EnergieAgentur.NRW

Wind Energy Takes Off.

Competence from the Energy Region NRW

EnergieRegion.NRW
Cluster Nordrhein-Westfalen

Contents

Dear Readers,

North Rhine-Westphalia is Germany‘s most important energy region. We have a great responsibility for the energy supply of tomorrow, and the new State Government will in future give renewable energies priority over all other energy sources in our State.

This is the only way we will be able to attain the nationally and internationally mandatory climate protection targets. This applies for fuel production and heat provision as well as for power generation. The resources for renewable energies are available in almost unlimited quantities and they are an important growth engine for NRW‘s economy. Renewable energies are key technologies for North Rhine-Westphalia‘s export-oriented companies.

If we in North Rhine-Westphalia want to substantially expand the existing potentials for renewable energies, we can make a start in particular with the generation of power from wind. The new State Government has set itself the goal of increasing the percentage of power generated from wind to 15 % in the course of the next ten years (by 2020). We are quite clear that this is an

ambitious objective which will involve great effort as well as new approaches and measures regarding the handling wind power. We will have to break down certain obstacles in the form of statutory regulations, decrees and long-winded licensing procedures which place an unnecessary burden on the expansion of wind power. I'm quite sure, for example, that new locations to be identified and the replacement of old installations by repowering will lead to a substantial growth in power generation from wind turbines. In this we will not lose sight of the proper interests of nearby residents and the protection of nature and bird-life.

Although a densely populated land-locked state, North Rhine-Westphalia is an excellent location for wind power. In national rankings for installed wind power capacity we are today in fifth position, just behind the coastal region of Schleswig-Holstein. At the same time we are a significant industrial location for the wind industry. NRW has a wide-ranging competence in energy technology which is acknowledged worldwide and numerous market leaders in wind power technologies are based here. Many manufacturers of wind turbines and related supply companies in NRW are medium-sized enterprises with a long tradition, contributing mechanical engineering and electrical engineering experience – sometimes accumulated over a century. Today expertise gained in the automotive and chemical industries is also incorporated to an increasing extent in the product wind turbine. A close-knit network of research institutions provides the conditions for developing innovative products and services for the wind power industry.

Given that North Rhine-Westphalia has a sustainable wind power mix of experience, know-how and innovation, I am certain that the wind power in our State will rise in the coming years to become the leading technology in power generation from renewable energies. This is good for climate protection, more jobs and regional economic policy in NRW.

I hope you find this new publication of the EnergyAgency.NRW an interesting read since it deals with all these topics.

Johannes Remmel
Minister of Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the State of North Rhine-Westphalia

Strong Teamwork: The Wind Power Network

More than 2,800 wind turbines with a total capacity of 2,900 megawatt provide more than just wind in the energy supply of North Rhine-Westphalia. From modest beginnings in 1982 with the first 20-kW wind turbine to go on stream in Mettingen, and an energy resource has been developed and established within just less than 30 years with which 3.71 % of the net power consumption in North Rhine-Westphalia can be covered. Whereas until the end of the last millennium the windmill operators tended to regard their turbines or stakes in them as personal contribution to climate protection with an ecological return, with the erection of the first wind farm there was a shift in emphasis and it was considered more as a strategic capital investment. In terms of installed capacity, the State – despite its landlocked situation – is now one of the top five in Germany; 11 % of power from wind energy nationwide is generated here. And whereas the average output of a turbine was 115 kilowatt (kW) in 1993, today it is a little more than 1,000 kW.

But in the industrial region of North Rhine-Westphalia the – highly welcome – contribution of wind power to a sustainable energy supply and climate protection is not the only concern. The policy also focuses on exports opportunities and jobs. For a region with the expertise to develop and utilise complex energy technologies, the manufacture and use of innovative wind power technologies are a major growth and economic factor.

Worldwide every second gear system employed in a wind turbine in 2007 came from North Rhine-Westphalia. To maintain this strong position and expand it further, the State Government established the Wind Power Network in early 2009 as part of the North Rhine-Westphalian cluster strategy. This Network, organized by the Energy-Agency.NRW, is integrated in the structure of the existing energy economy cluster EnergyRegion.NRW. Its purpose is to combine in a targeted fashion the highly varied activities of the wind energy sector by networking science and research, local authorities, manufacturers, suppliers and operators. More than 700 specialists from all important technological and sector-based fields are thus involved as active players in the Network. And it is especially people from the areas of mechanical engineering, electrical engineering and materials which are considered crucial for future success. This concerted ongoing development of the expertise is an indispensable contribution to preserving and creating jobs and helps maintain and expand the high degree of competence in wind power technology in North Rhine-Westphalia.

The Network will in future be accompanied by a steering group comprising representatives of wind turbine and component manufacturers, of science and research and of politics and administration. Across company boundaries experts along the value chain will be working in various working groups on strategies and solutions for an innovative wind energy industry in North Rhine-Westphalia.

Specifically the Wind Power Network pursues the following objectives:

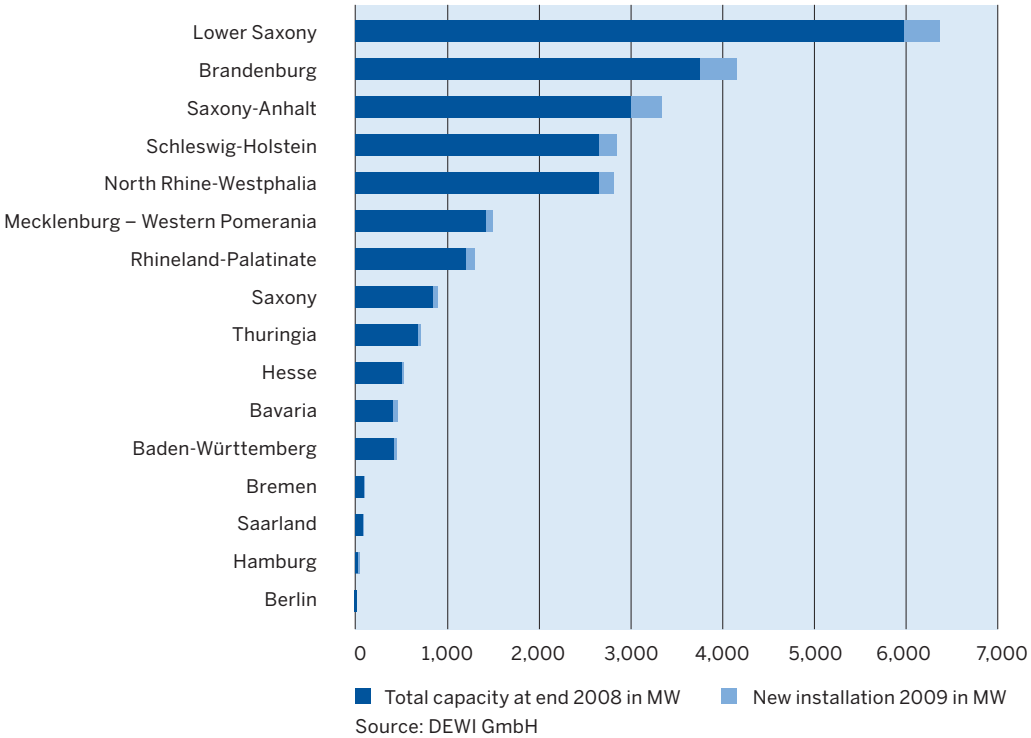
- synchronisation of the objectives of politics, science and industry,
- political and strategic support in the ongoing development of technology with respect to efficiency, profitability, availability and supply reliability,
- continued expansion of competence in the wind energy sector,
- the safeguarding and the sustainable creation of jobs as well as the secure furtherance of the next generation,
- enhancement of the acceptance of wind power utilisation on the part of the general public
- and intensification of national and international collaboration and improved international visibility.

The Wind Power Network is still in the initial phase. But the work in important institutions and projects is already progressing well, for example in the preparations for a "Wind Power Technology Competence Centre", an association of component suppliers, inspection service providers, wind farm operators, universities and institutes. The main concern here is to face up to new challenges in the field of mechanical and plant engineering and inspection services, specifically also with a view to offshore operations. North Rhine-Westphalia has ideal structures and qualities for dealing with these topics. With the expertise gained from the world's largest inland test site for wind turbines in Grevenbroich and from large-scale test rigs in the region there is a considerable amount of know-how available.

One interesting example is the "WIND Supply Pool Office" GADORE in Philadelphia. In partnership with the State of Pennsylvania a Pool Office for small and medium-sized industrial companies is being developed there. Companies from North Rhine-Westphalia and Germany are to help gain a toehold in the USA – one of the world's largest export markets. The project is organised as a private business venture.

Sector-based meetings such as the "Wind Energy Sector Day NRW" or the so-called "Windstammtisch NRW" ("Wind Discussion Circle NRW") are already well established. Here the participants exchange views and gather information from expert papers on new technologies, new participants in the industry and changes or developments in legislation and policy.

Regional Distribution of Installed Wind Capacity in Germany



Source: DEWI GmbH

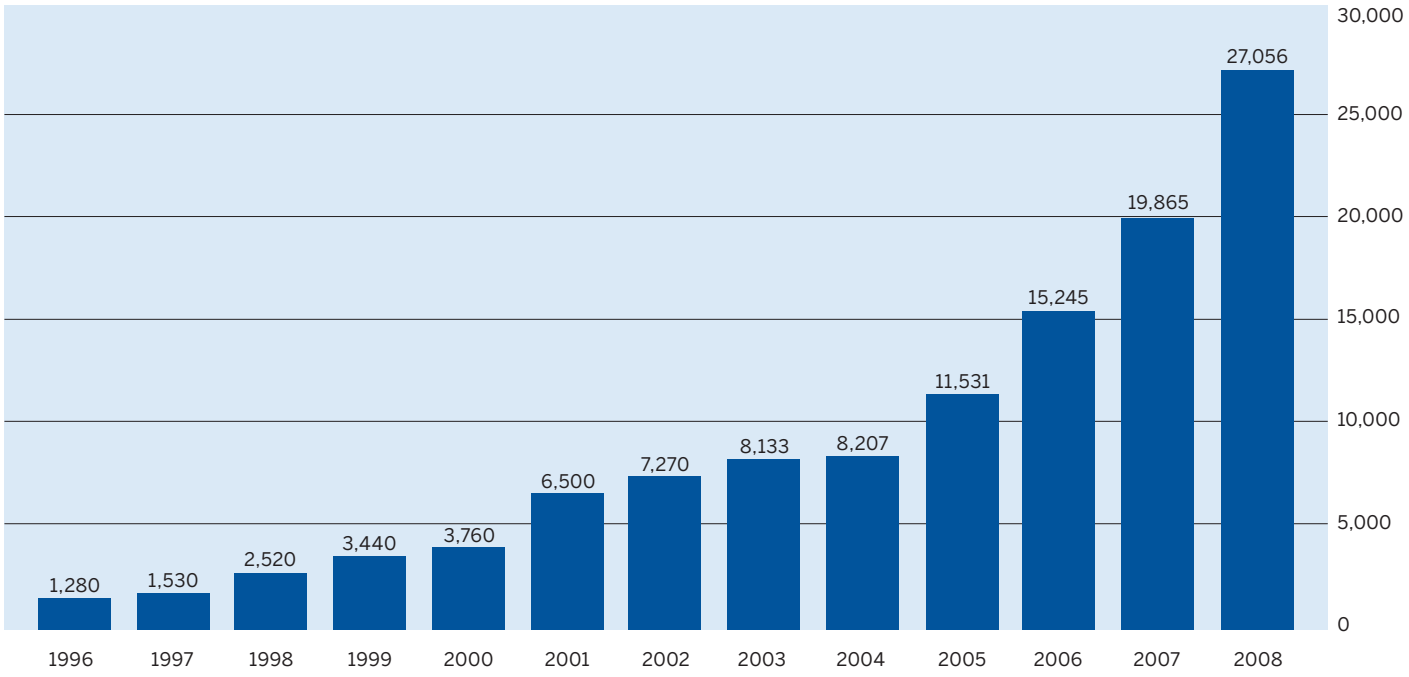
Prospects for Wind Power in North Rhine-Westphalia
Continuing Development of the Resident Wind Industry

The worldwide demand for efficient climate protection and hence for technology to expand renewable energies has created a global market which is still programmed for growth despite the financial crisis. More than 120 billion euros had already been invested around the globe in renewable plant technologies in 2008 – and the trend is up. The most important drivers of this enormous market development include wind energy and photovoltaics sectors from the power domain, accounting for about half the total world volume. The future prospects of sustainable energy sources are supported in particular by the intensified political will towards climate protection and countering global warming on many different political levels. The EU has resolved to expand the proportion of renewable energies in relation to the total energy supply – in other words power, heat and transport – to 20 % by 2020. Wind energy can guarantee, with an installed capacity of 200 to 250 gigawatt, about 12 to 15 % of the EU's power supply by 2020.

This is the result arrived at in analyses conducted by the "European Wind Energy Association" (EWEA), an umbrella organisation with about 600 members from 60 different countries. In the USA the objectives and projections are even more ambitious. According to the Department of Energy there, which is the competent ministry, it can be expected that by 2030 the wind energy will be contributing 20 % of US power consumption. The bottom line is that the wind industry will then contribute significantly and increasingly not only to climate protection, but also to independence from energy imports, and will act as a possible brake on power and gas price rises.

In the attainment of these goals great hopes are placed mainly in the development and manufacturing competence of North Rhine-Westphalian industry – after all it has been the decisive pacemaker in the development of wind turbines over the past three decades. And this is in a landlocked region which tends to be "low-wind" and has no natural location advantages such as the states in the coastal regions enjoy. But this shows that other strengths and a favourable structural starting situation are incomparably more important. As a historically evolved energy region and research-intensive economic area North Rhine-Westphalia can build up on a close networking between research and industry, thus achieving combined effects from close proximity plus faster implementation and application. But the industrial manufacture of wind turbines relies primarily on competence in mechanical and plant engineering. This is essential in the manufacture of gear systems and bearings, generators and transformers, clutches and brakes, as well as of the whole control technology. This all requires suitable production facilities and highly specialised manufacturing procedures, qualified specialists, expanded transport and logistical networks, and suitable access to market participants – in short, factors such as North Rhine-Westphalia can offer in combination, more so than almost any other economic region in the world.

Capacity Installed Worldwide Per Year 1996–2008



Source: GWEC

It is therefore hardly surprising that the North Rhine-Westphalian wind energy industry's share in the world market is around 50 % and the export quota 60 %. In the wind turbines erected worldwide in 2007 with a total capacity of around 20,000 megawatt every second gear system comes from North Rhine-Westphalia – the German State which has the highest location density of gear manufacturers for wind turbines. Suppliers based here deliver to wind turbine manufacturers on all the world's markets. The employment rate in the North Rhine-Westphalian wind sector rose from 2007 to 2009 by about 28 % to around 6,700 workers, and in the same period the sales increased by 28 %. So there's no doubt that this industrial location is one of the winners in the wind energy boom which persists across the globe. And the future prospects can also be rated as favourable. Due not least to the planned expansion of offshore installations in coastal waters, in Europe alone more than 500 billion euros are to be invested in wind turbines in the next 20 years, on average about 25 billion euros a year. Many of the new jobs created will be with system and component manufacturers in North Rhine-Westphalia. But at the same time competition is becoming fiercer. China and the USA will attempt to repeat the German success story, or even surpass it. It is therefore all the more important that the present technological lead be maintained and extended. The North Rhine-Westphalian wind industry has the responsibility to strengthen its leading position so as not to be overtaken in international competition. The basic prerequisite for further success in global competition is mainly a stable domestic market which will act at the same time as a suitable technology shop window.

Intensification of Climate Protection Locally by Expansion and Repowering

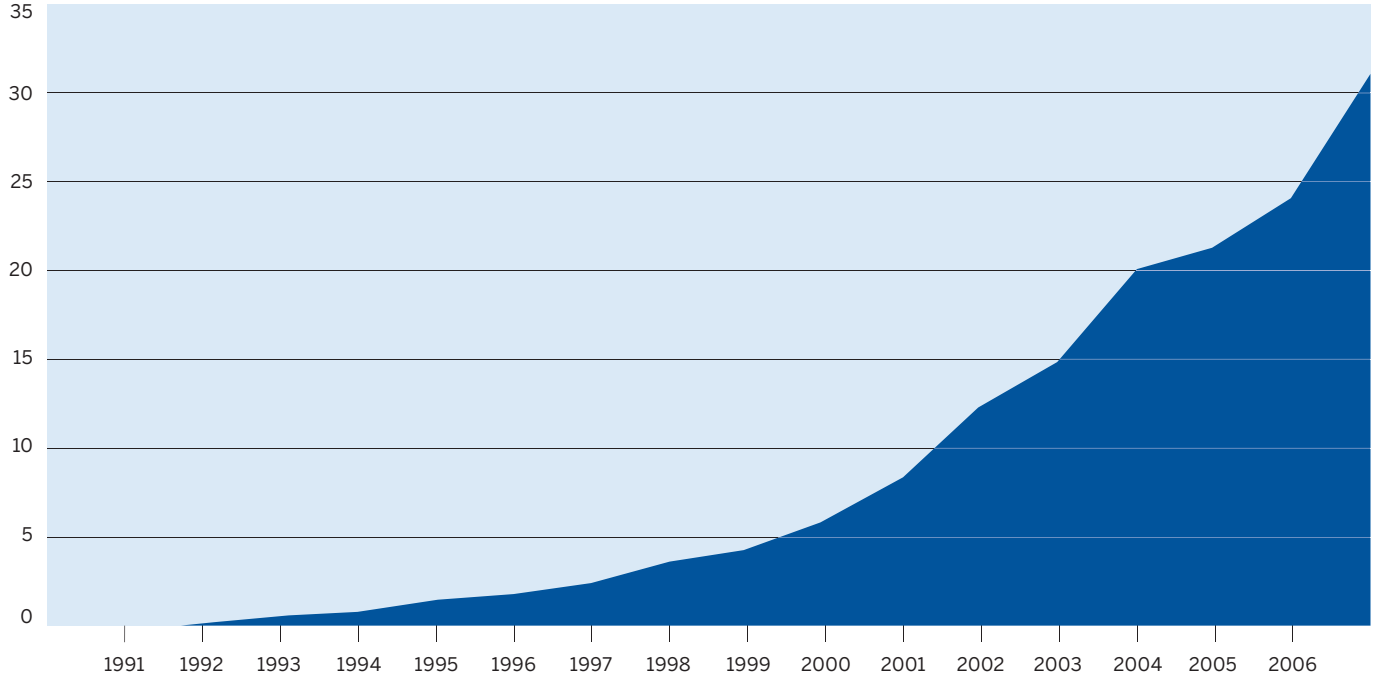
The new NRW State Government, which has been in office since 2010, has resolved to provide a stronger legal basis for the expansion of renewable energies in the form of a special climate protection act. The general target aimed at is a 25 % reduction in CO_2 emissions by 2020. With this in mind the share accounted for by wind-generated power is to rise from the current 3 % to 15 % by 2020. To achieve this it is intended in future to make available 2 % of the region's land area for the utilisation of wind power. To this end special attention is being paid to the suitability of areas along trunk roads and railways and on industrial forests. In addition it is intended to abolish the restrictive provisions governing the height limitations for wind turbines.

This will mean that the expansion of wind power in North Rhine-Westphalia will experience considerably greater backing in political terms. But alongside the construction of new installations, the replacement of old ones will in future be intensified – by repowering.

Repowering describes the replacement of older and smaller wind turbines with low capacity – mainly erected in the years following 1990 – by modern, more efficient and in particular more powerful ones. These new installations will also yield a substantially higher revenue thanks to their high technical availability, and at the same time they will facilitate improvements in grid security. Under the Renewable Energies Act old installations with an operating life of more than ten years are eligible for repowering.

Since North Rhine-Westphalia is one of the pioneering regions in wind power, there are between Rhine and Weser a correspondingly large number of smaller installations with technical equipment which is no longer necessarily state of the art. A situation which explains the average output of the 2,800 wind turbines in North Rhine-Westphalia amounting to 1.0 megawatt, substantially less than the nationwide average of over 1.2 megawatt. Around the year 2010 more than 50 % of the

Reduction of CO_2 Emissions by Use of Wind Energy



Emissions avoided by power from wind turbines in million t CO_2
Source: Federal Environment Ministry, as at: April 2009

wind turbines in North Rhine-Westphalia will be older than ten years, ideal conditions for repowering on a grand scale. At the same time this will be a major opportunity for climate protection through the anticipated growth in renewable energy, through the greater efficiency of the new installations. In addition it will also be a major opportunity for the North Rhine-Westphalian wind industry: the State can also become a pioneering and reference market in repowering for manufacturers, suppliers, planners and operators. The prerequisite for this, however, is that the reservations felt by residents and obstacles in planning law be overcome. This concerns primarily the currently applicable height limitations and required distances for installations imposed by local authorities.

The economic incentive for investments in the renewal of old installations is already present in any case. It was reinforced by the amendment to the Renewable Energies Act (EEG) which has applied since 2009. For onshore wind turbines which replace old ones the starting charge has been increased since then by 0.5 cents per kilowatt hour (kWh). It is required, however, that the installations replaced be from the same or a neighbouring district and that they be at least ten years old. At the same time a new installation must attain at least double the output of that replaced – but without exceeding five times the output.

This statutorily based repowering bonus will help to ensure that wind turbines of the first generation are replaced by modern, more efficient turbines. With a halving of the number of turbines and a simultaneous doubling of the output, it will be possible in the next few years, with efficient use of the locations, to triple the revenue and more. At the same time there will arise in the next decade a potential annual market of at least 500 megawatt or, in economic terms, of an additional half a billion euros in sales.

Expansion of Wind Energy Research

For the successful industrial use of wind energy it is extremely important not least to have an appropriate scientific infrastructure locally. The closest possible geographical contact, the most extensive possible interlinking of basic research on the one hand and application experience on the other is the ideal starting situation for progress through the efficient deployment of means. One of the two large regional focal clusters in Germany with such a high degree of bundling of research activities can be found in North Rhine-Westphalia. While in the north German coastal area the focal concerns tend to be outside the actual machine of a wind turbine, for example in wind physics and in the aerodynamics of rotors, the research and teaching of the North Rhine-Westphalian cluster is concentrated primarily in the fields of mechanical engineering, electrical engineering and energy economy – in other words in power transmission, the further processing of electricity and system safety as a whole.

In RWTH **Aachen** University alone, one of the world's leading universities for engineering with a high standing in research and a strong application orientation, a total of 16 different institutes are working on such questions. Recently their activities were combined at a test facility which is a world first: in a new testing shop which is almost 1,000 square metres in area and belongs to the Institute for Machine Elements and Machine Design (IME). On a 750 tonne oscillating foundation there is a measuring control room from which the highly varied testing sequences can be monitored and controlled, such as the examination of so-called "heavy drive trains". This is already booked out for the foreseeable future. On this purpose-built system test facility it is possible to conduct optimum research into the operational behaviour of wind turbines under defined test conditions. Also at RWTH, in the Power Generation and Storage Systems Institute of the E.ON Energy Research Center, intensive work is in progress on the further development of power

electronics components and electrical conversion systems in order to convert the energy generated at any time. This is to happen in such a way that the turbines of a large wind farm can be reliably interconnected, thus making it possible to feed the accumulated electrical energy collected with a constant frequency and voltage into the transmission grid. In view of the naturally fluctuation in the wind energy generated, this is a question of central importance for future use, especially with a view to the anticipated offshore expansion in the middle of the sea.

In the Faculty of Engineering at the University of **Duisburg-Essen** research is also being conducted in this major field of energy management. After all, the incorporation of wind energy into the existing power grid is actually a science in its own right, made problematical not least by the steady abandonment of conventional base-load power plants which work constantly and whose effect is therefore to stabilise the grid. In contrast with wind turbines there are time and again periods when no power is generated, either because there is no wind or because the wind is so strong that the turbine concerned has to be braked. The subjects dealt with on the Duisburg campus therefore range from formulating the requirements for individual turbines which these have to satisfy during operation and the grid connection rules for wind turbines as a whole, through to feasibility studies for the integration of wind energy on a national level. One way or the other future installations will have to be integrated more closely than hitherto in the grid regulatory mechanisms.

Two chairs at the Ruhr University in **Bochum** are working simultaneously at moment on the dynamic loading of wind turbines. For example their gear systems are subject to such heavy loads that any small progress in their design will soon have an economic effect. While at the Chair of Machine Elements, Gear Systems and Automotive Engineering all conceivable influences on the load distributions and gearing corrections are being studied on multi-stage planetary gear systems, such as tooth deformation, deformation of a plant wheel carrier or housing deformation, the work of the Chair for Machine Elements and Design Theory focuses on important investigations into the use of friction bearings in wind turbines. Although the approaches are so different, the goals are related: a general increase in the operational safety and service life of wind turbines, combined with modern technical answers to the enormous overall sizes and loads in the growing megawatt class.

The Energy Economy Institute (EWI) at the University of **Cologne**, on the other hand, is increasingly concerned with research, teaching and consultancy in matters of energy economics. They are examining the detailed impact of political and economic decisions and technological developments have on the markets, and specifically those concerning wind energy. Current major topics at the EWI include, for example, the development of the European energy mix in power generation, the integration of renewable energies, supply reliability in the European power and gas economy and the evaluation of large-scale infrastructure projects. Alongside research, teaching and consultancy the EWI also contributes to promoting young qualified talent in this field, since their involvement will in future definitely be increasingly in demand.

The Framework Conditions of Wind Power Utilisation in North Rhine-Westphalia

The foundation for a consistent utilisation of wind energy in Germany was laid in Germany as early as 1991 by the German Power Feed Act (Stromeinspeisungsgesetz). On 1 April 2000 there followed the Renewable Energies Act (EEG) and in its third version it is now well established. The EEG regulates the priority of renewable energies and what is charged for each of them. It thus creates a high degree of planning and legal security for the expansion of renewable energies.

The EEG provided the initial impetus for the wind energy infrastructure as we find it today in North Rhine-Westphalia. There is no doubt that in this state in particular the EEG also represents a major contribution to the strategy of industrial policy. But nowhere else do the energy generation and the use of the corresponding industrial production go hand in hand more, and not least for global export.

On a state level this foundation is being expanded and refined in depth by the Wind Turbine Decree NRW, which lays down the planning aspects and the building and pollution control law specifications for the erection of wind turbines. The decree of 21 October 2005 is currently being amended. Within the framework of the new Wind Energy Decree the State Government is concerned primarily with integration in the climate protection strategy. The new Decree makes it possible to identify priority zones in regional planning with the limited opening of forested areas and the maintenance of nature conservation as taboo zones. In addition explanatory remarks are given on the framework conditions for the repowering, as are recommendations for the review of height restrictions and statements on safety distances for wind turbines in relation to residential housing. The criteria for obtaining a permit include not only the avoidance of noise nuisance for residents and of major interventions in the landscape, but also the maintenance of aspects of species protection, of minimum distances in relation to residential areas and nature conservation areas and of statutory pollution control procedures.

So much for the statutory framework conditions. But the portfolio of the means of shaping policy under which wind power utilisation in North Rhine-Westphalian has developed and is still developing also offers other kinds of game. What first attracts attention here is what is now the third round of the funding competition "Energy.NRW". The idea here is in particular to identify innovative project ideas on the subject of "renewable energies"; for instance within the framework of wind power project ideas on automation and quality assurance in vane manufacture, as well as innovative small-scale wind turbines.

Companies, research institutions and local authority players are called upon to submit their project proposals. With its orientation this competition has long become established as an important instrument in the development of future technologies in North Rhine-Westphalia. The results of the 2010 funding competition will be available after the 2011 summer break. This competition will again be held in 2011.

EEG Amendment 2009

The most important provisions as of 1 January 2009 concerning onshore wind energy are:

The initial charge for onshore new turbines since 1 January 2009 has been 9.2 ct/kWh (previously 8.03 ct/kWh). This figure will be lowered every year by 1 % (previously 2 %) for new turbines commissioned.	For onshore wind turbines which replace old turbines (repowering) the initial charge will increase by 0.5 ct/kWh. The turbines replaced must come from the same district or a neighbouring one and must be at least ten years old. A new turbine must attain at least twice the output of the one replaced.
For onshore wind turbines which contribute to certain improvements in grid integration the initial charge will increase by a so-called system service bonus of 0.5 ct/kWh.	For energy quantities not purchased in the context of the infeed management the grid operator must pay financial compensation. Wind turbines must be subject to subordinated shut-down.
Grid operators are now expressly obliged not only to expand the grid but also to optimise and strengthen existing grids.	Direct marketing of power from EEG turbines is possible in future on an alternating monthly basis.

Way to Go: Examples of Successful Projects

Schleiden Wind Farm

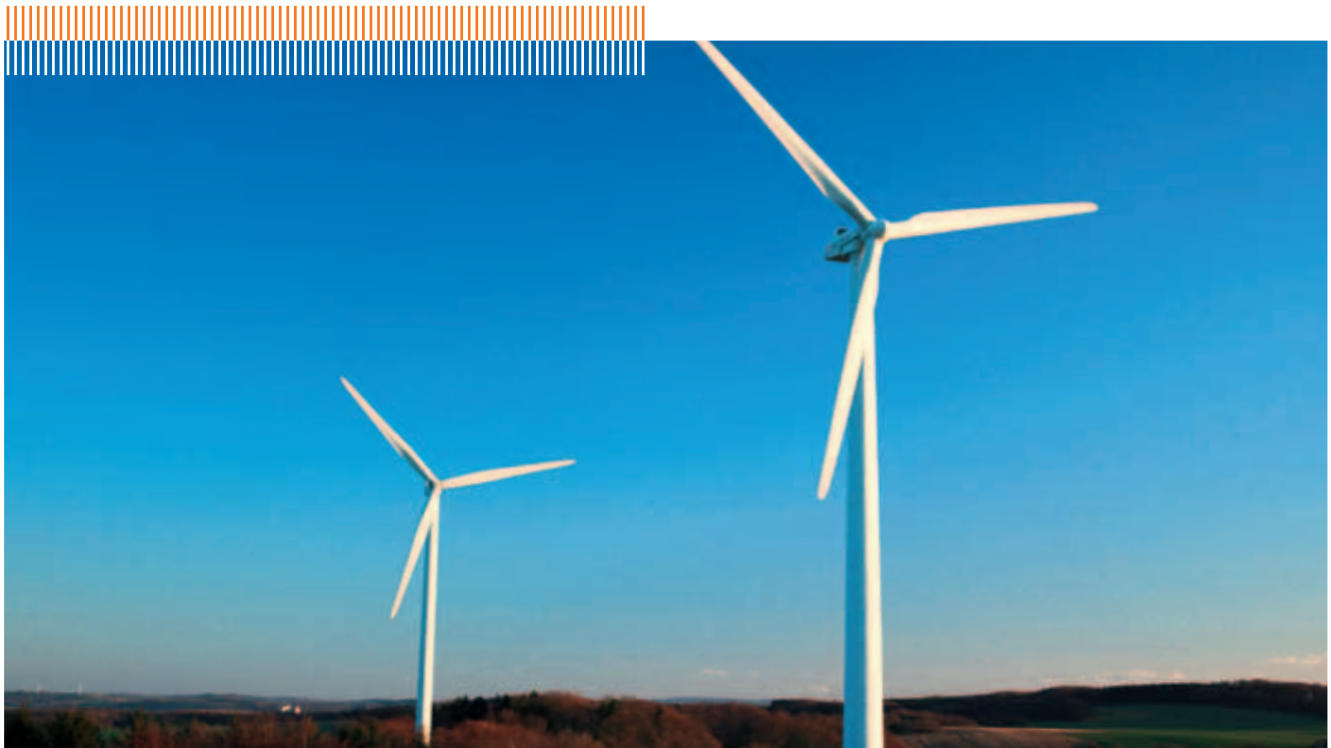
The geographical concentration of wind turbines in the form of wind farms has the advantage that the utilisation of the existing wind turbine stock is optimum with efficient use of the corresponding infrastructure in the wind energy domain (grids, connections, transformer station). The Schleiden Wind Farm in the district of Euskirchen has more than twelve wind turbines, each with 1.5 megawatt rated capacity and a total capacity of 18 megawatt. The annual work of the 85 metre high machines is about 32 million kWh, which means an annual CO_2 avoidance of over 20,000 tonnes. The technical operational management of the wind farm is handled by ABO Wind. 258 fund subscribers have invested with conviction in domestic wind power utilization via a closed fund. A Wind Farm thus becomes in many ways a Win Farm.

Project	Schleiden
Operator	ABO Wind
Erected	2000
Installed cap.	18 MW
Annual work	approx. 32 million kWh
CO_2 avoidance	approx. 20,800 t/a
Households	8,000
Turbine type	GE 1.5s (12 units)

Sintfeld Wind Farm

The Sintfeld is a piece of high ground in the southern part of the Paderborn Plateau. Thanks to its favourable topographic situation it offers ideal conditions for exploiting wind on a grand scale. The adjacent foothills of the Eggegebirge range form the first barrier here to the winds coming from the north. Over a total area of 765 hectares 65 wind turbines from various manufacturers have been installed in the Sintfeld Wind Farm. Their operating companies are combined under the umbrella of "Sintfeld Rego Strom GmbH". The whole terrain offers an impressive view, and it now has the character of a tourist attraction. On completion this facility was considered Europe's largest inland wind farm. To connect it to the grid Germany's largest privately erected transformer station was constructed specifically for the purpose. The Wind Farm's total capacity is 105 megawatt, covering the energy requirements of more than 45,000 households.

Project	Sintfeld
Operator	Sintfeld Rego Strom GmbH
Erected	2001
Installed cap.	105 MW
Annual work	approx. 180 million kWh
CO_2 avoidance	approx. 117,000 t/a
Households	45,000
Turbine type	various



Wind Power Utilisation on the Hoppenbruch Mine Waste Heap in Herten

The higher a windmill is located, the more favourable are the prevailing working conditions. This is quite natural in view of the correspondingly greater wind speed. So what could be more obvious than to use the artificial pieces of high land created in North Rhine-Westphalia over many years by mining operations for modern and intelligent energy extraction. And this is also true in the area on the River Emscher, which otherwise has hardly any appreciable elevations, while at the same time neither artificial nor natural obstructions affect the speed. The Hoppenbruch mine waste heap in Herten, which has been freely accessible on foot since 1992, has a height of 70 metres and a volume of 32 million tonnes, and it is located on the former Ewald mine site. It is today part of the Emscher Landscape Park. In 1997 the first wind turbine erected in North Rhine-Westphalia on a mine waste heap went on stream. With a hub height of 67 metres it generates around 3 million kWh annually, supplying about 750 households with energy. 300 Herten residents have taken a financial stake in the facility and have thus demonstrated their direct commitment to wind energy. The installation was co-funded by the EU and the State of North Rhine-Westphalia.

Project	Halde Hoppenbruch
Operator	Ruhrwind Herten GmbH
Erected	1997
Installed cap.	1.5 MW
Annual work	approx. 3.0 million kWh
CO_2 avoidance	approx. 1,950 t/a
Households	750
Turbine type	E-66

Wind Power Utilisation on the Gelsenkirchen-Scholven Mine Waste Heap

“Energy on the Waste Heap” is on the advance in the northernmost district of Gelsenkirchen, in Scholven as well. On the Oberscholven waste heap, over 140 metres high, the foundation stone was laid in July 2010 for two wind turbines. The two Enercon machines are intended to yield an annual output of about 10 million kWh – equivalent to the annual energy supply for about 2,500 households. The operating company is ELE Scholven Wind GmbH, a joint subsidiary of the local energy supply company Emscher Lippe Energie (ELE) and of Essener Mingas-Power GmbH, which in turn is a joint subsidiary of Evonik Industries and RWE Power AG. According to the plan the new wind turbine is possibly only the start of a whole series of similar installations which can be erected one after the other over the next few years – in close collaboration with the owner and potential leaseholder of numerous other mine waste heaps in the Ruhr region, RAG Aktiengesellschaft. This mining company has accumulated experience over many years in the management of mine waste heaps. According to studies a total of 61 of the 120 waste heaps in hard coal and brown coal mining in the Ruhr region and in the Rhineland are suitable as sites for the erection of wind turbines.

Project	Halde Oberscholven
Operator	ELE Scholven Wind GmbH
Erected	2010
Installed cap.	2 x 2.3 MW
Annual work	approx. 10 million kWh
CO_2 avoidance	approx. 6,500 t/a
Households	2,500
Turbine type	E-82

Repowering in Paderborn-Neuenbeken

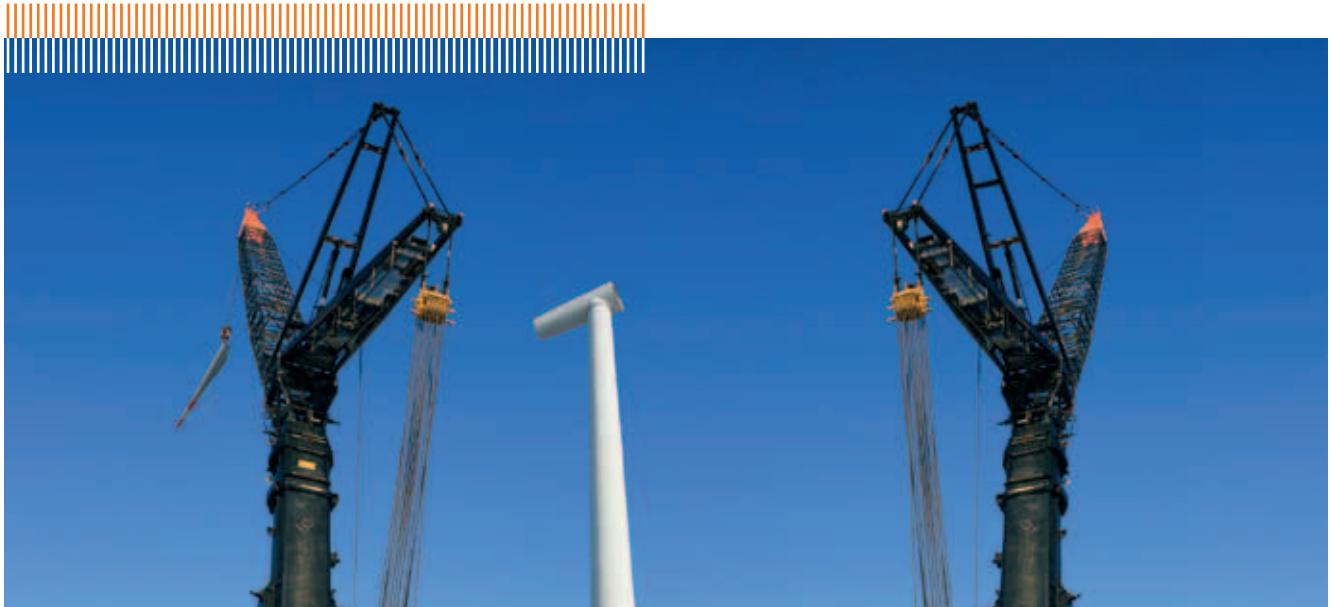
An installation in the East-Westphalian district of Paderborn-Neuenbeken illustrates how the modernisation strategy of repowering in the generation of wind power can lead to increased efficiency. In the spring of 2007 the first large-scale repowering project in North Rhine-Westphalia was completed here and connected to the grid. In the course of the replacement an installation from the company Enercon with a capacity of 2,300 kW was installed. This now supplies four times the power of its predecessor, which has in not been scrapped but has been re-erected in Eastern Europe. Substantially greater technical reliability contributes to the enhanced efficiency of modern installations such as that in Paderborn-Neuenbeken. Furthermore the rotor turns more slowly and more quietly, which considerably reduces interfering noise in the surrounding area. Since a single new state-of-the-art windmill can normally replace a number of old installations, the impairment of the landscape is also reduced in this way. In the long term the wind power yield in North Rhine-Westphalia can be more than quadrupled by consistent repowering – with a simultaneous halving of the previous number of turbines.

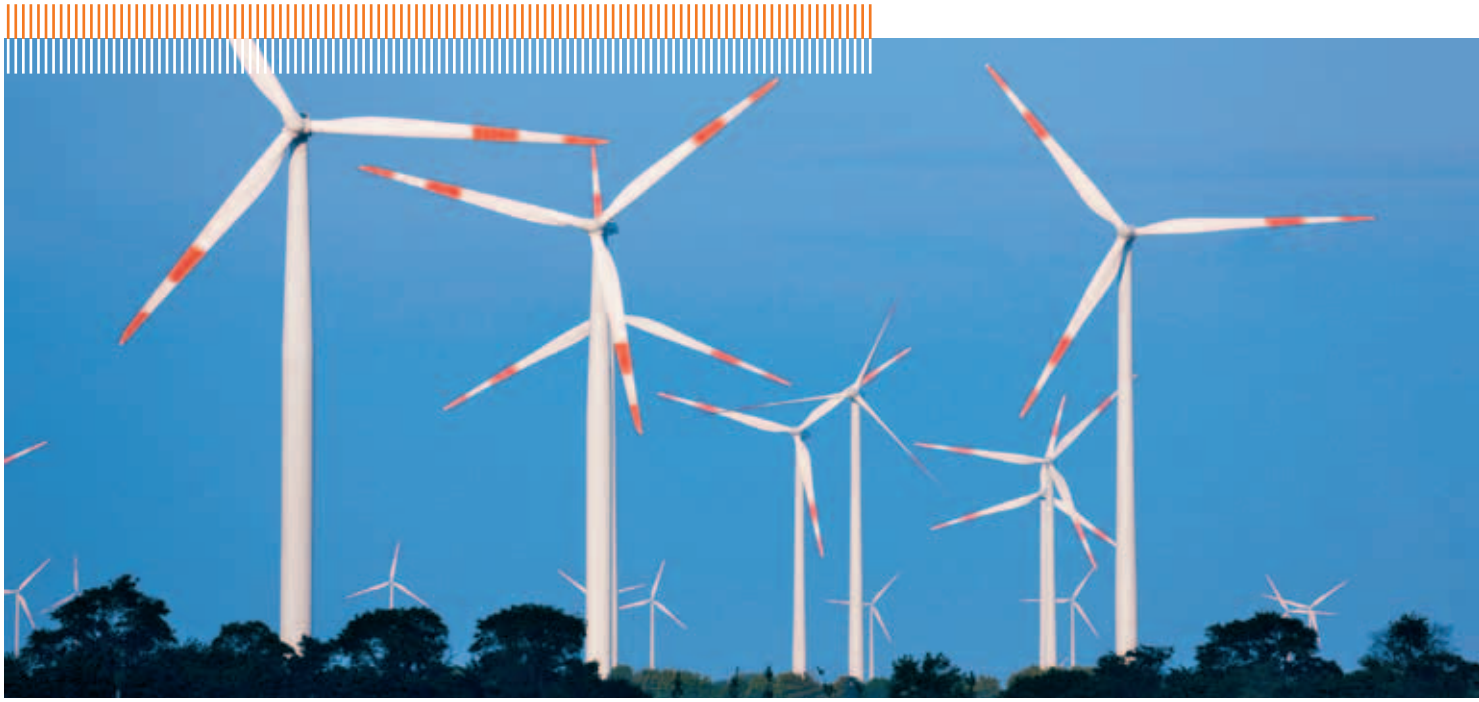
Project	Neuenbeken
Operator	Buker Windkraft GmbH
Erected	2007
Installed cap.	2.3 MW
Annual work	approx. 4.2 million kWh
CO_2 avoidance	approx. 2,730 t/a
Households	1,050
Turbine type	E-70

Repowering in Ahlen

Between Ahlen and Sendenhorst in the Ahlen urban area what is probably the largest repowering project in NRW is underway. As a joint planning venture Sendenhorster Windenergie GmbH & Co. KG is replacing eleven older wind turbines of various types by new wind turbines with a hub height of 108 metres. The rated capacity of the eleven older wind turbines is 9.9 megawatt, and that of the new ones is 20.7 megawatt. In future it is thus intended to generate about 40 million kWh power a year and to supply about 10,000 average households. The licence for the new turbines has been granted and so the construction work is currently in progress. This power project was only made possible by the fact that the district of Waldorf's licensing authority and the expert assessment body assigned, enveco GmbH, conducted constructive consultations with respect to sound remediation. Thanks to old licensing regulations it was possible to erect the old installations near residential housing, e.g. that of the operators of the old installations. For this reason the sound reference levels are sometimes substantially exceeded. In spite of the uncontrolled housing development in the planning area it was possible to implement sound remediation for the impact locations with repowering. Further repowering measures are being planned in the wind priority area.

Project	Ahlen
Operator	Sendenhorster Windenergie GmbH & Co. KG (nach Repowering)
Erected	2011
Installed cap.	9 wind turbines, 20.7 MW
Annual work	approx. 40 million kWh
CO_2 avoidance	approx. 61,500 t/a
Households	10,000
Turbine type	E-82





Wind Power Utilisation in the Forest: Hilchenbach

The wooded hilltops in the Mittelgebirge range are excellent wind power locations. In exposed positions higher wind speeds can be used to generate power. The aim here is not only to protect the environment, but to conserve nature and the landscape. If we take the example of the "Citizens' Wind Farm" (Bürgerwindpark) in Hilchenbach, completed in 2008, it is clear that considerably more power could be generated by wind power than this place on the edge of the Rothaargebirge mountain range needs to supply its own private households – even in 2009, where there was little wind, this still meant 21.7 million kWh. In addition the five wind turbines of the operator RothaarWind GmbH with their 138 metres hub height have ensured that this year the environment was relieved of more than 15,000 tonnes of carbon dioxide and other polluting gases and dusts which would otherwise have arisen through the conversion of fossil fuels to electricity.

Project	Hilchenbach
Operator	RothaarWind GmbH
Erected	2008
Installed cap.	11.5 MW
Annual work	approx. 24 million kWh
CO_2 avoidance	approx. 15,600 t/a
Households	6,000
Turbine type	E-82

Wind Power Utilisation in the Forest: "Ewiger Fuhrmann"

With the identification by the town of Olpe of a priority area for wind turbines in the border area between the Siegerland and Sauerland the activities aimed at the local utilisation of wind power began. The "Ewiger Fuhrmann" wind turbine is the first installation for which a forest conversion licence has been granted. As a precedent it prompted a change in Wind Energy Decree in 2000, which made it possible to make limited use of the forests. For ecological and economic reasons the low use of land at this forest location was important. In the neighbouring area the Engelsberg Wind Farm was set up in 2004 as a public participation model on an area of meadowland cultivated as a co-operative. This involves three MD 77s, for whose erection it was decided to use lattice pylons. More than 11 million kWh power are generated there annually. The "Ewiger Fuhrmann" is a Vestas machine on a 117 meter high lattice pylon. At the time of erection this wind turbine was the highest wind turbine in the world. It generates approx. 2.8 million kWh a year.

Project	Ewiger Fuhrmann
Operator	Ewiger Fuhrmann Windkraft GmbH
Erected	2000
Installed cap.	1.6 MW
Annual work	approx. 3 million kWh
CO_2 avoidance	approx. 1,959 t/a
Households	750
Turbine type	V66

Strong Tailwind: Citizens‘ Wind Farm Hollich near Steinfurt

Wind power enjoys considerable favour among the general public – even if its actual technical implementation does not always and not everywhere immediately receive unreserved applause locally. This is why, for the reception and long-term success of wind turbines, it is all the more important to have funding models which are based on the broadest possible and ideally also local involvement. So-called “citizens‘ wind farms” (Bürgerwindparks) are also open to local small investors who, with minimum stakes of 500 or 1,000 euros, are not only granted the opportunity to participate in the expansion of sustainable energy generation, but also to profit financially from its utilisation. This leads sustainably to a broad acceptance of domestic wind power utilisation. In Steinfurt, to the north west of Münster, the goal was formulated as early as 2000 to open up regenerative power production with a just distribution of the wind lease, low impairment of agricultural operations and the environment, and a contractual charge for the residents. The total investment volume was approximately 32 million euros. The own funds portion demanded by the banks was raised by 217 members of the public from the Steinfurt region. 18 modern wind turbines with a capacity of 1,500 to 2,000 kW each today feed an approximately 54 million kWh a year of climate-friendly power into the public grid from the Hollich Citizens‘ Wind Farm.

Project	Hollich
Operator	Windpark Hollich GmbH & Co.KG
Erected	2001
Installed cap.	27.5 MW
Annual work	approx. 54 million kWh/a
CO_2 avoidance	approx. 35,100 t/a
Households	13,500
Turbine type	various

Citizens‘ Wind Farm WestfalenWind

The wind district between Bad Wünnenberg and Borchen in the Westphalian Bight, not far from the Sintfeld Plateau, also demonstrates what opportunities wind power in a region can offer when private citizens are involved. It‘s by chance and not without some pride that locals now call the wind power potential of the whole Paderborn Plateau the “powerhouse” of North Rhine-Westphalia. Even so the initiators of Bürgerwindpark WestfalenWind GmbH are looking mainly to direct utilisation for the surrounding area – it is intended that wind energy open up new sources of income for the local population, increase the value of the agricultural land, put more revenue from business tax in municipal funds and not least support local projects and associations. 21 Enercon E-82 wind turbines with a capacity of 28 megawatt and annual production of about 120 million kWh are to be developed. Those responsible stress that their motivation in exploiting wind power with the greatest possible involvement of private citizens is in the final analysis a decidedly simple one: “We live here as well, we have family and friends in the local villages and we have our roots in the region.”

Project	WestfalenWind
Operator	WestfalenWind GmbH
Erected	imminent
Installed cap.	28 MW
Annual work	approx. 120 million kWh/a
CO_2 avoidance	approx. 78,000 t/a
Households	30,000
Turbine type	E-82

Grevenbroich Wind Energy Test Field

In order to make wind turbines steadily more efficient it is necessary to test them – on large test fields. To facilitate the direct comparison of different technologies all the other test conditions should be identical as far as possible. Since 1998 wind turbines have been tested on a grand scale in Grevenbroich – on the world‘s largest, inland test field for wind turbines operated by windtest grevenbroich gmbh. Turbines of varying size and from different manufacturers of the 600 kW to 2,500 kW class stand in a row positioned transversely to the main wind direction (south west).

Every two turbines have one wind measuring mast. Prototypes and test installations are operated, which are tested and measured exclusively according to national and international regulations. Once they have completed their work, the turbines are dismantled again and replaced by new prototypes. The data collected with regard to the power curves, loads or electrical characteristics is used by the manufacturers to optimise mechanical, dynamic and electrical characteristics. The clients are normally manufacturers of wind turbines.

Industrial Transformation to “Windland NRW”: New Opportunities for Resident Companies

Structural change is an abstract term – for decades now it has become a reality in the industrial landscape on the Rhine and Ruhr. Basically in the most populous German federal state it has long been possible to talk about a “tradition of structural change”; after all, the pressure to change in the classic home of coal and steel has been especially great over the past few decades. As a response to this pressure there is evidence time and again of impressive adaptations and developments. In the centre of these in the final analysis there are invariably technological changes.

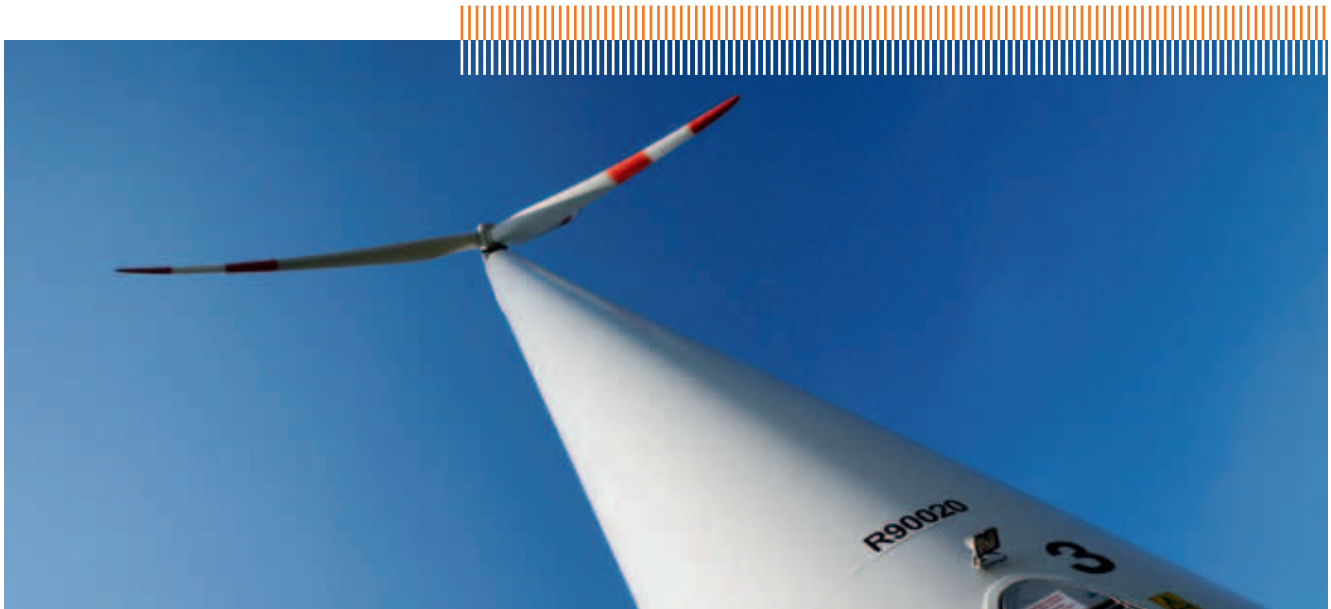
The rise of wind energy is such a source of impetus. In North Rhine-Westphalia not only can the establishment of many new companies be attributed to this - but long established companies and industrial sectors are also using this young industry to place existing know-how in new application contexts, to participate in the development work with innovations or to get directly involved in grand style through new business segments. The examples mentioned here illustrate this diversity of opportunities – and show how they are taken.

Fresh Wind for the Companies from the Mining Industry

In this classic industrial sector it is particularly evident from what depth of knowledge and experience market successes can also be achieved in highly modern sectors such as wind turbine manufacture. The company Gebr. Eickhoff Maschinenfabrik und Eisengießerei GmbH in Bochum is a medium-sized enterprise with a rich tradition in the mechanical engineering field. It was founded in 1864 as a foundry, and because of its mining background it concentrated more and more on compact gear systems with high performance density under the hardest conditions of use. Today the company uses its technical experience to expand its business in particular by constructing gear systems for wind turbines. Eickhoff is now one of the leading suppliers to the world market. With a wide range of services Eickhoff offers everything on a one-stop basis, from customer-specific development and prototype design, including special testing and field trials through to series production.

Fresh Wind for the Steel Industry as well

Rothe Erde is based in Dortmund and manufacturers large roller bearings. It now belongs to the ThyssenKrupp Group. It has a history stretching back to 1855, when the company was founded under the name Paulinenhütte. After it had initially made a name for itself mainly in the production of railway components, it developed over the past few decades expertise in the manufacture of ever more precise steel products. Today Rothe Erde is one of the world’s leading producers of large roller bearings and rings – and hence also an increasingly important partner and supplier in the construction of wind turbines. An optimum bearing system for the immense axial and radial forces is of central importance for the efficiency and service life of these installations. With a diameter of up to 8 metres the roller bearings from Rothe Erde today work hard on the wind, in a wide range of capacity classes and at a wide variety of locations throughout the world.



Tailwind for Chemistry

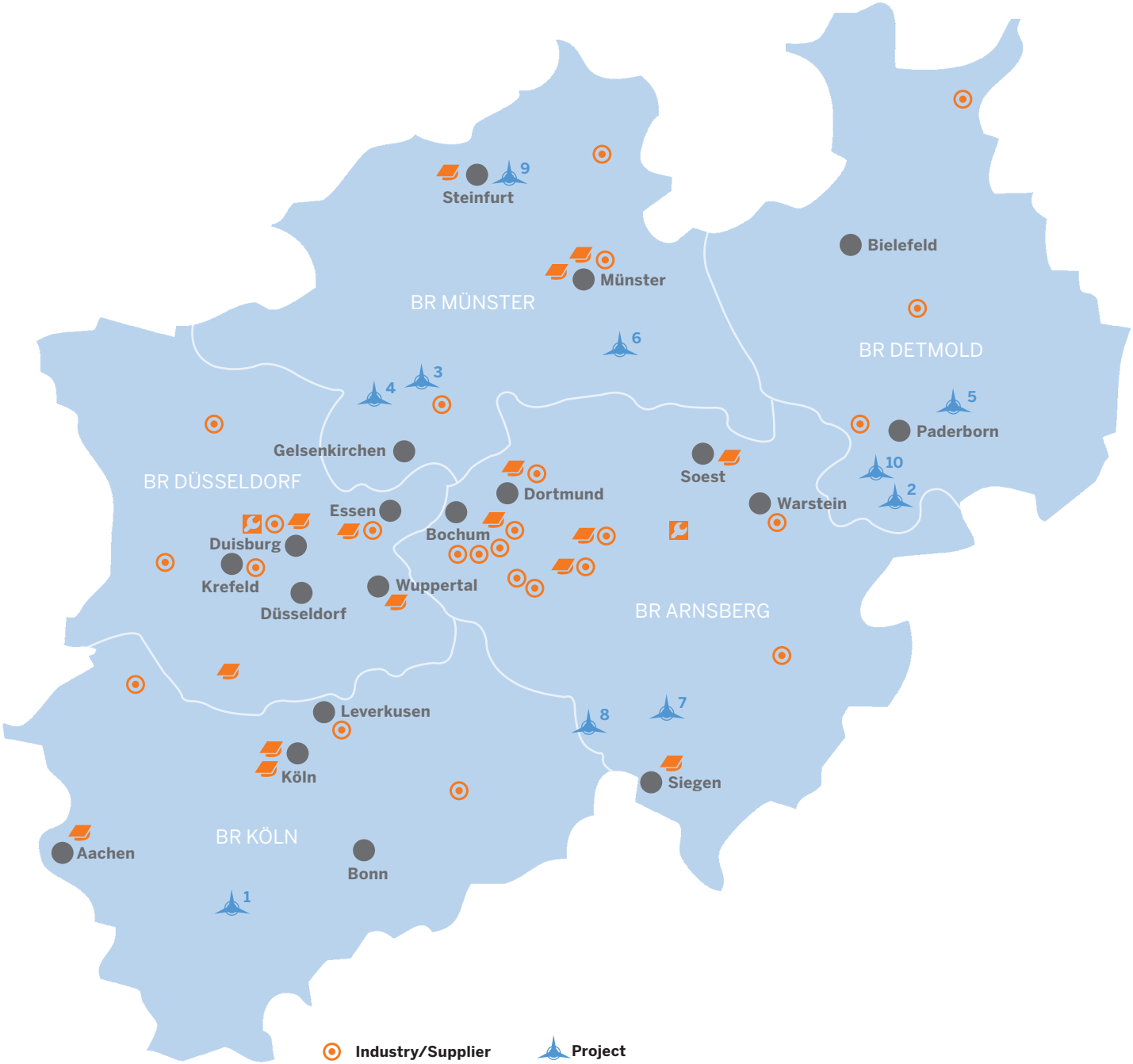
When optimising wind turbines there is a need for the material sciences and hence for chemistry. Specifically with composite materials such as are needed to manufacture rotor blades nanotechnology and facilitate major progress. Carbon nanotubes are 50,000 times thinner than a human hair and they are currently being developed by Bayer MaterialScience through the nanomodification of fibreglass-reinforced plastics. With these carbon nanotubes it is possible to make rotor blades lighter and bigger, meaning wind turbines can become more efficient. Bit it isn't only the big names who are creating a sensation at the interface between chemistry and wind energy. Environmentally friendly coating technologies have a long tradition at the company Dörken in Herdecke. For more than 25 years the company has been developing highly complicated micro-coat corrosion-proofing systems which increasingly succeed in withstanding the complex demands and extreme stress in wind turbine construction, even with extremely small coating thicknesses.

Automotive Supply and Mobility Industry Makes Headway

Hanning & Kahl from Oerlinghausen is an old company known for braking systems and safety engineering in railway vehicles. Once again there are surprising points of contact with wind turbine construction. After all, these technical structures must also be capable of being effectively braked. Hanning & Kahl relies on the superiority of electromechanical brakes as opposed to hydraulic systems because they appreciably simplify operation of the turbines. All the maintenance work required for the trouble-free and safe operation of hydraulic braking systems are dispensed with: regular oil change, replacement of hydraulic hoses, system venting. Furthermore electromechanical brakes also work perfectly at extreme temperatures.

The company Sternberg AG in Schmallenberg can look back over a hundred-year history in metal working. But today the company not only operates as a supplier to the automobile industry; it pursues an additional core activity in the development and planning of new products. At the present time it is engaged in a promising way with a new kind of wind turbine based on the vertical-axle principle. With small dimensions and decentralised, it can serve to supply heat and support heating systems so to speak from your private garden. It is quiet, low, inexpensive and has a high degree of efficiency thanks to its low starting torque.

Wind Energy in NRW: Selected Projects and Installations



Industry/Supplier
Research
Manufacture

Project

1 Schleiden Wind Farm
2 Sintfeld Wind Farm
3 Hoppenbruch Mine Waste Heap
4 Gelsenkirchen-Scholven Mine Waste Heap
5 Repowering Paderborn-Neuenbeken
6 Repowering Ahlen
7 Wind Power Utilisation Hilchenbach
8 Wind Power Utilisation “Ewiger Fuhrmann”
9 Wind Farm Hollich near Steinfurt
10 Wind Farm WestfalenWind

EnergyAgency.NRW

The EnergyAgency.NRW works on behalf of the State Government of North Rhine-Westphalia as an operative platform with broad competence in the energy domain: from energy research, technical development, demonstration, market launch and energy consulting through to continuous occupational training. In times of high energy prices it is more important than ever to forge ahead with the development of innovative energy technologies in NRW and to highlight from a neutral position how companies, local authorities and private individuals can handle energy more economically or make meaningful use of renewable energies.

The EnergyAgency.NRW manages the energy economy cluster which goes under the name of EnergyRegion.NRW and the energy research cluster which bears the name CEF.NRW. In addition the EnergyAgency.NRW offers energy consultancy services in the form of initial and contracting consultancy for companies and administrative bodies as well as information and continuous training facilities for specialists and private individuals. The organisation‘s area of work also includes training user behaviour.

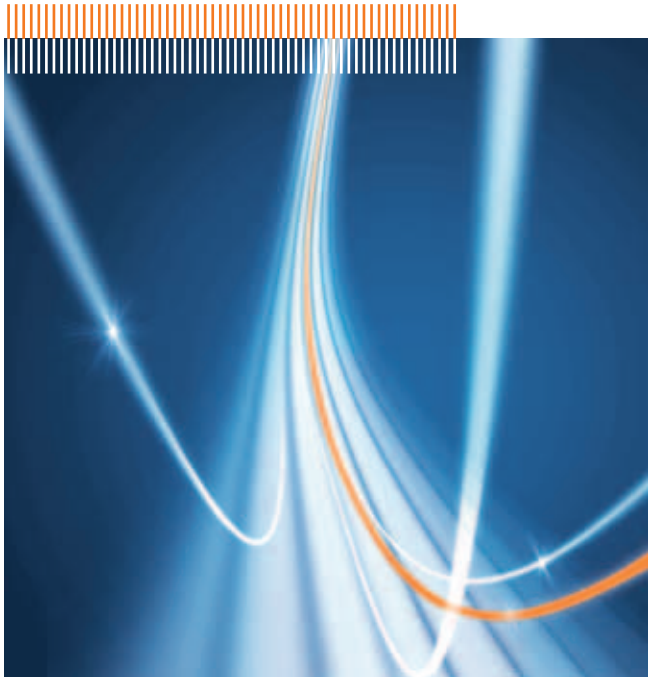
The Focal Areas of the EnergyAgency.NRW in Detail

Cluster Management
The EnergyAgency.NRW is responsible for managing the cluster EnergyRegion.NRW with the its eight networks Biomass, Fuel Cells and Hydrogen, Energy-efficient and Solar Construction, Geothermal Energy, Fuels and Drives of the Future, Power Plant Technology, Photovoltaics and Wind Energy, and also for management of the cluster CEF.NRW. In both clusters universities, companies, local authorities and experts are provided with successful platforms for a collaboration. Both clusters concentrate on pushing innovation processes in NRW, on initiating strategic alliances and speeding up the market launch of innovative products nationally and internationally. This also includes support for companies from NRW in matters of foreign trade.

Energy Consultancy
Here engineers of the EnergyAgency.NRW gather information on energy weak spots – from technical systems in buildings to production sequences in companies. The spectrum ranges from heating systems and heat recovery through to insulation as a protection against heat and cold in large factory shops, from leak detection to the preparation of energy concepts. The engineers give advice on possible funding, help companies to cut energy costs and hence help increase competitiveness.

Continuous Training
The EnergyAgency.NRW offers a series of continuous training seminars – also for end consumers. The 50 seminars can be used by continuous training institutions, energy supply utilities, federations, associations, universities, local authorities and companies in NRW. Within the framework of this programme “E-fit” action weeks are also offered for company workforces. With the Enpedia. NRW the EnergyAgency.NRW offers an online platform for basic and further occupational training on the internet.

State-wide Campaigns and Joint Actions Campaigns such as “NRW Saves Energy”, “My House Saves”, “50 Solar Housing Estates in NRW”, “100 Climate Protection Housing Estates in NRW”, “Photovoltaics NRW”, the “Wood Pellets Action” or The “Heat Pumps Marketplace NRW” give information to the general public in NRW about environmentally friendly and innovative heating technologies, and they give tips on energy conservation.



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