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| **WES18 HOME** | [download pdf](http://www.wes18.com/files/pdf/Complete%20Description%20WES18.pdf) |

The WES18 is a two bladed, high performance, reliable 80 kW midsize wind turbine with a rotor diameter of 18 meters. The mechanical part of the WES18 was designed in 1983, the electrical part has been redesigned in 2005. WES18 turbines are manufactured and exported by WES in the Netherlands. WES18 wind turbines are sold, installed and maintained all over the world by a global network of certified and trained dealers. WES18 Main characteristics High performance (6,5 m/s wind; 193.000 kWh/year)   Ideal turbine for average wind speeds up to 8,5 m/sec. Low cut in wind speed, 2.7 m/sec.  Over 750 units installed around the world.  Low [visual impact](http://www.wes18.com/index/246/visual_impact) Little maintenance needed.  Easy installation.  High reliability.  Life expectancy of 20 years or more.  Lattice or tubular towers, in different heights.  Standard container or trailer transport.  Low mechanical loads on blades, gearbox and tower.  Mechanical passive blade pitch and active yaw.  Possible to install without crane.  Ideal for hard to reach, remote locations.  IPC based computer control system.  Advanced AC/DC/AC IGBT control cabinet.  Patented wind diesel frequency control system.  Internet monitoring. |    |   |

**My WES18**

WES18 is a standard product, built in series, installations are site specific.

Every WES18 installation is unique and needs careful and specific planning of many different things including:

* Feasibility studies.
* Permits.
* Planning permission.
* Grid connection permit.
* Funding and payback.
* Transport.
* Installation.
* Connection to the grid.
* Commissioning.
* Maintenance and service.

WES dealers have detailed knowledge of WES turbines and have access to all relevant technical data. WES dealers are aware of all local specific circumstances regarding wind turbines. WES dealers are key in the planning process. Your WES dealer uses a detailed site survey to organize all details once you have ordered your WES18. With this site survey the WES dealer and WES project team have a clear understanding of the project and details for transport, installation and commissioning can be prepared. If needed WES specialists will assist the WES dealer on site during installation or in advance during preparation.

At WES we focus on developing and building the best midsize wind turbines on the planet. WES dealers make sure your WES18 is installed in the right way and runs successfully for many years.

Owning a WES18 wind turbine is very lucrative for a long period of time, under the right circumstances. WES dealers investigate for you if circumstances are right. Please check our [dealer page](http://www.wes18.com/index/86/dealers) to locate your nearest WES dealer.

**My WES18, Funding and payback.**

It all starts with land, wind and the production of electricity.

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| http://www.wes18.com/files/foto/small/calculator_250.jpgWES18 calculator  | The amount of electricity your WES18 will produce depends on the wind. The [Power Curve](http://www.wes18.com/index/92/power_curve) gives you an accurate estimation of the electricity production of your WES18. Historical wind data is often used to estimate electricity production for the future. Historical wind data can be bought (in most countries detailed wind data at different heights is available).   |

The other option is to measure wind speed at your location. Your WES dealer knows where to aquire or how to measure wind data. The disadvantage of wind measurements is that they can take a long time and are, compared to the total costs of a WES18, expensive. Another option is to check wind turbines that have been installed in same region under the same conditions. Often wind data can be obtained from other turbines. When the wind speed at a specific height and the roughness of the land is known mathematical formulas can be used to calculate the wind speed at hub height.

Installing a WES18 wind turbine is a custom job, costs are different in every situation. Your WES dealer can offer you the whole project on a turn key basis. From the start on you have a clear overview of initial costs and operational costs of your WES18. The price paid for electricity produced in the future and government grants are important to calculate the revenue. Your WES dealer can make calculations for you based on wind speeds, electricity price, project costs, maintenance, insurance costs and all other costs associated with your WES18 wind turbine project. This calculation can be used to attract funding from a bank or finance company. In countries where wind energy is common, banks and investors are willing to invest. In countries where wind energy is not common yet it can be more difficult to attract funds. WES has contact with Dutch investor groups that are interested in funding Wind energy projects abroad, please contact your local WES dealer for more details.

A WES18 wind turbine with its long life expectancy and low operational costs is a good investment. Especially where fuel prices are going up and (national) governments set up stimulus packages for wind energy. After it's short payback period, a WES18 wind turbine will generate revenue for many more years.

**My WES18, Permits.**

Permits are needed before you are allowed to install a wind turbine.

The location of your wind turbine is important and influences the process of getting permits. Rules, laws and regulations concerning wind turbines are different in each country and can be different in each part of a country. On top of that, these rules and laws change all the time.

Information about noise is often required. Please check our WES18 noise calculator to find out what the noise will be at a certain distance from the wind turbine.

In formation about the visual impact is often required aswell. WES turbines have a relative small visual impact, check our [visual impact page](http://www.wes18.com/index/246/visual_impact) to find out why.

In regions where wind turbines are common, the process of getting permits is clear and predictable. A [WES wind turbine study tour](http://www.wes18.com/index/247/study_tour) can help all involved to experience visual impact and sound of WES turbines.

In regions where local authorities and electricity companies have little or no experience with wind turbines the permit process takes more time and is less predictable, getting a permit can take a year or even more.

Your local WES dealer is aware of the permit processes in your region. WES dealers work with local authorities all the time and can help you in getting a permit. WES18 wind turbines can be found all over the world. WES has experience in assisting dealers to work with your local authorities.

In general, getting permits for a WES18 is not a complex procedure but it can take some time. To make sure your permit process has no delays it is important to map out at an early stage what kind of permits are needed, and in what order, and format any data, studies and/or measurements that have to be presented. Your local WES dealer is an expert and can help you with this.

**Visual impact.**

WES turbines have little visual impact.

This webpage explains more about the visual impact WES turbines have on the environment. To read a complete WES-turbine-visual-impact-study please contact our [dealers](http://www.wes18.com/index/86/dealers).

Details that influence visual impact of wind turbines.

Many different kind of turbines and turbine technologies are used around the globe today. Different kind of turbines and technologies have different visual impacts. To understand what causes these differences it is important to take a closer look at turbine details that influence visual impact. These details include:

1. Weight and material-efficiency.
2. Shape, design and function.
3. Size and rotor diameter.
4. Colour.

1) Weight and material-efficiency.

The  weight of a wind turbine has a strong effect on visual impact. Heavier turbines have a bigger visual impact. The best way to compare the weight of different turbines (and turbine technologies) is to look at material-efficiency.
Material-efficiency of a wind turbine is calculated by dividing the mass of the nacelle in [Kg ] by the total surface of the swept area covered by the rotor in [m2]. There is a significant variation in material-efficiency between different wind turbines types and technologies. The picture at the top right gives an overoview of material effciciency of many different kind of wind turbines.

2) Shape, design and function.

**Nacelle**
WES nacelles are light and compact compared with other nacelles. The working platforms on both side of the nacelle are made of rack material and combine low visual impact with efficient, spacious and save working environments for technicians. These working platforms help WES turbines fade away in the background fast.
**Blades**
The rotor and blades of WES turbines absorb mechanical stress in a efficient way. WES blades are lighter and slimmer compared with other wind turbine blades. As a result WES turbines fade away faster in the background.
The second picture on the right illustrates this.
**Tower and foundation**
The high material-efficiency of WES turbines allow slimmer and lighter design of all supporting structures, including towers. The relatively low amount of material used in the construction of the WES towers makes WES turbines less visible.

3) Size and rotor diameter.

Over the years power and size of wind turbines have increased rapidly, the bottom picture at the right gives an overview of the rotor diameter, the power output and development throughout the years. Today WES turbines are midsize wind turbines, until 1992 WES turbines were amongst the biggest turbines on the market.

4) Colour.

The colour of a wind turbine has an effect on the visual impact. The typical blue colour of WES tnacelles was chosen over 30 years ago. To optimize the way WES turbines blend in the background the colour of tower, blades and nacelle can be adjusted to the environment.

Study tour

A [WES wind- turbine-study-tour](http://www.wes18.com/index/247/study_tour) is an effective way to understand what influences the visual impact of wind turbines. Come and see with your own eyes.

**My WES18, Foundation.**

For each WES18 a site specific foundation needs to be designed.

Over the years many different type of foundations have been designed to support WES18 wind turbines. The design of a foundation depends on tower height, type of soil and local regulations. Your WES dealer knows about these regulations. WES dealers also have access to examples of previous foundations and have an overview of all mechanical loads on the foundation. Your WES dealer will work with the local authorities and a local foundation expert that will design, calculate and build the right foundation for your WES18. If needed WES civil engineers can assist your local dealer in designing a specialist foundation.

A key part in each foundation is the foundation anchor. The anchor is delivered a few months ahead of the turbine and is integrated within the concrete of the foundation. After hardening of the concrete the foundation is ready to be used. Parts of the anchor will stick out of the foundation and are used to support the lower section of the tower. The positioning of this anchor is critical. Each type of tower has its own type of anchor, its own set of fasteners and its own set of mounting instructions.

Each foundation is prepared to guide cables from the electrical topbox in the nacelle to the control cabinet. Each foundation is also prepared to conduct electricity from any lightning strike to the ground. Your WES dealer will make sure the mechanical and electrical parts of the foundation are within specifications and are in line with local and safety regulations.

For a WES18 on a 30 meter tower you need about 25 cubic meters of concrete.

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| **My WES18, Connection.**A WES18 wind turbine always needs a grid to be able to deliver its electrical energy. The type of grid that is available, the cost price for electricity and the availability of a feed-in tariff define what the best way is to connect your turbine to the grid. There are 3 ways to connect your WES18 wind turbine to the grid:

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|   |   | **1) Directly into the grid** |   |   | **2) Behind the meter**  |   |   | **3) Hybrid (wind/diesel)** |   |   |
|   |   |  |   |     |  |   |     |  |   |   |
|   |   | Electricity generated with a WES18 wind turbine can be sold back to the grid at an agreed feed in tariff.Once your WES18 is installed an approved kWh measurement device will measure the electrical energy that is exported into the grid.The measured amount of energy multiplied by the price per kWh is what will be paid back for energy production or will be deducted from your regular electricity bill.  |     |   | WES18 wind turbines can be used to reduce own energy import. The produced electricity is not measured and / or  bought by the electricity company but is used directly for own consumption. This type of configuration is called "behind the meter". Behind the meter installations are interesting in those situations where electricity consumption is high and the feed in tariff is low compared to the purchase price of electrical energy. |     |   | WES18 Hybrid turbines offer a full integration with diesel generated power.When diesel engines are used to drive generators and generate electricity economics change completely. Prices per kWh increase dramatically. When wind is available the WES18 can reduce your energy costs in a spectacular way. For more information go to the [hybrid page](http://www.wes18.com/index/76/hybrid) |   |   |
|   |   |   |   |   |  |   |   |  |   |   |

Because regulations, grants, feed-in tariff and the price of electricity can change over time it is important to be able to change the way you are paid for the energy produced by your WES18. Changes between all 3 types off connections are possible. The installation change from one configuration to another is simple and takes little time.Electricity companies all over the world are comfortable buying energy generated with WES18 wind turbines for a number of reasons, including:Maximum power limitation.The maximum power output of the WES18 can be limited through settings in the IPC control system. This can be useful when your local grid is not yet strong enough to support the maximum power generated by your WES18. Your WES dealer can adjust or remove the limitation on maximum power output of your WES18 once the grid  has been improved and is strong enough to support the full power output.Power factor improvement.The WES18 control cabinet is able to influence the power factor of your grid. Through settings in the IGBT convertors the power factor can be moved in both directions. Besides generating electrical energy the WES18 is able to improve the quality of your grid.Shut down during grid failure (anti islanding UK G59).When the grid voltage or frequency are out of tolerances or when a grid black-out occurs the WES18 will shut down automatically within tens of milliseconds. Remote access through the InternetWES18 turbines can be monitored and operated from a distance. Future connections.Your WES18 wind turbine will generate electrical energy in the same way for 20 years or more. The environment in which it will deliver its energy will change over time. Your WES18 is ready to deal with any change and will always be able to deliver its energy in the way that is most beneficial for you.Your WES dealer is aware of local situations and can calculate for you how much will be paid for electricity generated with your WES18 or how much will be saved. Your local WES dealer will inform you when changes in regulations or laws have impact on the way you are compensated for electricity generated with your WES18. |

**My WES18, Transport.**

Standard ways of transport bring your WES18 to any place on the world.

Arranging transport and delivery for a WES18 is a job for specialists. Most parts of the turbine are strong and robust while others, like the blades and control cabinet, are delicate and need extra attention when prepared for transport. Your WES dealer and the WES shipment team select the best way of transport for your wind turbine.

WES18 turbines fit in standard containers or in standard trucks. Containers are shipped from Rotterdam all over the world, ideal for deliveries outside of Europe. For European projects standard trailers will deliver your WES18 directly from the WES factory in the Netherlands to your site.

Sometimes standard 40 foot containers or big trucks cannot make it all the way to the site. In those situations the WES18 components are offloaded close to the site and delivered on site by special transport. When multiple turbines are shipped to the same location combinations are made, 4 turbines (without towers) fit for example in one container or on one truck.

WES towers are being produced all over the world by certified tower manufacturers and are often directly shipped to site. The foundation anchors are shipped ahead of the rest of the turbine and are integrated in the foundation.

**My WES18, Hoisting.**

WES18 hoisting is a job for experts and needs to be well prepared.

Your local WES dealer will select a local hoisting expert and they will make a hoisting plan for your WES18 wind turbine. If needed a member of the WES project team will be on site to assist during hoisting or hoisting preparation.

Many different questions need to be answered when a hoisting plan is made, the most important ones are:

* On what kind of soil will the crane operate?
* Are access road and working platform sufficient or is additional excavation needed?
* What crane is the best fit for the job?
* In which weather conditions is hoisting possible?
* How to offload the turbine from the truck or container?
* How to move the different components around on site?
* How to assemble sub components?
* How to assemble the complete turbine?
* How many people are needed on site and what kind of equipment is needed?
* How do the people communicate during hoisting?
* What safety regulations apply on site?

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| A WES18 with a lattice tower can be erected without a crane. Ropes, pulleys, winches, some temporary constructions and manpower allow you to construct the lattice tower without the need for a crane. Once the lattice tower has been erected the nacelle and rotor can also be lifted and connected without the use of a crane. Installing a WES18 on a lattice tower without a crane is also a job that needs to be prepared by your local WES dealer and the local construction team. If needed the WES project team can be involved. |

A WES18 wind turbine with a tubular tower is often erected using only one 70 ton crane (or bigger). The lenght of the boom should be at least 10 meters higher than the height of the tower.

**My WES18, Installation.**

The big moment, installation and commissioning of your WES18.

After months and sometimes even years of preparation everything is installed on site and your WES18 starts to produce its first profitable and clean energy. The installation of a WES18 wind turbine is something special, often local press is invited to cover the event.

WES18 wind turbines can be installed and put into service within a week. Your WES dealer takes care of project management and makes sure all the right people are on site and are prepared for their job. If needed WES engineers come over to supervise the installation and assist with the commissioning of your WES18.

During the first part of the installation the tower segments are connected and are placed on the foundation. During the next step the nacelle, rotor and blades are assembled and placed on top of the tower. All bolts and nuts get the right predefined torque to make sure the mechanical dynamics of the structure is within specs.

The electrical and Internet part comes last. Before putting the WES18 in full operation all electrical connections from turbine to control cabinet and grid have to be made and tested. During commissioning all systems and subsystems are tested, special attention is paid to the safety systems.

Within 500 hours after commissioning a maintenance job is done on site to complete the installation. After this "first 500 hour maintenance job" regular maintenance and monitoring over the Internet done by your dealer makes sure your WES18 keeps producing clean electricity for more than 20 years.

**My WES18, Maintenance.**

Little and simple maintenance, 2 times a year, keeps your WES18 running.

WES18 wind turbines have a live expectancy of more than 20 years. But in reality WES18 turbines spin much longer than 20 years. Maintenance is the key to successful and profitable service for many years. A WES18 wind turbine needs little maintenance compared with other wind turbines. The smart WES18 design with few moving parts, passive pitch and with limited loads on blades, gearbox and tower result in less forces and less wear.

Maintenance is done once every six months by a certified maintenance engineer on site who climbs up in the tower. Maintenance engineers are trained and certified in the Netherlands by WES. WES dealers work with the right maintenance engineers to do maintenance for you. If needed WES maintenance specialists assist the WES dealer.

Your WES18 is connected to the Internet, its behavior is monitored and the monitored data is stored. This data and the general behavior of the WES18 is collected in a database. This database can be approached through a website. Every WES18 has its own website and can be checked over the internet. Maintenance engineers check this site before they go to a turbine for a maintenance job. Some parts need maintenance every six months. Other parts need less maintenance, once every 1 or 3 years for example. Small maintenance jobs on a WES18 can be done in a few hours.

Wind turbine maintenance is a bit like car maintenance in this perspective, not all maintenance jobs on your car are similar.

Typical things that need to be done during half years maintenance are: General inspection of nuts and bolts, sensor check, safety features check. Typical things that need to be done during one and 3 years maintenance are: Lubrication and oil sampling.

**WES wind turbines study tour.**

Come to Holland and see for yourself.

Since the Middle Ages Holland has reclaimed land from the sea using ten thousands of wind mills, in the 15th century wind was also used to saw, grind and mix. The Dutch use of wind was peerless and brought prosperity.

About 5 decades ago Dutch engineers took the lead in global modern wind turbine development. Today still all kinds of wind turbines from all ages and in all kinds of sizes can be found in the Dutch fields.

This makes Holland an interesting place for people that want to understand more about wind turbines.

WES organizes wind turbine study tours through Holland with a focus on WES turbines. A study tour starts at 8.30 am in [Hoorn](http://www.hoorn.nl/smartsite.shtml?id=931) and ends around 5 pm in Hoorn, close to the WES factory. During the study tour you will see thousands of wind turbines, there will be stops at:

* Farms.
* Windparks.
* Maintenance companies.
* Maintenance teams in action (depending on schedules).
* WES factory.

During the tour experienced wind specialists will answer questions and explain about wind technology, design, economy, development, impact on environment and future. Also you will meet people that have owned turbines for a long time.

The best way to travel is to arrive at [Amsterdam Airport (Schiphol)](http://www.schiphol.nl/index_uk.html) the day before and travel by train (50 minutes) to Hoorn. Good hotels are available within walking distance from the Hoorn-central-train-station. After the tour the train will bring your back to the airport, arrival at airport around 6 pm.

WES windturbine study tours are interesting for:

* Future owners.
* Developers.
* Planners.

To book a WES wind study tour please contact one of our [dealers](http://www.wes18.com/index/86/dealers).

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| **WES18 Power curve**

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| There are two ways to generate a wind-turbine Power curve:•    Calculate how much energy the air passing through the swept area of the turbine can generate, or•    Measure the amount of electrical energy being produced by the system. The second way to generate a Power curve is the more reliable one. The Power curve for the WES18 has been measured by the ( [ECN](http://www.ecn.nl/home/) ) the Dutch Energy Research Centre.  |
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| WES dealers use the results of these measurements and have access to the detailed Power curve data. WES dealers can make an accurate calculation of the amount of energy that can be produced in your specific environment.Use the WES18 calculator for a first production estimation for your site. |   |

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| http://www.wes18.com/../files/foto/small/calculator_250.jpgWES18 calculator  |

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| http://wes18.com/files/foto/medium/wes18_PV_500.jpg   |

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| **Wind speed [m/s]** |  **Power [kW]** |
| 2,7 | Cut-in wind speed |
| 3 | 0,8 |
| 4 | 2,9 |
| 5 | 6,0 |
| 6 | 11,0 |
| 7 | 17,7 |
| 8 | 27,7 |
| 9 | 39,2 |
| 10 | 51,4 |
| 11 | 63,8 |
| 12 | 74,2 |
| 13 | 79,9 |
| 14 | 82,2 |
| 15 - 25 | 83,0 |

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|  |  |
| http://wes18.com/files/foto/medium/wes18_EP_500.jpg |

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| **Wind speed [m/s]** |   **Annual energy [MWh]** |
|   4,0 |   52 |
|   4,5 |   74 |
|   5,0 |   102 |
|   5,5 |   130 |
|   6,0 |   161 |
|   6,5 |   193 |
|   7,0 |   224 |
|   7,5 |   256 |
|   8,0 |   284 |
|   8,5 |   313 |
|   9,0 |   341 |
|   more than 9 |   341 + |

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**WES18 Rotor**

The rotor of the WES18 has two blades. With a length of 7.8 meters for each blade, the overall rotor diameter is 18 meters. For this reason the wind turbine is called WES18. The blades are made of carbon- and glass fiber reinforced epoxy. They are light, strong and flexible and are well protected against erosion by a shock absorbing coating on the leading edge. A WES18 blade weighs less than 100 kilogram. Initially designed over 25 years ago, the blades have been thoroughly tested and optimized over the years.

The blades are connected to the rotor with a hinge. In stand still position the blades are hanging a bit backward. When the wind comes up the blades will come forward (flapping). This hinged connection results in a reduced load on the construction. This allows for a lighter construction and less maintenance and makes that the WES18 has less wear and a longer life expectancy compared to other turbines.

The way this flapping works: In stand still position the wind will push the blades in the direction of the tower. The hinged connection of the blades make that the position of the blades is then slightly backward. Starting to rotate the blades will come forward due to the centrifugal forces on the blades. In final position the blades will form a "flat" circle. Changing wind (and therefore RPM and thus centrifugal forces) and changing pressure due to the blade passing the tower will make the blades to flap.

The right blade-angle is important for the efficiency of the rotor. The balance of the blades together with the springs in the rotor will set the angle of the blades (pitching). A synchronization mechanism in the centre of rotor makes that the angle of both blades is always the same. Wind speeds less than 13 m/s will not affect the blade-angle, the blades remain in their maximum position. When the wind speed gets above 13 m/s, the increased rotor speed will activate the passive blade-angle adjustment. The blades become less efficient, the rotor speed will maximize to about 120rpm and the result is that power output of the turbine is limited to a nominal value of 80 kW. This mechanism is the first safety system of the WES18 wind turbine.

# **WES18 Hybrid**

When sufficient wind is available in a remote, isolated grid, area the WES18 Hybridsystem can reduce energy costs in a spectacular way.

## Introduction:

Diesel generators are often used to produce electricity in remote areas with isolated grids. Electricity generated in this way is expensive. Besides the purchase price for diesel there are other specific costs that have to be taken in to account. Costs for transport and storage and costs of losses, for example. On top of this diesel generators are not very efficient and will generate about 3 to 4 kWh out of one litre of diesel. As a result the price for electrical energy in isolated grids is high, sometimes up to 80 Euro cent per kWh. On this web page we present total costs overviews of 3 cases.

## How does it work:

The hardware of the WES18 Hybrid is identical to the hardware of the WES18. Electrical energy is transferred from the turbine into the wind / diesel grid through an IGBT AC/DC/AC converter in the control cabinet. The three-phase alternating current generated by the generator is transformed to a direct current (AC/DC conversion). This direct current is converted back into an alternating current (DC/AC conversion). The last AC/DC conversion generates an AC current that is synchronous to the wind / diesel grid. The difference between the two systems is the software. The WES18 Hybrid system uses the IGBT convertors to generate frequencies slightly higher or lower than what the isolated grid is asking for. In this way the behaviour of the diesel generator is influenced. The diesel generator will only generate electricity when the WES18 Hybrid system is not able to deliver enough. On top of this the WES18 Hybrid takes full advantage of the characteristic of the a-synchronous generator and the inertia of the spinning parts of the turbine to prevent power gaps. There is no limitation to the number of Hybrid systems that can be installed in one isolated grid. WES18 Hybrid systems and WES30 Hybrid systems can both be used simultaneously in the same isolated grid.

## Easy installation:

A WES18 Hybrid system fits in a standard foot container or truck and, when lattice towers are being used it can be even installed without a crane. Installing a WES18 Hybrid system does not take any longer than installing a WES18.

## Scalable:

The WES18 Hybrid system can be scaled easily to match your specific growing energy requirements. There is no limitation to the number of WES18 or WES30 Hybrid systems you can combine in one wind/diesel grid, nor is there a limitation to the number of diesel generators in the wind/diesel grid. The diesel generators and the WES Hybrid systems do not have to be installed near each other, they can be installed (even with step-up and step-down transformers) a long way apart from each other. The system works as long as all is connected to the same wind/diesel grid.

## Cost effective:

The WES18 Hybrid system is cost effective. The WES18 Hybrid collaborates with the diesel generators without the need for additional hardware (such as: a flywheel, dumpload, battery storage, data lines, sensors and central energy management system). A grid connection is the only connection needed for a WES18 to deliver energy into the isolated grid and start reducing energy costs.

## Example calculations:

Click here for some [example calculations](http://www.wes18.com/index/240/calculations_for_wes18_hybrid). The data used in these cases was taken from calculations made for customers using remote, isolated diesel grids.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   |   | **(Variables are in bolt)** |   |   | **[Dimension]** |   |   | **Case 1** |   |   | **Case 2**  |   |   | **Case 3**  |   |   |
|   |   |  |   |   |  |   |   |  |   |   |  |   |   |  |   |   |
|   |   | Energy consumption per year  |   |   | kWh  |   |   | 1.000.000  |   |   | 1.000.000 |   |   | 1.000.000 |   |   |
|   |   | **Diesel performance**  |   |   | kWh / liter diesel  |   |   | **2,5**  |   |   | **3,0** |   |   | **3,5** |   |   |
|   |   | Diesel losses  |   |   | %  |   |   | 10  |   |   | 10  |   |   | 10 |   |   |
|   |   | Litres diesel needed (Including losses)  |   |   | Liter  |   |   | 440.000 |   |   | 314.286  |   |   | 314.286 |   |   |
|   |   | **Purchase price diesel**  |   |   | Euro / liter |   |   | **0,70**  |   |   | **0,65**  |   |   | **0,60** |   |   |
|   |   | **Transport costs diesel**  |   |   | Euro / liter  |   |   | **0,30**  |   |   | **0,20** |   |   | **0,10** |   |   |
|   |   | **Storage costs diesel**  |   |   | Euro / liter  |   |   | **0,20**  |   |   | **0,15** |   |   | **0,10** |   |   |
|   |   | Total yearly fuel costs  |   |   | Euro  |   |   | 528.000 |   |   | 298.571  |   |   | 251.429 |   |   |
|   |   | Costs per kWh  |   |   | Euro / kWh  |   |   | 0,53 |   |   | 0,37  |   |   | 0,25 |   |   |
|   |   | **Wind speed**  |   |   | meter / sec  |   |   | **7,5**  |   |   | **7,0** |   |   | **6,5** |   |   |
|   |   | Energy production  |   |   | kWh / year |   |   | 256.000  |   |   | 225.000 |   |   | 193.000 |   |   |
|   |   | Fuel costs saved  |   |   | Euro/ year |   |   | 135.168  |   |   | 82.500 |   |   | 48.526 |   |   |
|   |   | Estimation of payback  |   |   | Years |   |   | 1 to 2 |   |   | 2 to 3 |   |   | 3 to 5 |   |   |
|   |   |   |   |   |  |   |   |  |   |   |  |   |   |  |   |   |

# **WES18 Nacelle**

The nacelle is the box on top of the tower that contains equipment such as gearbox, generator, yaw-system and control system. The base plate of the nacelle is made of hot dip galvanized steel. The yaw bearing connects the nacelle to the tower and makes that it can be positioned facing the wind.

## Visual impact

The WES18 nacelle is light and small compared with the nacelle of other (in power comparable) wind turbines, in some cases a WES18 nacelle weighs 4 times less.

The working platforms on both side of WES turbines are made of rack material and combine low visual impact with efficient, spacious and save working environments for technicians. These working platforms help WES turbines fade away in the background. Klick [here](http://www.wes18.com/index/246/visual_impact) for more about the limited visual impact of WES turbines.

## Gearbox

The FLENDER gearbox increases, in two stages with a ratio of 1:20, the rotor speed to the working range of the generator (1200 to 2400 rpm). The rotor is directly mounted to the low speed shaft of the gearbox. The generator is connected to the high-speed shaft of the gearbox with a flexible coupling. When the turbine is in its parking position (120 degrees out of the wind), the wind will be at the back side of the blades.

A blocking device in the gearbox prevents the rotor from turning the wrong way (anti-clockwise). The rotor will come to a stand-still. During maintenance it is required that the rotor is blocked. After bringing the turbine in its parking position a pin will be put in manually to block the high-speed shaft of the gearbox.

## Generator

The generator is a 4-pole a-synchronous generator especially manufactured for wind turbine applications by ABB in Finland. Since an a-synchronous generator is brushless, it is virtually maintenance free. The generator is totally enclosed and cooled by a fan, directly mounted on the shaft. The nominal power of the generator is 80 kW. The reactive current, needed to allow the generator to build up a magnetic field, is obtained from a capacitor package.

The choice for a a-synchronous generator is key in the WES18 design. Fluctuations in wind speed are absorbed by rotor and generator frequency. Fluctuations in wind speed do not cause fluctuations in loads on blades, gearbox or tower. This is the main reason why the WES18 has a long live expectancy and needs little maintenance. The combination of an a-synchronous generator and IGBT technology allows the WES18 to deliver electricity in weak or small grids.

## Yaw system

The yaw-system turns the nacelle in or out of the wind. The IPC in the control cabinet collects wind data from wind vane and anemometer and directs the nacelle through the yaw-system. In case of a grid failure the yaw-motor will be, through a capacitor bank, directly connected to the generator. As a result the turbine will yaw out of the wind to the parking position all by itself.

## Sensors

Several sensors such as wind vane, anemometer, imbalance sensor, rotation counter and cable twist sensor are located in the nacelle and connected to IPC. Based on the information from these sensors the IPC will direct the turbine or stop it when needed.

**WES18 Tower**

A variety of towers is available for the WES18. Tubular towers come in different lengths: 18, 24, 30 or 39 meter. The hot dip galvanized steel tubular tower consists of cylindrical parts, mounted to each other with flanges. The 18, 24 and 30m towers are made from straight pipes, the 39m tower is conical. All towers have an external ladder with safety cable for the fall-protection gear of the maintenance engineer.

A WES18 with tubular tower can be erected with one crane, there is no need for a second one. If a heavy lifting crane is not available, or if the terrain does not allow access, a specially designed lattice tower can be used. The lattice tower is 32 meters high and, together with the nacelle and rotor, can be erected without crane.

A WES18 tower fits in a standard container or truck an can be delivered all over the world. A number of selected manufacturers around the globe can produce WES' towers, reducing transport costs.

**WES18 Controller**

The control of the WES18 is based on a Industrial PC or IPC. This IPC based system acts like a PLC and has I/O modules in the control cabinet and a remote I/O unit in the nacelle.

All sensors in the nacelle, switches, relays and the converter are wired to the I/O modules in the control cabinet. The IPC also runs an internal Ethernet LAN which connects the IPC to the I/O modules, the converter and the local control panel.

The control panel is located on the control cabinet door for friendly user interface. The screen shows the actual wind speed, wind direction, rotor-speed and the generated power. It also provides the cumulative kWh production and the historical data. Using the buttons on the control panel, parameters controlling the behavior of the system can be changed. Some of these parameters can be set remotely over the Internet as well.

The controller and the electrical system are 'fail-safe' designed, which means that in case of a failure the turbine goes in a safe position.
The IPC logs detailed information about any failure. WES18 turbines are connected to the Internet. System log files, status reports, wind speed, the actual and cumulated performance can be monitored remotely. Each turbine can have it's own URL, login and password and can be reached through any Internet browser.

**WES18 Electrical**

Electrical energy is generated by the generator in the nacelle of the WES18. Cables run from the generator to the control cabinet. The flexible cable loop in the top of the tower is protected from twisting by an anti-twist sensor. When the nacelle has made 3 complete rotations in one direction the control system orders the yaw system to unwind the cables by turning the nacelle 3 times in the other direction.

The control cabinet is positioned in a shed nearby the tower. For safety reasons you have to be able to see the turbine reacting when operating the control panel on the control cabinet door.

The advanced IGBT technology makes the WES18 a relatively easy wind turbine to connect to any kind of grid. Local regulations can make that some components or security devices have to be adapted. Your WES dealer is aware of the specific regulations and restriction from your local electricity company.

Grid companies develop and upgrade their grids all the time, the WES18 control cabinet is designed to deal with this. The maximum power output of the WES18 can be set to a level lower than 80kWatt. This can be handy when your local grid is not strong enough to support the maximum power. Your WES dealer can adjust or remove the limitation on maximum power output of your WES18 once you can use all the electricity yourself or the grid has been improved and is strong enough to support the full power output.

# **WES18 Hybrid**

When sufficient wind is available in a remote, isolated grid, area the WES18 Hybridsystem can reduce energy costs in a spectacular way.

## Introduction:

Diesel generators are often used to produce electricity in remote areas with isolated grids. Electricity generated in this way is expensive. Besides the purchase price for diesel there are other specific costs that have to be taken in to account. Costs for transport and storage and costs of losses, for example. On top of this diesel generators are not very efficient and will generate about 3 to 4 kWh out of one litre of diesel. As a result the price for electrical energy in isolated grids is high, sometimes up to 80 Euro cent per kWh. On this web page we present total costs overviews of 3 cases.

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| How does it work: The hardware of the WES18 Hybrid is identical to the hardware of the WES18. Electrical energy is transferred from the turbine into the wind / diesel grid through an IGBT AC/DC/AC converter in the control cabinet. The three-phase alternating current generated by the generator is transformed to a direct current (AC/DC conversion). This direct current is converted back into an alternating current (DC/AC conversion). The last AC/DC conversion generates an AC current that is synchronous to the wind / diesel grid.  |     |     | Movie about the WES Hybrid system. |

The difference between the two systems is the software. The WES18 Hybrid system uses the IGBT convertors to generate frequencies slightly higher or lower than what the isolated grid is asking for. In this way the behaviour of the diesel generator is influenced. The diesel generator will only generate electricity when the WES18 Hybrid system is not able to deliver enough. On top of this the WES18 Hybrid takes full advantage of the characteristic of the a-synchronous generator and the inertia of the spinning parts of the turbine to prevent power gaps. There is no limitation to the number of Hybrid systems that can be installed in one isolated grid. WES18 Hybrid systems and WES30 Hybrid systems can both be used simultaneously in the same isolated grid.

## Easy installation:

A WES18 Hybrid system fits in a standard foot container or truck and, when lattice towers are being used it can be even installed without a crane. Installing a WES18 Hybrid system does not take any longer than installing a WES18.

## Scalable:

The WES18 Hybrid system can be scaled easily to match your specific growing energy requirements. There is no limitation to the number of WES18 or WES30 Hybrid systems you can combine in one wind/diesel grid, nor is there a limitation to the number of diesel generators in the wind/diesel grid. The diesel generators and the WES Hybrid systems do not have to be installed near each other, they can be installed (even with step-up and step-down transformers) a long way apart from each other. The system works as long as all is connected to the same wind/diesel grid.

## Cost effective:

The WES18 Hybrid system is cost effective. The WES18 Hybrid collaborates with the diesel generators without the need for additional hardware (such as: a flywheel, dumpload, battery storage, data lines, sensors and central energy management system). A grid connection is the only connection needed for a WES18 to deliver energy into the isolated grid and start reducing energy costs.

## Example calculations:

Below some example calculations. The data used in these cases is taken from calculations we have made for some of our customers using remote, isolated diesel grids.

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|   |   | **(Variables are in bolt)** |   |   | **[Dimension]** |   |   | **Case 1** |   |   | **Case 2**  |   |   | **Case 3**  |   |   |
|   |   |  |   |   |  |   |   |  |   |   |  |   |   |  |   |   |
|   |   | Energy consumption per year  |   |   | kWh  |   |   | 1.000.000  |   |   | 1.000.000 |   |   | 1.000.000 |   |   |
|   |   | **Diesel performance**  |   |   | kWh / liter diesel  |   |   | **2,5**  |   |   | **3,0** |   |   | **3,5** |   |   |
|   |   | Diesel losses  |   |   | %  |   |   | 10  |   |   | 10  |   |   | 10 |   |   |
|   |   | Litres diesel needed (Including losses)  |   |   | Liter  |   |   | 440.000 |   |   | 314.286  |   |   | 314.286 |   |   |
|   |   | **Purchase price diesel**  |   |   | Euro / liter |   |   | **0,70**  |   |   | **0,65**  |   |   | **0,60** |   |   |
|   |   | **Transport costs diesel**  |   |   | Euro / liter  |   |   | **0,30**  |   |   | **0,20** |   |   | **0,10** |   |   |
|   |   | **Storage costs diesel**  |   |   | Euro / liter  |   |   | **0,20**  |   |   | **0,15** |   |   | **0,10** |   |   |
|   |   | Total yearly fuel costs  |   |   | Euro  |   |   | 528.000 |   |   | 298.571  |   |   | 251.429 |   |   |
|   |   | Costs per kWh  |   |   | Euro / kWh  |   |   | 0,53 |   |   | 0,37  |   |   | 0,25 |   |   |
|   |   | **Wind speed**  |   |   | meter / sec  |   |   | **7,5**  |   |   | **7,0** |   |   | **6,5** |   |   |
|   |   | Energy production  |   |   | kWh / year |   |   | 256.000  |   |   | 225.000 |   |   | 193.000 |   |   |
|   |   | Fuel costs saved  |   |   | Euro/ year |   |   | 135.168  |   |   | 82.500 |   |   | 48.526 |   |   |
|   |   | Estimation of payback  |   |   | Years |   |   | 1 to 2 |   |   | 2 to 3 |   |   | 3 to 5 |   |   |
|   |   |   |   |   |  |   |   |  |   |   |  |   |   |  |   |   |

[Click here](http://www.wes18.com/files/pdf/Complete_Description_WES30_Hybrid.pdf) to download a complete description

**WES R&D**

WES turbines have been available for many years. WES18 and WES30 wind turbines are successful and proven wind turbines. But over time WES will constantly improve and update or add new features to the turbine.

Because of its robustness and reliability WES turbines are also used to proof new wind energy concepts.

When a WES Turbine is installed in an extreme temperature location (< -20°C), the WES R&D team gets also involved to make sure the WES turbine will keep on running safely. In extreme cold conditions vital parts of the WES turbines are heated or replaced by specialties. In extreme hot conditions cooling needs extra attention. In locations with tornados and hurricanes the rotor with the blades can be winched down (before the storm) and can be re-installed afterwards without the use of a crane. In this way the WES turbines will survive wind speeds above the standard survival wind speed of 60 m/s (134mph).

In some situations WES R&D works on grid related challenges. When a WES turbine is connected to a small or weak grid IGBT converters need to be adjusted to work in the right way and (if requested) improve the quality of the local grid.

In remote areas transport and hoisting can be a problem. In that case the WES R&D team will assist our local dealer and will develop special tools and/or methods to conquer the challenges and install the turbine.

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| **WES18 Specifications**WES18 General  |
| Supplier/manufacturer  | WES BV  |
| Life expectancy  | 20 years  |
| Service/maintenance  | Twice a year  |
| Nominal power  | 80 kW  |
| Cut in wind speed  | 2.7 m/sec. (6.04mph)  |
| Cut out wind speed  | 25 m/sec. (56mph)  |
| Nominal wind speed  | 13 m/sec. (29mph)  |
| Survival wind speed  | 60 m/sec. (134mph)  |
| Passive power regulation  | Pitching (blade-angle adjustment)   |
| Active power regulation  | Fully variable back-to-back IGBT system  |
| Noise emission at 8 m/s  | 45dB(a) at 100m  |
| Operating temperatures  | From -20°C up to +40°C  |
|   |    |

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| WES18 Applied standards  |
| Degree of protection  | IP55  |
| Standards  | NEN1010 (electrical) EN50308 (safety) EN6096 (wind turbines) UL1741 (anti islanding) IIEC61346-2000 (cabinet)  |
| CE-mark  | yes  |
|   |   |

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| WES18 Electrical |
| Grid voltage  | 400V ±10%  |
| Grid frequency  | 50/60Hz ±3Hz  |
| # Phases  | 3 phase + neutral  |
| Specific power  | 315 W/m2  |
| Converter type  | Back-to-back IGBT converter  |
|   |   |

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| WES18 Blades |
| Number of blades  | 2  |
| Diameter  | 18 m  |
| Position  | Upwind  |
| Direction  | clockwise  |
| Angle of the main shaft  | 7 deg with horizontal  |
| Swept area  | 254 m2  |
| Speed  | variable 60 -120 rotations per minute  |
| Power regulation  | Passive pitching (blade-angle adjustment)  |
| Min. blade-angle  | 1.0  |
| Flapping angle  | 180 -164  |

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| Blade length  | 7,8 m  |
| Weight (1 blade)  | 100kg  |
| Chord  | 500 – 625mm  |
| Twist  | 5 deg  |
| Mounted  | flexible  |
|   |
| WES18 Gearbox |
| Brand  | Flender (Siemens)  |
| Number of stages  | 2  |
| Weight  | 820kg (incl. oil)  |
| Ratio  | 1:20  |
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| WES18 Generator |
| Brand  | ABB  |
| Type  | a-synchronous  |
| Nominal power  | 80 kW  |
| Number of poles  | 4  |
| Nominal voltage  | 230/400 volt  |
| Frequency  | Variable: 40 - 80 Hz.  |
| Weight  | 400kg  |
| Protection  | IP 55  |
|   |   |

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| WES18 Tower |
| Type  | Tubular  |
| Number of sections  |   3  |
| Tower height  |   18, 24, 30, 39m  |
| Material  |   Hot dip galvanised steel  |
| Location ladder  |   External  |
| Type  | Lattice  |
| Tower height  |   32 m  |
| Material  |   Hot dip galvanised steel  |
| Location ladder  |   External  |
|   |   |

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| WES18 Controller |
| Control by  | IPC (Beckhoff)  |
| Remote monitoring  | Yes  |
| Data logging  | Optional  |
|   |   |

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| WES18 Yaw-system |
| Yaw system  | active  |
| Signal from  | wind vane  |
| Driven by  | Electro motor with worm-wheel reduction  |
| Power yaw-motor  | 0,55 kW  |
| Yaw speed  | 1,20/sec.  |
| Yaw bearing  | Single ball bearing; externally geared (Rothe Erde)  |
| Yaw-brakes  | Constant friction-brakes; 4 pcs.  |
|   |   |

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| WES18 Safety |
| First safety system  | Passive blade pitching  |
| activated by:  | * rotor speed (110 rpm)
 |
| Second safety system  | Yawing out of the wind  |
| activated by  | * rotor speed (>120 rpm)
* excessive vibrations
* failure anemometer or wind vane
* failure in one of IPC’s
* grid failure
* too high generator or inverter temperature
* fault in yawing system
 |
| Blocking system  |  |
| rotor blocking system  | pin in high speed shaft; for service purposes  |
| activation  | manual  |
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| WES18 Weights |

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| Rotor incl. blades  | 1.100 kg  |
| Nacelle excluding rotor  | 2.200 kg  |
| Control cabinet  | 400 kg  |
| Tower  | 7.820 kg (30 m. tower)  |
|   |   |

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| WES18 Material specifications |
| Blades  | Carbon and glass fible reinforced epoxy  |
| Nacelle/rotor  | Steel  |
| Covers  | Polyester  |
| Tower  | Steel (hot dip galvanised)  |
| Foundation  | Concrete Block with steel anchor  |

**Projects**

**Dealers**

# **WES Windfacts**

On this page you will find general information about wind energy. Click on the questions below to read the answers.

[Q1) How does a wind turbine make electricity?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q001)
[Q2) What influences the output of the wind turbine?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q002)
[Q3) How much of the time do wind turbines produce electricity?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q003)
[Q4) Two-bladed versus Three-bladed Wind turbines, waht is the difference?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q004)
[Q5) How safe is wind energy?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q005)
[Q6) Local law and subsidies](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q006)
[Q7) What advantages do I get if I place the wind turbine?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q007)
[Q8) Do I need permission for placing a wind turbine?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q008)
[Q9) How much wind is needed to produce electricity?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q009)
[Q10) How do I read the characteristics?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q010)
[Q11) How much service cost is there?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q011)
[Q12) If I supply the over production to the grid, will I get paid for?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q012)
[Q13) How much will the power company pay per kWh?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q013)
[Q14) Can I use a wind turbine without a connection to the power grid (electricity network)?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q014)
[Q15) What is the life expectancy of a wind turbine?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q015)
[Q)16 Who does the service and maintenance on my wind turbine?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q016)
[Q)17 Do I need a grid connection?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q018)
[Q)18 Can I use a wind turbine in a diesel-powered grid?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q019)
[Q)19 My farm/factory uses a lot of electricity. Can I use wind energy?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q021)
[Q)20 I live in a hurricane-prone area. What pre-cautions do I take to protect my wind turbine?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q22)
[Q)21 Does the wind turbine switch on and off automatically when the wind speed changes?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q023)
[Q)22 Does wind energy have an impact on the environment?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q024)
[Q)23 Do wind turbines influence birds?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q025)
[Q)24 Do wind turbines frighten livestock?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q026)
[Q)25 Are wind turbines noisy?](http://www.wes18.com/cms/de/editor.php?name=deContent&refresh=2107405404#Q027)

+ the answers.

**Info; Call to Action Form**