volker Kendziorra. But there is always room for further improvement: so we are continuously broadening the improvement process broadened to all levels."



Monitoring-Office of ENERCON Service:
Maximum technical availability for 5,743 wind turbines in Germany (at 10. 01. 2006).

but also the Service Department, an environmental management system according to DIN EN ISO 14001 was introduced for ENERCON Service and – together with quality management – certified in autumn 2005. During external audits Germanischer Lloyd Certification Hamburg particularly complimented ENERCON on their comprehensive development and efficient realisation of improvements. "We always strive for improvements. Quality, environmental protection and occupational safety play an important role in this context", explains Volker Kendziorra, Managing Director of the ENERCON Service in Germany. "We can conserve natural resources and reduce waste."

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