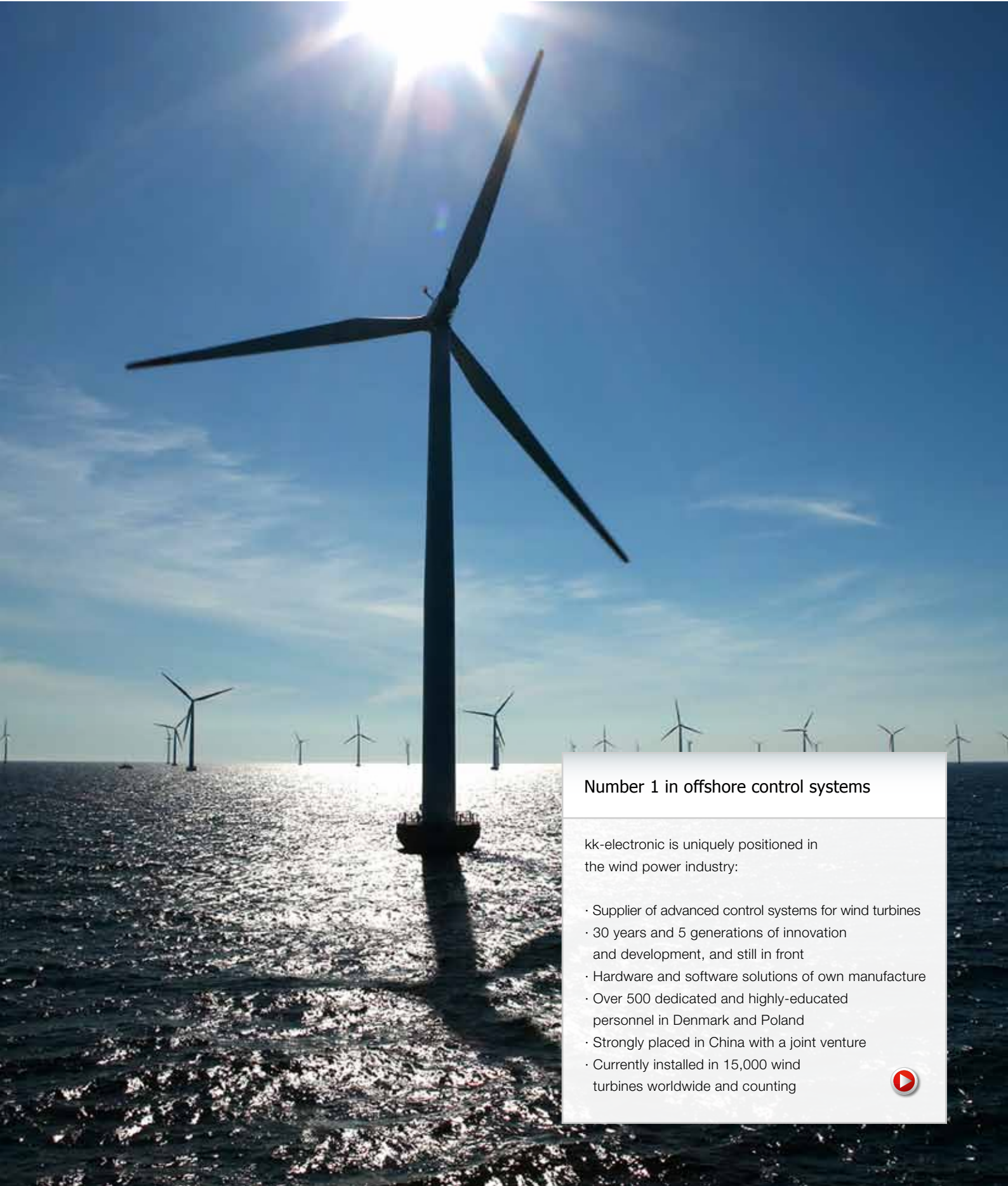




kk-electronic®



Number 1 in offshore control systems

kk-electronic is uniquely positioned in the wind power industry:

- Supplier of advanced control systems for wind turbines
- 30 years and 5 generations of innovation and development, and still in front
- Hardware and software solutions of own manufacture
- Over 500 dedicated and highly-educated personnel in Denmark and Poland
- Strongly placed in China with a joint venture
- Currently installed in 15,000 wind turbines worldwide and counting



"30 years ago, the wind turbine industry was born from a desire to harness wind power. kk-electronic has been a part of this growth from the start, making this possible – and we are still deeply committed to the industry."
Tommy Gundelund Jespersen, CEO, kk-electronic

Nature cannot be tamed, but it can be managed for maximum performance

The wind energy industry is in a period of global consolidation and enormous growth. Energy suppliers and industrial companies share this challenge of changing the nature of wind farm investment, and interconnecting multiple energy sources to the power grids.

More than ever there is a need for turnkey solutions that satisfy the needs of wind turbine manufacturers. For three decades kk-electronic has evolved together with the wind energy industry, supplying innovative advanced control solutions that match perfectly the market of today.

Advanced control solutions from kk-electronic are currently inside more than 15,000 onshore and offshore installations as you read this. We are number one in offshore control systems, because we know and understand your business, and our solutions are tailored to precisely your application.

Greater complexity + the right control solution = more added value

At approximately 5% of the investment and yet many times that in value, an investment in the right advanced control system pays for itself in no time. kk-electronic is a total solution provider, supplying a complete electronic control solution that integrates seamlessly with the customer's system.

We are uniquely placed to deliver

kk-electronic is uniquely placed to tackle the challenges of growing complexity of wind turbines, and the design elements in advanced control solutions from kk-electronic reflect this. We add more than just the "standard features" such as protection against lightning, corrosion from salt and humidity, redundancy of critical components with more sensors and feedback points, data logging, remote software updating, and much more.

Uniquely strong position in the wind power control industry

kk-electronic develops hardware and software control solutions for wind turbines. We cover all electrical systems in the wind turbine – the main controller, pitch, yaw, converter, supervisory systems, communications, grid connection, wiring and an electrical system integrator.

Through 30 years and 5 generations of control systems, kk-electronic has built up an unparalleled record of innovative project management covering design and prototype development, batch production and commissioning in the wind turbine. We conduct quality and durability testing using verifiable procedures.

- **proven technology** – with almost 50% of current installations, no one's bigger in offshore applications
- **rapid time-to-market** – iterative process ensures the right product at the right price delivered on-time, verifiable by you
- **tailored solutions** – match your needs
- **protection for your investment** – your wind power turbines will run to the highest possible rates of effectiveness, securing energy supply and reducing downtime.

Keeping the green energy vision alive



As the scale of green energy production from clean technology increases, so too does the need for advanced control. The vision continues to grow – from the initial land-based wind turbines in the late 1970s to today, where major offshore wind farms are closely integrated with other energy generation sources.

– and under advanced control



Advanced control systems offer fantastic opportunities for managing the entire energy sector. kk-electronic supplies advanced control systems that meet the demands of the modern power grid. We ensure stable energy supply from remote areas on land or at sea, reducing risk and keeping the clean and green vision alive.



kk-electronic®




"We needed experience, skills and innovation for our new 5MW Offshore Turbine. Therefore we chose kk-electronic."
 Director Jörg Fangman, Bard Emden Energy


The future lies offshore



There's more to this than meets the eye



An advanced control solution from kk-electronic ensures that each wind turbine is optimised individually, taking into account the specific risk factors with installations at sea. Park Power Management control then ensures optimum delivery to the grid, integrating delivery from other wind farms as well as from land-based energy generation sources.



The strong and stable winds at sea offer great potential. Utilisation rates here are considerably higher than for onshore and near shore locations and therefore larger turbines and wind farms are planned. Advanced control systems supplied by kk-electronic meet the challenge of the open sea and make the distance from land manageable.

We're already there

As wind farms become more complex, focus is increasingly on the integration of intelligent components in more extensive control systems with better monitoring. kk-electronic can supply systems that can predict conditions and optimise the wind turbine accordingly, including better predictions for preventive maintenance.

The heavy demands of installations at sea

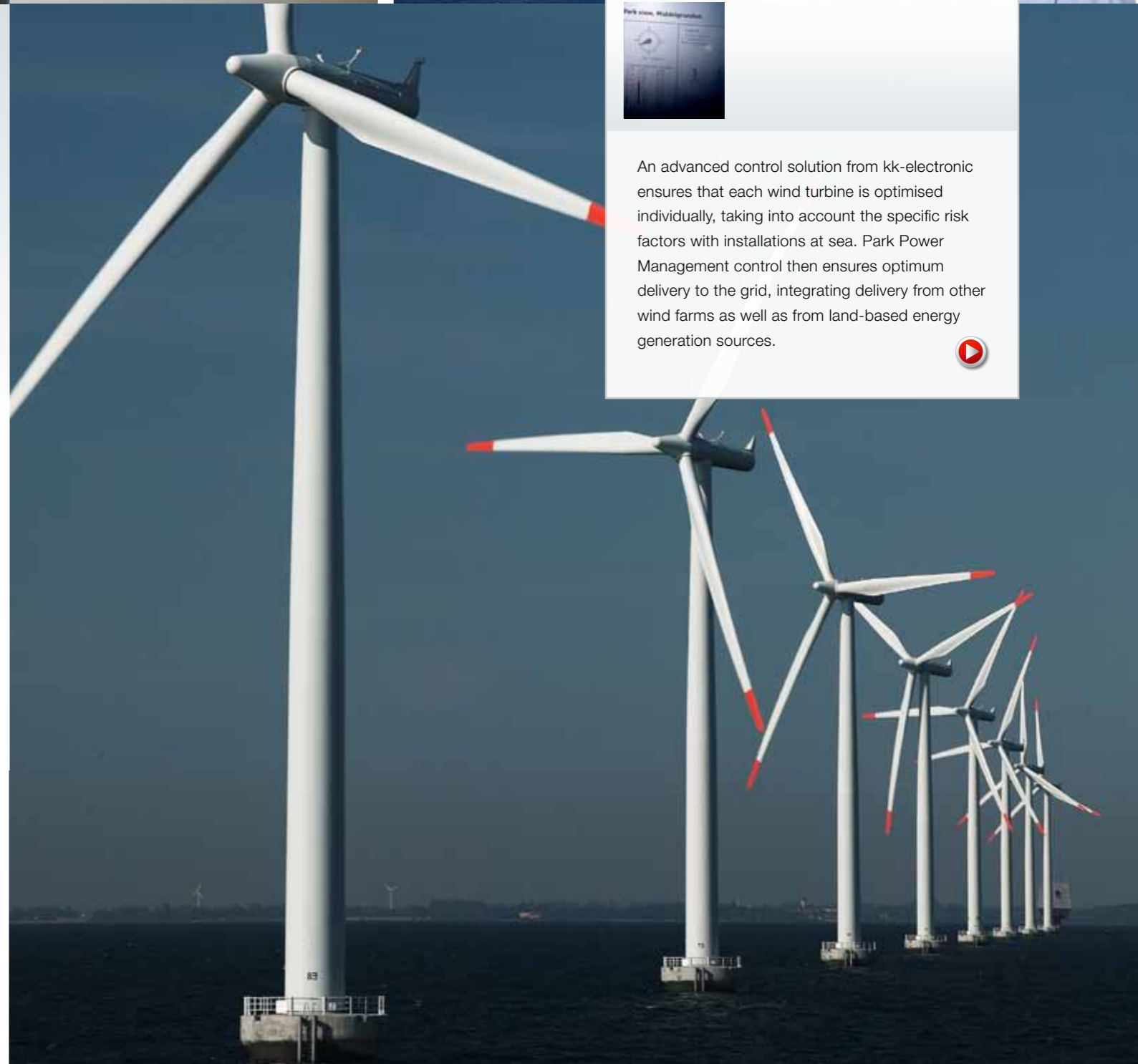
All hardware installations at sea must be protected from gusts of wind, salt water, heat and humidity. kk-electronic ensures that control systems are protected against corrosion. Heat exchanges keep the wind turbine cool, and lightning protection, power backup, and automatic resets reduce downtime. Remote management, monitoring and software updating reduces the requirement for onsite inspections.

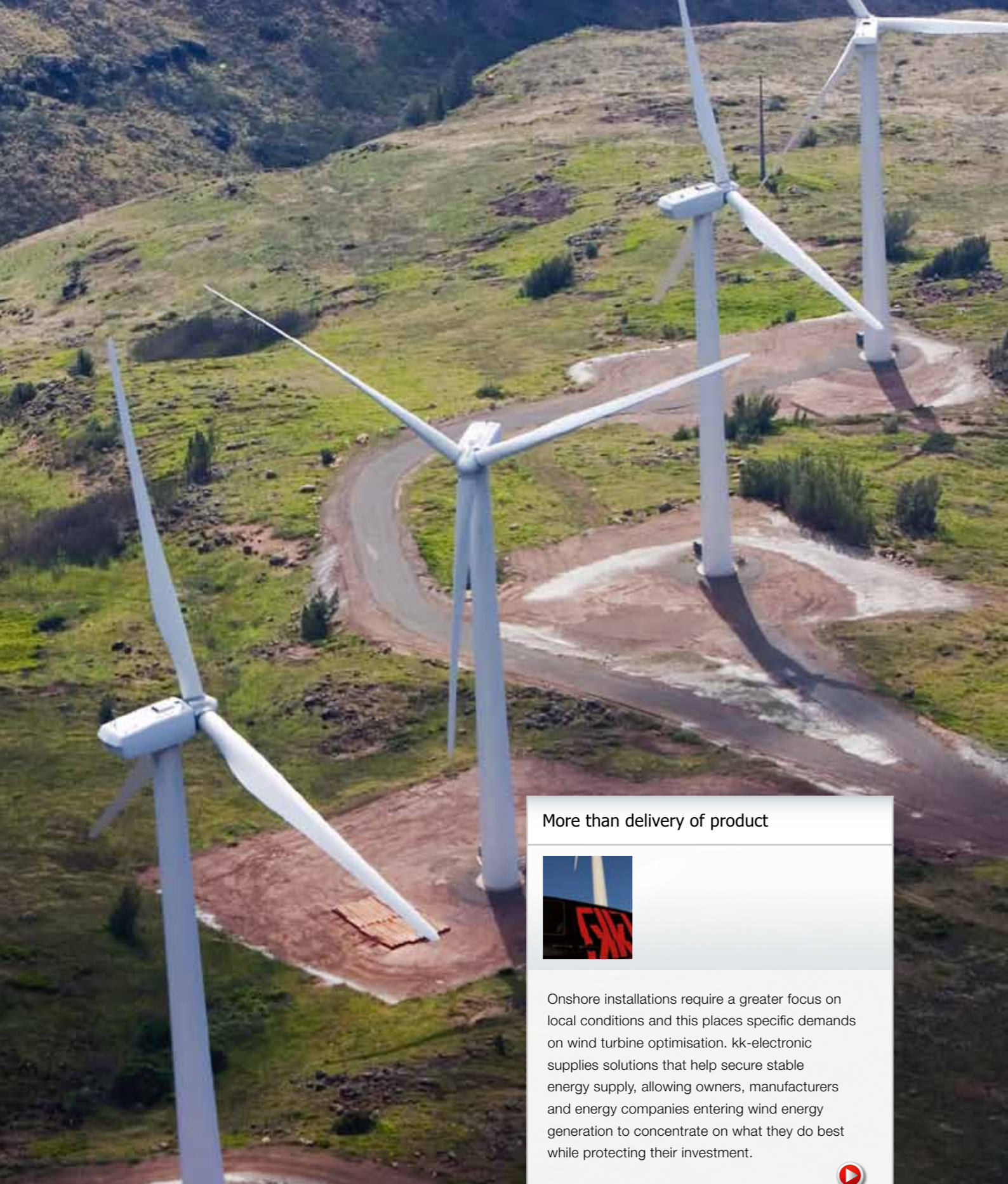
Maintaining operation even under difficult conditions

Wind farms are not always operating under blue skies and on flat seas. Strong winds, storms and high seas provide challenges for inspection, maintenance and repair visits. The accurate monitoring with data logging and the effective control and communication with power backup supplied by kk-electronic ensures that the wind turbine can be trimmed for turbulence and other extreme conditions.

Monitoring for control reduces downtime

Difficult conditions at sea make preventive maintenance and monitoring of vital parts such as rotor, shafts, bearings, gear box and generator hugely important. kk-electronic has been integrating control with monitoring offshore for 20 years, meaning that service calls can be pre-emptive rather than reactive. This reduces downtime and costly on-site maintenance.





Onshore – where placement is critical

Often, onshore wind farms are the first step for energy companies who add wind power to their energy generation sources. This is a learning process that requires the integration of a fluctuating energy source with existing systems – a process in which kk-electronic has been deeply involved for more than 30 years.

Interconnectivity – a complex requirement
Challenges for the interconnectivity of the power grid are increasing. Energy companies require the integration of fluctuating wind energy with other energy generation sources, and this is a complex process. An advanced control system from kk-electronic ensures that each individually-optimised wind turbine finds its place on the grid.

Land use and ownership, environmental concerns and impact on communities are all important considerations for onshore wind farms. Placement is critical to ensure maximum output, and wind turbines are often placed in hilly regions to exploit the topography, placing special demands on wind turbine optimisation.


Good neighbours onshore
Onshore wind farms exploit coastal and mountainous regions with good weather conditions, and consideration must be given to local communities and interests.

Lower costs, greater flexibility
Costs are falling for onshore and offshore wind farm installations, and wind power is increasing its share of power generation.

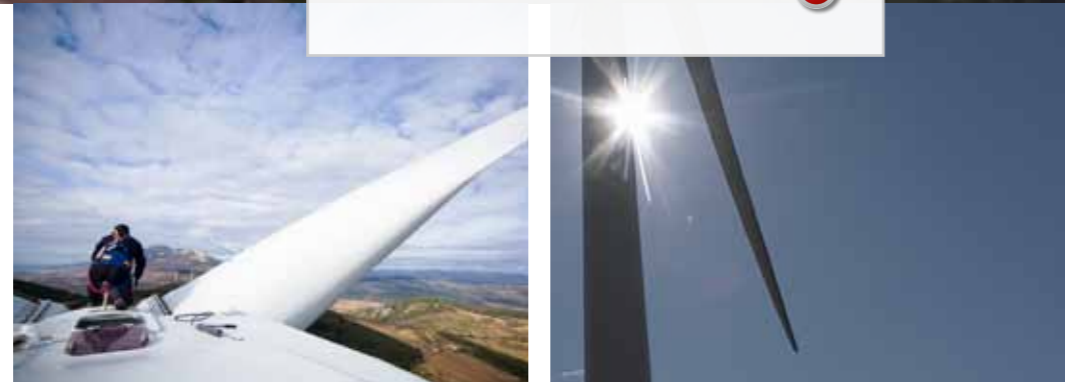

kk-electronic supply products that minimise the shadows cast from wind turbines, reduce noise, ensure optimum operation at altitude, and designed for controlling the temperature and humidity levels to ensure safe operational conditions.

In Denmark, wind power generation now makes up 20% of the total energy production, and the goal for the coming years is 50%. This places great demands on new advanced control systems that meet the demands for effectiveness measured in cost per kWh and for flexibility of energy production.

More than delivery of product



Onshore installations require a greater focus on local conditions and this places specific demands on wind turbine optimisation. kk-electronic supplies solutions that help secure stable energy supply, allowing owners, manufacturers and energy companies entering wind energy generation to concentrate on what they do best while protecting their investment.



Clean energy secures investor returns

Energy companies have highly specific concerns, ranging from the price and the security of their energy supply to public sensitivity and political trends that dictate expenditure. To reduce risk for energy companies, suppliers of advanced control solutions need to show a proven track record of reliability with clear lifetime cost benefits.

An advanced control solution from kk-electronic helps balance risk and return, and offers our partners an evolving cost structure that is cheaper for all parties in the long-term. kk-electronic understands the key issue of wind energy management: to minimise operational costs while maximising the generated power. This starts with the optimisation of each individual wind turbine.

Optimise integration between energy sources

Many electricity networks were originally planned and constructed mainly for centralised large-scale electricity generation and distribution. Today, they have to meet new demands for monitoring, integration and the requirement that different energy sources interconnect on the power grid. Advanced control solutions from kk-electronic have been doing this for years, growing as the industry has grown.

Built-in intelligence maximises returns and minimise risk

Energy companies integrate fluctuating energy sources and traditional energy sources into intelligent, flexible and reliable transmission, distribution and sales networks. Built-in intelligence from an advanced control solution from kk-electronic ensures a basis for shared IT platforms in smart grids, supporting energy companies in an energy market where technology and investment moves rapidly.

Ideal wind farm management

In recent years, the demands on advanced control systems have become greater. kk-electronic has 30 years with 5 generations of control systems to draw upon, and this is why we are able to keep wind turbines optimised and running for more than 20 years. Our solutions enable preventive maintenance for increased lifetime and help provide a solid basis for price-optimised production.

What kk-electronic brings to the table

As a single-source supplier, kk-electronic has the skills required to tailor advanced control solutions that help energy companies tackle the challenges of legislation, CO2 emission quotas, growing wind farms, integrated energy sources and interconnected grid networks. We can supply energy companies with products and solutions with integrated systems that match and even exceed future demands, adding value to investments made.



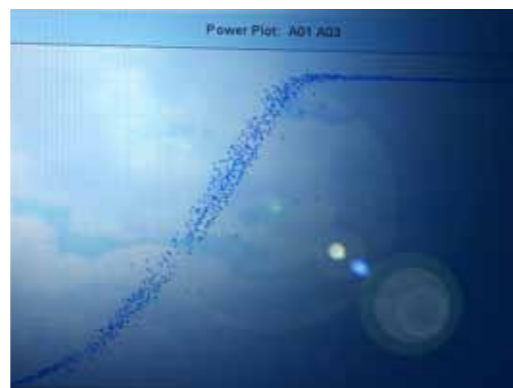
5% of your investment ...



... and yet many times that in value

As wind farms grow in size and complexity, so too does the need for advanced monitoring and control – and getting this right pays back on your investment many times over. What are the key issues for an energy company when building or expanding a wind farm? And what is the future role of advanced control in an increasingly integrated supply grid linking many energy generation sources?

To start with, wind power has negligible fuel costs, but a high initial investment. To calculate the estimated average cost per unit, consideration must be given to the cost of construction of the turbine and transmission facilities, loans, the expected return to investors with the cost of risk included, estimated annual production and other cost components, such as hardware and software costs, planned service and so on. All this is then averaged over the projected lifetime of the wind farm, which may be in excess of twenty years.



kk-electronic®

Our commitment to partnership



When you engage in a project with kk-electronic, you are not merely entering a buyers and sellers market, you are truly a part of a partnership, from the first handshake to post-implementation feedback.

- **Initiate:** We meet and agree strategic issues.
- **Requirement specification:** Identify needs with all actors, technology issues, legacy issues with existing systems and technologies, and specific wishes and demands, including feasibility and alternatives.
- **Project:** Focus on economy, management and reporting tools, and knowledge sharing.
- **Stay close:** We focus on feedback and improvements

The product design will ensure that all quality procedures and manufacturing and serviceability principles are maintained and verifiable.

The solution you get is modular and has been built incrementally according to your wishes and what we've agreed through the process. This is a cost-effective way of doing business – we save you money over time up to implementation, and you earn more from operations for the product lifetime because of less downtime.



Optimise processes with design houses and consultants

The massive investment and growth in the wind power industry has seen the appearance of many design houses and consultants. They make their services available to wind turbine manufacturers seeking turnkey solutions to get their wind turbines to market rapidly.

Design houses and consultants enter the product development process at an early stage, and kk-electronic often engage in these stages to ensure the correct definition of a control strategy. A control system connects to all functions in a wind turbine and proper definitions of the control system's functionality can be used to optimise other systems. This ultimately means the control system reduces the ultimate cost of the wind turbine and increases the value for the user.

Sharing our expertise

Cooperation and knowledge sharing are very important in the global wind industry. If a wind turbine manufacturer chooses to work with a design house or consultancy, kk-electronic helps make this cooperation possible. We do this by offering our expertise with electrical and control systems to design houses and consultancies, ensuring a perfect fit from an earlier stage in the product development process.

Setting standards for a global industry

To ensure that industry standards are set and maintained in a globalised industry with many actors, design houses and consulting companies play an important role together with many manufacturers, including developers of advanced control solutions. As the world's leading supplier of advanced control solutions, kk-electronic is very much a part of this process of setting and maintaining global standards.

There's a lot at stake

The projected lifetime of a wind turbine may be in excess of 20 years, and the investment in an advanced control solution can be just 5% of the total investment in product development. kk-electronic keeps all channels open and ensures that product development of advanced control contributes to the competitiveness of wind energy.



kk-electronic®



This industry is driven by innovation

The wind power industry has always been about creating knowledge and the ability to apply this knowledge to innovative product development. But there's more to this – to innovate and create constructively, you've got to have the right research partners and access to the right development projects.

You could say that kk-electronic is deeply embedded in knowledge creation in the wind power industry. With 5 generations of control systems behind us and an unequalled position in offshore power control, that certainly is the case.

The right research and development partners

Ensuring that the substantial public and private investments in wind energy are translated to optimised production and operation requires the right R&D partners. kk-electronic works closely with knowledge centres in Denmark, such as the National Laboratory for Sustainable Energy at Risø, Aalborg University and the Technical University of Denmark (DTU). In particular, kk-electronic continually supports a number of Ph.D. projects and ensures a real-world orientation of the research.

The correct focus on power control

In addition to working closely with energy companies such as DONG Energy in Denmark to ensure the smooth operation of complex grid networks in the future, kk-electronic works closely with many leading technology companies and hardware suppliers, covering knowledge sharing and cooperation on projects.

Dedicated to industry-wide value creation

kk-electronic is an active member of The Danish Wind Industry Association and we cooperate with other suppliers. Our involvement means we are even better placed to create value for our customers, where we work actively with performance improvements of wind turbines, of subsystems and interfaces, of the control system to prolong the life of critical components, and for the protection of wind turbines. This is knowledge we bring to each and every customer project.

Commander



– making the control choice easier for customers

The Commander concept offers the benefits of modularity for rapid development that increases speed to market, an increased return on investment, increased availability and lower system risk.

From essential modules to full customisation

Starting with a customer questionnaire to define requirements, the simple and efficient Commander concept is built up around modules with basic functions. Add-on units are available for further optimisation, and there is also the possibility of customisation of a part or of the entire solution.

"I like to say that our customers are satisfied before we are – and that is in fact the case! This is because we strive for perfection and we approach this with a passion."
Karsten Okholm, Senior Vice President, kk-electronic

Project management in a class of its own



A strong project culture guides how we will work together, ensure a transparent process and that all deliverables are on-time and as agreed.

Development project case



Our commitment to perform

The situation – Our customer is developing a product prototype. During this process, the Project Manager realises they require a connection box of a certain size and with a defined number of terminal boxes. The customer approaches kk-electronic.

The project – kk-electronic starts up a "rapid response project", as flexibility is central to our philosophy of ensuring the customer experiences cooperation with kk-electronic as positive.

The outcome – kk-electronic's project and prototype department produces drawings, documentation and a completed connection box within 2 days, ensuring the customer can meet their deadlines.



Stay close and incremental

kk-electronic develops solutions incrementally, agreeing milestones, ensuring that the product supplied fits precisely to the application. This approach ensures a close dialogue, matching expectations from start-up to commissioning and ultimately saves you money.

There's no point saying you have ambition, if you're not able to innovate and improve. Similarly, bringing passion to a project doesn't help much, if you're not able to deliver on a promise of perfection. That is why we believe in staying close to our partners, and this approach fits perfectly with an incremental product development model.

The kk-electronic philosophy

When we at kk-electronic commit to a project, we resolve it. We pride ourselves on being a single-source supplier, which means we are a total solution provider for total wind turbine control systems and electrical equipment.

Our company culture is built up around project management and innovative product development, and our focus through 30 years has been to make things easy for wind turbine manufacturers.

Product development, step by step

Incremental product development at kk-electronic involves our clients and partners in a carefully-structured project. Our model is based on a series of project stages, where the customer's involvement at each step ensures the optimum launching pad for the next stage.

For example, project identification requires an approval; the design must be verified by the customer; the construction requires an acceptance; product release leads to a formal handover to the wind turbine manufacturer; and a thorough evaluation allows us to close the project and agree an after-sales process.



kk-electronic®

The ideal factory concept – your factory under our roof

Part of the partnership you as customer will experience with kk-electronic is the sensation of having your own factory under our roof. We have ensured that all aspects of the production process are entirely under our control – and that means you have full control, too.

As a single-source supplier, kk-electronic delivers solutions that include innovative and intelligent embedded applications that add value and are future-proof, not least by minimising maintenance costs throughout the product lifetime. This is possible because kk-electronic manages all processes under one roof.

Component manufacture and quality testing in one process

Thousands of circuit boards are manufactured yearly at kk-electronic's facility, ranging from prototypes to batch production, to the assembly standard IPC 610 Class 3. Our manufacturing and test facilities are electrostatic protected areas, and we take the appropriate steps for ESD prevention.

The Surface Mount Device (SMD) production line at kk-electronic ensures capacity and capability with high accuracy and precision, and consists of SMD equipment, automatic soldering equipment, and an automatic optical test facility. Barcodes ensure complete tracking and tracing, and statistic process control for regular quality control.

Production facilities in Poland

At our facility in Szczecin, Poland, we manufacture all parts for our advanced control solutions. This high-tech facility is operated by highly specialised personnel who safeguard quality and the complex logistics when ensuring parts lists for large wind farms. kk-electronic is an ISO 9001:2000 certified manufacturer.

Prototype production

At kk-electronic, we follow-up the innovative work done by our R&D specialists by moving across the hall to our own prototype facility and test areas in Ikast, Denmark. Often the prototype is a result of a close cooperation between our own and our customer's technicians, engineers and specialists.

The short distance from thought to action adds value to the development process through knowledge sharing, a deeper understanding of needs, and ensuring agreement at every stage.

Completely tested in our own facilities

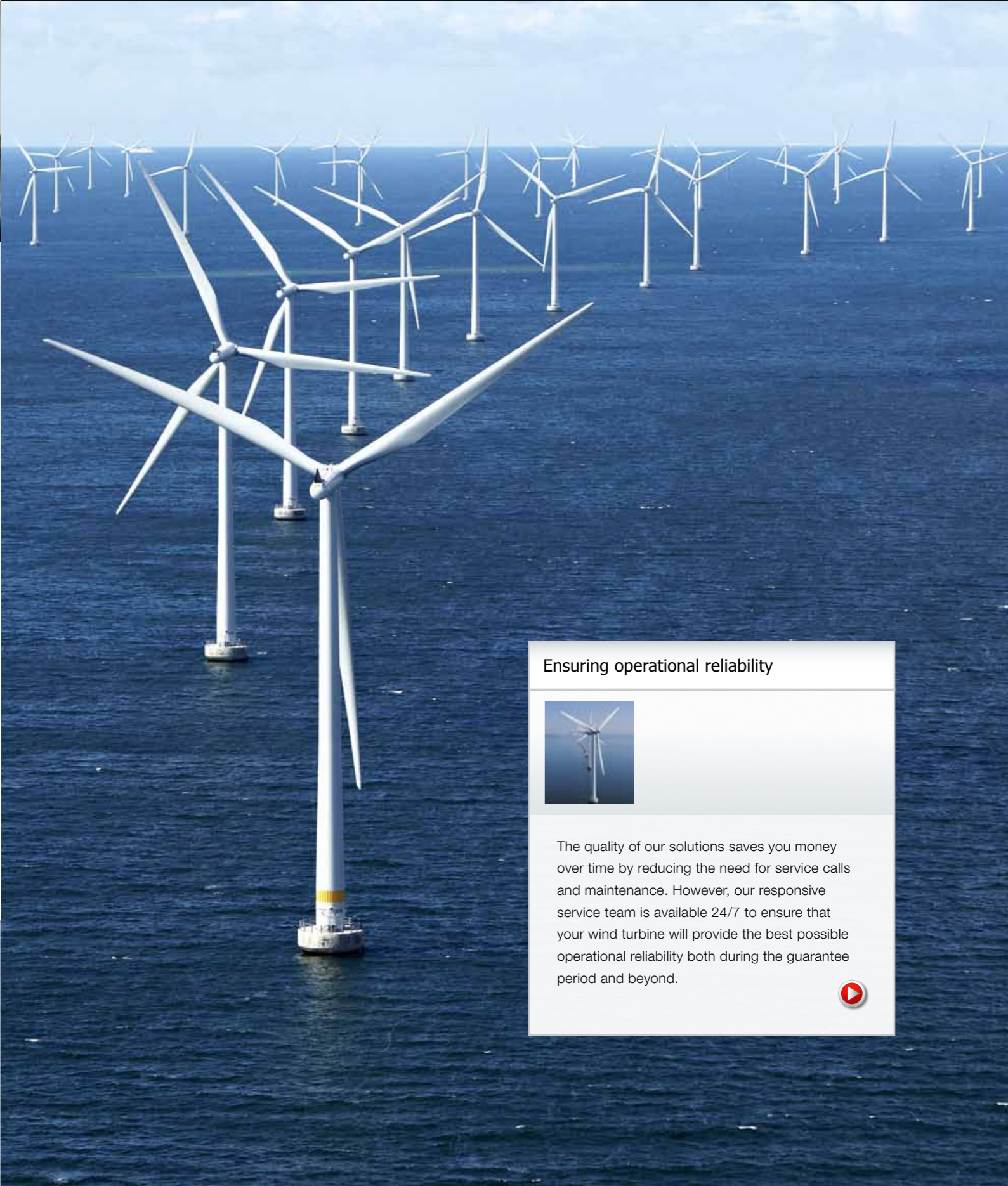
kk-electronic extensively tests all software and hardware solutions prior to serial production. This happens already following the development of a prototype, and any issues that result from the stress, durability, load, and performance tests we carry out can be quickly resolved.

"The innovative environment at kk-electronic is quite extraordinary; we are dedicated to develop further concepts and solutions that are already superb. Direct contact with our customers and partners keeps us on our toes, hearing their specific requirements and ideas. It's a great way of staying ahead and keeping focus."

Henrik Simonsen, Vice President Technology, kk-electronic.



kk-electronic®



Up and running and adding value to your business

How we at kk-electronic develop and manufacture solutions has consequences for your after sales experience. We deliver the solution to the operating environment, and stay with you through the commissioning phase. This is to ensure that the system is calibrated and adjusted to local conditions.

In this business, time-to-market is decisive. With quicker delivery of your tailored solution, kk-electronic ensures you get the right product, on time and at the right price, and without the risk of costly downtime in the installation and commission phase.

Responsive and capable service

Service offerings from kk-electronic ensure that wind turbine manufacturers, energy companies, and wind farm operators meet their production and operational goals, leveraging field expertise and unique technologies to deliver key results for your business.

kk-electronic – uniquely placed to help you grow

Established in 1981, kk-electronic is the global innovator in advanced control systems and electronic equipment for wind turbines and wind farms. Now into our fifth generation of control systems, we have a unique understanding of the industry.

In addition to the headquarters and prototype factory in Ikast, Denmark, kk-electronic has production facilities in Szczecin, Poland and a joint venture in Chongqing, China. KK-QIANWEI enables kk-electronic to supply control panels of own manufacture directly to the Chinese market.

kk-electronic is together with ELOGIC part of kk-group and are members of The Confederation of Danish Industry, The Danish Wind Industry Association and The Danish Breaker Panel Association.

Ensuring operational reliability



The quality of our solutions saves you money over time by reducing the need for service calls and maintenance. However, our responsive service team is available 24/7 to ensure that your wind turbine will provide the best possible operational reliability both during the guarantee period and beyond.





There's a kk-electronic
advanced control system near you

For further information:

www.kk-electronic.com

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