Energy in North Rhine-Westphalia

Facts & figures

North Rhine-Westphalia (NRW) is Germany's leading energy location and the most important energy region in Europe. Around 30 percent of Germany's electricity is produced here – more than in any other federal state, and 90 percent of German coal and 53 percent of German lignite is produced here. Nearly 35 percent of the total energy needed in Germany is consumed in NRW.

Around one third of all the employees subject to social security contributions in the German energy and water supply industries and approx. one fifth of those in the German manufacturing and supply industries for the energy sector come from NRW. Of the more than 43,000 employees in the coal mining, oil and natural gas sectors, around 30,000 work here, i.e. more than two thirds (2010).

On a national scale, around 20 percent of the entire electricity consumption and nearly 12 percent of the total end energy consumption came from renewable energies in 2011. In first place for electricity generation is wind power, which generated 8 percent of German electricity consumption. This was followed by biomass with 6 percent, and hydro-electric power and photovoltaics, each with 3 percent. This makes renewable energies the second most important energy producer overall after lignite with 25 percent. This is followed by anthracite with 19 percent and nuclear energy with 18 percent, and natural gas with 14 percent.

The state has attained a leading international position in the development, testing, and market launch of technologies that harness new, inexhaustible sources of energy, such as the sun and wind. From 1988 to the end of 2007, around 700 million euros from the State and the European Union (ERDF program) were spent on more than 60,000 assisted projects in the state's funding program progres.nrw for the development, demonstration and introduction on the market of innovative energy technologies and energy consulting. The funds provided attracted further investments of about 3.8 billion euros. From 2008 to 2011, a further approx. 14,700 projects were provided with funding of around 70 million euros. In 2010, approx. 3,600 projects were funded to the tune of around 13.3 million euros in the market launch program area. In 2010, around 26,500 employees are working on the development and utilization of renewable energy technologies in 3,500 companies, generating total sales of more than 8.3 billion euros.

From a long tradition of utilizing natural resources, a broad expertise in energy technology has grown in NRW. The state is home to a dense network of research institutes as well as to numerous companies offering innovative energy products and services for increasing energy efficiency and utilizing renewable energies. For many future-oriented companies, NRW is the ideal location – from the extraction of raw materials for energy to conversion, e.g. in fuel cells. In order to build on its leading position and to achieve its energy policy goals (climate protection, conservation of resources, economic efficiency and security of supply), the state has in the EnergyAgency.NRW an instrument possessing a wide range of competences.
As a result of the German Bundestag decree passed on 30 June 2011 to phase out nuclear power by the year 2022 (energy turnaround) the energy industry in NRW is undergoing radical change. To promote renewable energies and to achieve Germany’s climate protection goals the state of North Rhine-Westphalia has introduced its own Climate Protection Law. This provides for a reduction of greenhouse gas emissions by the year 2020 of at least 25 percent and by the year 2050 of at least 80 percent compared to 1990.

**Renewable energies**

- **Biomass:** Biomass is a naturally growing material from living and dead organisms. The carbon stored within it is a fuel with particularly high potential and compared to fossil fuels biomass provides considerable ecological benefits. In NRW, about 82 percent of regenerative heat was generated from biomass producing 8.6 billion kWh (kilowatt hours), and about 46 percent of regenerative electricity at 4.8 billion kWh (2010). Furthermore, around 380,000 tons of regenerative fuel were produced. In the field of agricultural biogas plants alone, approx. 430 plants were operating with capacity of 170 MW (megawatts) at the end of 2010. By the end of 2011 a further 70 biogas plants were installed with additional total capacity of approx. 25 MW.

More than 1,300 players from the industry have pooled their resources to work together on new projects in the Biomass Competence Network of the EnergyAgency.NRW. The cluster of excellence "Tailor-Made Fuels from Biomass" at RWTH Aachen University takes an interdisciplinary approach to research into new, biomass-based fuels. With the clusters of excellence, internationally visible and competitive research and training institutes will be established at German university locations, thereby facilitating scientifically necessary networking and cooperation. The Oberhausen-based Fraunhofer Institute UMSICHT received approx. 1.4 million euros for its "Biorefinery" concept to research into the energy utilization of renewable resources.

- **Geothermal energy:** The subject of geothermics is steadily growing in importance among the energy technologies. As the chosen location of numerous market-leading companies, NRW occupies a key position. Within the Ruhr Metropolitan Region alone – those are the 53 municipalities of the Ruhr region – there are approx. 230 companies operating in the geothermal market. The geothermal industry provides about 4,000 to 5,000 jobs in NRW.

The earth's heat, which is being utilized increasingly in Germany, provides an inexhaustible reservoir of energy. Heat pumps cut heating costs and help protect the environment by using ambient heat to a large extent. In the meantime, approx. 30 percent of new buildings in NRW, as well as many existing buildings, are heated using heat pumps. Of the 450,000 heat pumps now installed all over Germany, more than 91,000 (20 percent) provide environment-friendly heat generation in NRW. This figure is to increase to over 200,000 by the year 2020.

To ensure that the geothermal energy can be used by all the citizens in the state, NRW commissioned the Geological Survey NRW with the "Study of
Geothermal Energy Potential in NRW" to determine the state's near-surface geothermal energy potential. The result is a state-wide geothermal map on which all relevant sub-surface data and geothermal productivity for geothermal energy drilling up to a depth of 100 m can be retrieved for every location in the state.

With 130 houses, one of Europe's largest geothermal probe housing projects is located in Werne in Westphalia. Compared to housing estates which heat with conventional fuels, the residents in Werne save 125 tons of CO₂ per year. In March 2007, building work began in Cologne on Germany's largest housing construction project. The estate completed in 2009 with over 400 single-family houses as well as rented and owner-occupied apartments for approx. 1,000 people is supplied almost exclusively with geothermal energy.

• **Hydro energy:** The use of hydropower to generate energy is capable of helping to reduce climate problems worldwide. The technically usable potential of hydropower in NRW today is defined as 800 GWh/a (gigawatt hours) of electricity, of which 200 GWh/a could not, however, be used to date. The state government has so far subsidized 181 plants with total output of more than 18 MW. Subsidies totaling around 13 million euros triggered further investments of more than 49 million euros.

• **Mine gas:** The use of mine gas as a source of energy is gaining more and more importance in NRW. The large number of mine shafts in closed-down mines offers easy access to this natural resource, with which electricity is generated in block-type thermal power plants. The process is environmentally friendly, and guarantees greater safety, as gas which surfaces uncontrollably through crevices in the ground represents a latent source of danger. In 2011 there were approx. 99 mining permits to utilize mine gas in NRW. 125 block-type thermal power plants operate in the state with electrical output totaling 184 MW at the end of 2011. In 2011 alone, they produced 711 million kWh of electricity – enough to supply approx. 160,000 households with power. The total mine gas potential used resulted in a CO₂ reduction of approx. 3.3 million tons in 2011. The development of methane-rich gas deposits by means of targeted drilling also has good prospects as methane gas possesses a very high fuel value. The Herne Utility Board, for example, generates over 40 million kWh of electricity in its five mine gas-fired, block-type thermal power plants, which represents an annual CO₂ reduction of approx. 200,000 tons.

• **Solar energy:** NRW is an important location for solar energy. With more than 7,600 employees and 4.2 billion euros in sales (2010) solar energy is the largest sector in the regenerative energy industry. In recent years, the photovoltaic sector in particular has experienced a burst of growth. In 2010, installed solar electricity capacity totaled 1,941 megawatt-peak. Under the title "50 solar settlements in NRW" the state is promoting new residential projects in which the sun is used as the main source of energy. In the meantime, 37 settlements containing over 3,500 residential units have been completed for approx. 9,000 tenants or owners, with a further 14 currently under
construction. At the end of 2009, the project entitled "100 climate protection settlements in NRW" was presented as part of the North Rhine-Westphalian energy and climate protection strategy. The purpose of the new model settlements is to show how the levels of the current German Energy Saving Ordinance can be undercut by more than half with a combination of solar energy, high insulation standards, modern heating technology and heat recovery in ventilation, as well as how CO₂ emissions can be further reduced. Nine settlements are already under construction, and a further 26 are planned. With these projects, NRW is the European front-runner when it comes to solar settlements.

No grants were required for the first open-space photovoltaic plant in NRW in the town of Nottuln in Münsterland (population 20,000), which went into operation with 16,000 modules in October 2008 and can now supply electricity for 300 households with annual output of 1.2 MW while saving 1,000 tons of CO₂. With a saving of 2,400 metric tonnes of CO₂ and an output of 3.8 MW, North Rhine-Westphalia's largest solar park was commissioned in Inden (Düren district) in 2011. This means that 1,000 households can be supplied with climate-compatible electricity.

• Wind energy: In NRW there are nearly 2,900 wind turbine generators turning with an installed capacity of approx. 3,070 MW. This means that the state remains in 5th place on a nationwide scale. More than 7,000 people in the Rhine and Ruhr region earn their living with the construction of wind power technology, especially in the supplier areas gears/gearboxes, converters, steel towers, and anti-friction bearings and they generate sales of around 2 billion euros (2010). Five of the world's leading gearbox suppliers for wind turbine generators alone are based in NRW, including Bosch Rexroth from Witten, Renk from Rheine, and Winergy from Voerde. According to trade association figures, the export rate of the German wind power industry, which employs 96,100 people, is around 70 percent.

Germany’s first wind turbine generator was built on the eighty-meter-high coal dump plateau in Herten in 1997. At what used to be Europe’s largest wind farm near Paderborn, about 65 million kilowatt-hours of electricity are produced with 68 generators and a rated output of 39 MW. Mathematically, this corresponds to the energy requirements of approx. 50,000 households. Windtest Grevenbroich GmbH has been operating the world’s largest testing field for inland wind energy systems on the Neurather Höhe near Grevenbroich since 1998.

Alternative technologies

• Combined heat and power generation: There is a major unexhausted potential in combined heat and power (CHP) generation. Industrial CHP in particular has attained relatively high fuel utilization ratings and use hours. The main problem in implementing the technology is the frequent lack or inadequate availability of a heat sink. The state government of North Rhine-Westphalia intends to increase the proportion of power generation accounted for by CHP as a central bridging technology to 25 percent. For this purpose a
comprehensive funding programming to the tune of 250 million euros covering several years has been launched. The aim is, among other things, to eliminate investment obstacles to the expansion of CHP and to expand and condense the near-industry district heating infrastructure. Initially the state of NRW has given instructions for a potential study to highlight the economically feasible potentials of CHP in NRW. A further important measure is the expansion of the Ruhr district heating network. To create the appropriate basis for this a feasibility study is currently being drawn up in which the prospects for district heating supply in the Ruhr Region for 2050 are being examined.

**Electric mobility:** The future of mobility is becoming increasingly electric. This is demonstrated by various hybrid concepts from car manufacturers as well as purely electric vehicles which will become a common sight on the roads in the future. Driving with electricity reduces dependence on oil on the one hand while at the same having the effect that fuel savings mean a reduction in greenhouse gases. It is the declared goal of the federal government to make Germany the leading market for electric mobility. By the year 2020, the target is to have at least 1 million electric vehicles driving on Germany's roads, including at least 250,000 in NRW.

NRW is very well placed as an energy and technology region, and also as a center of the automotive supplier industry. Numerous research institutes already concern themselves with the electrification of vehicle powertrains, hybrid technologies, fuel cells, high-energy batteries and smart electricity networks. In order to implement the recommendations of the Electromobility.NRW Master Plan, the centers of excellence Battery (focus in Münster), Automotive Engineering (focus in Aachen) and Infrastructure & Networks (focus in Dortmund) have been set up. In the course of the first phase of the Model Region Rhine-Ruhr, projects subsidized with federal funds include the construction of over 500 charging points and the road-testing of over 200 electric vehicles. In the second phase, a further approx. 200 further electric vehicles and nearly 200 charging points are planned. In addition, the state of North Rhine-Westphalia is actively involved with an electromobility promotional competition, providing approx. 60 million euros of state and EU funds for 36 research and development projects.

**Fuel cells:** According to expert opinion, the fuel cell will play an important role in energy supply in the 21st century. NRW offers outstanding conditions for the development, production, application, and marketing of this technology. To date, the state government has supported 100 fuel cell and hydrogen projects via the "Fuel Cell and Hydrogen Network NRW", which was established in 2000. The objective of these projects is to establish hydrogen and fuel cell technology as an integral part of future energy supply while at the same time exploiting the economic opportunities that the technology presents for NRW as a business location. In view of the challenges of the energy turnaround, climate protection and the improvement of energy efficiency, as well as the further development of renewable energies, hydrogen and fuel cell technology is seen as being a key technology in all areas of the energy system. To this end, more than 110 million euros have been provided so far from state funding and from the EU, with the total investment amounting to
around 185 million euros. The network, the largest of its kind in Europe, is an association comprising approx. 400 mostly small and medium-sized enterprises and research institutes. As a consequence of the further development of renewable energy generation in the context of the energy turnaround, hydrogen will play an increasingly important role as a storage medium in future energy supply. Surplus wind energy can be converted by means of water electrolysis into hydrogen both centrally and above all decentrally. Hydrogen can subsequently be stored without difficulty in various technical ways, e.g. converted back to electricity highly efficiently by means of fuel cells if required, or used as a "domestic fuel", for example in fuel cell vehicles for zero-emission mobility. Projects to test this approach currently form a focal point of the network's activities. With the Center for Fuel Cell Technology (ZBT) in Duisburg and Forschungszentrum (research center) Jülich the state of North Rhine-Westphalia also has research and development institutes which are known and recognized all over the world.

• **Fuels and drive systems:** NRW is not only a significant energy region, but also a major fuels region. Domestic refineries produce about 25 percent of the crude oil consumed in Germany. The amount consumed by road traffic in NRW is approx. 9 million tonnes of oil annually. This is the equivalent of 20 percent of national sales in Germany. One possibility for lowering CO₂ emissions and protecting the climate is the use of alternative fuels and drives with renewable energy. About 410,000 tonnes of renewable fuels were already produced from biomass in 2009. The biodiesel producers in, among others, Lünen, Lülsdorf, Neuss and Südlohn are among the 15 largest producers in Germany. The "Fuels and Drives of the Future" network is mobilizing all its forces along the entire value chain. These are forging ahead with the sustainable use of future-proof fuels and drives and their use forms in NRW and establishing them in the region.

• **Power plant technologies:** With a power plant capacity of approx. 38,000 MW NRW is the most important power plant location in Germany, if not in Europe. Here 30 percent of the German energy requirement is generated and 33 percent consumed. With BoA 2/3 RWE is erecting in Grevenbroich-Neurath the world's most modern brown-coal-fired units. In this project alone, with an investment volume of approx. 2.3 billion euros, about 50 percent of the local value added is remaining in the region. Following the concept of the "Reference Power Plant NRW", coal-fired power plants are being constructed worldwide with efficiency ratings of up to 46 percent. This means that it is possible to save 138 g CO₂ per kWh as compared with the present average efficiency of 38 percent. If all the power plants in the world were to produce according to this standard, the CO₂ emissions would be cut by approx. 30 percent. Major synergy effects are being obtained for the industry with the transfer of expertise to solar thermal power plants (tower power plants). There roughly 70 percent conventional boiler technology is used in the power unit.

• **Wood pellets:** There are many arguments in favor of using wood pellets as fuel. Besides benefiting the environment, their use also has economic advantages. Wood pellets are a high-quality and renewable fuel. They have a calo-
The energy content of a kilogram of pellets is roughly equivalent to that of half a liter of heating oil. Thanks to targeted public relations and support in the form of state and federal grants, the number of wood pellet heating systems installed in NRW has risen considerably in recent years. In 2003 just 600 of these systems were installed; at the end of 2011 there were more than 20,000 households using this climate-friendly heat source. Around 155,000 systems are installed throughout Germany.

Pilot projects

- **InnovationCity Ruhr – model city Bottrop:** A model of efficient urban redevelopment is being tested in Bottrop. Within ten years the CO₂ emissions in a part of the Ruhr region city with its 69,000 inhabitants are to be reduced by 50 percent. This target is to be achieved through the energy-related improvement of existing building stock, through increasing energy efficiency in the public sector and in industry, and through promoting electromobility and renewable energy sources.

- **Smart Grids:** In two model projects in Mülheim/Ruhr (E DeMa) and Aachen (Smart Watts) systems for the intelligent use of electricity involving over 1,000 households are being tested. Several industrial enterprises, local suppliers and university research are involved.
Regional concentration

The regions with a particularly high proportion of employees subject to social security contributions in the energy industry are the district-free cities of Essen and Gelsenkirchen. Regions with a particularly high proportion of companies in the energy industry are the districts of Düren, Gütersloh, Höxter, Recklinghausen, Soest and Steinfurt, district-free cities of Gladbeck and Münster, and Erftkreis and Hochsauerlandkreis districts.

Employment concentration

Source: IT.NRW; figures refer to NACE Code Rev. 2: 35 (energy supply); data: as of 2009

Company concentration

Source: IT.NRW; figures refer to NACE Code Rev. 2: 35 (energy supply); data: as of 2009
Companies

With E.ON in Düsseldorf and RWE in Essen, NRW is home to two utility companies which are among the largest in the world. This selection of examples is restricted to companies from the renewable energies sector:

- **Biogas Nord AG, Bielefeld**: In 2006, the Bielefeld-based company went public in order to enhance its position in the growth market for renewable energies. Since 1995 it has built over 250 biogas plants in 12 countries. Clients include agricultural and industrial enterprises, as well as energy suppliers, institutional investors, and municipalities. In 2010, the company generated sales of approx. 56 million euros and employed more than 120 people.

- **Bosch Rexroth AG, Witten**: Part of the Bosch Group since 1977, the company operates in the fields mobile hydraulics and wind power, manufacturing, among other things, industrial, drive and swing gears, e.g. for wheel loaders, mobile excavators and crawled hydraulic excavators. For the wind power sector Rexroth in Witten develops and manufactures all gears used in wind power generators: from efficient generator gears through high-precision azimuth gears for continuous and exact yaw mechanisms to compact pitch gears for rotor blade adjustment. Over 1,000 people are employed in this business area, and 35,000 in the group as a whole, including 18,300 in Germany alone. In 2010, sales totaled 5 billion euros.

- **E.ON AG, Düsseldorf**: As the world's largest investor-owned energy service provider with around 93 billion euros in sales and close to 85,000 employees in 2010 and significant growth rates in 2011, E.ON is also active in the field of renewable energies. In the area of wind power, off-shore and on-shore wind parks are operated in the USA and England, and off the German North Sea coast there is a wind park producing 60 MW. With more than 100 on-shore wind parks supplying several hundred thousand households worldwide the company is one of the world's largest wind power operators. It uses hydro power in 212 plants throughout around the globe for the production of 18.5 (terawatt hours) per year. And in the utilization of biomass the company numbers among the world's technology leaders. In Germany alone, 30 MW electricity is generated in this way.

- **Masterflex AG, Gelsenkirchen**: The company operates successfully in the business areas hose systems, medical technology and fuel cell technology. Its products include series production-ready, hydrogen-based 50W fuel cells for mobile energy supply. In 2011, the company employed around 450 people and generated sales of 53 million euros.

- **Natural Energy West GmbH, Neuss**: NEW (Natural Energy West) based in Neuss has been producing biodiesel at its large-scale industrial plant in Marl since 2002. Upon completion of the second expansion stage in the middle of 2005, production capacity was doubled once again. By doing so, the company responded to the growing demand for biofuels. NEW employs 19 people in Marl.
- **Petrotec AG, Borken**: The company is the largest European manufacturer of waste-based biodiesel. On the basis of residual and waste raw materials such as yellow grease and using proprietary technology Petrotec produces one of the most sustainable and climate-friendly biodiesels. Petrotec sells its biodiesel under the EcoPremium Biodiesel brand. In a fully continuous procedure Petrotec technology is capable of processing fresh vegetable oils such as rape seed, soy and palm oil as well as oils and fats that are difficult to process such as yellow grease and animal fats and oils and fish oils. In 2011, sales totaled 173 million euros.

- **RWE Innogy GmbH, Essen**: RWE Innogy is the RWE affiliate responsible for renewable energies. Established in 2008, RWE Innogy bundles the group’s activities in this area. The portfolio embraces wind power plants on land and water as well as biomass plants and hydro power plants. 4,500 MW of power based on renewable energies are to be under construction or in operation by the year 2014, with 2,400 MW already available now. In 2025, 30 percent of the RWE power plant capacity will be based on renewable energies. The company employs over 1,200 people.

- **SolarWorld AG, Bonn**: With more than 3,300 employees and sales of more than 1 billion euros (2010), the listed company with its subsidiaries numbers among the world’s largest providers in the solar electricity industry. Since 1999 the company has operated exclusively in solar electricity technology, but covers all vertical stages from the raw material silicon to turnkey solar electricity plants. In addition to its production facilities in Germany and the USA, the company opened a module factory in South Korea in December 2008 as part of a joint venture. Sales offices in Germany, Spain, the USA, South Africa and Singapore serve the international solar markets. The foreign share of sales amounts to 50 percent.

- **Vaillant Deutschland GmbH & Co. KG, Remscheid**: The Vaillant Group is an internationally operating company in the fields heating, ventilation, and air-conditioning technology. The product portfolio ranges from efficient heating equipment on the basis of conventional energy sources to system solutions for the utilization of renewable energies. For many years the company has been working successful on the development and marketing of heating equipment based on combined heat and power. Another future project is the fuel cell heating device which has already been developed jointly with partner companies for several years. In the 2010 financial year, Vaillant, which has been family-owned since 1874, generated sales of approx. 2.3 billion euros with more than 12,400 employees, including approx. 3,400 in Germany.

- **Winergy AG, Voerde**: Winergy AG is the only supplier to the international wind power industry with decades of experience in the manufacture and combination of complete drive systems for wind turbines. At its headquarters in Voerde/Friedrichsfeld, Winergy AG has an assembly plant and state-of-the-art production and testing facilities for wind turbines. In 2009, the worldwide 800 employees generated sales of one billion euros. The company belongs to the Siemens Group (402,000 employees, 74 billion euros in sales in 2011).
University and research landscape

NRW is also in an excellent position when it comes to energy research: at more than 30 locations in universities and research institutions teaching and research are conducted in all the relevant fields of energy technology. This expertise is a genuine location advantage for industry, also reflected in the settlement policy for industrial companies in our region. Here is a selection of the universities and research institutes:

Energy studies

- **RWTH Aachen University (35,700 students)**
  The Faculty of Electrical Engineering and Information Technology offers two Bachelor’s and two Master’s degree courses specializing in energy and the environment in the fields electrical engineering, energy technology, and electrical power engineering. The Institute of Electrical Systems and Energy Economics is also worthy of mention.

- **University of Applied Sciences Bielefeld (8,300 students)**
  The main emphasis of the Bachelor’s degree course in Regenerative Energies lies on the generation, distribution and effective utilization of electrical energy on the basis of regenerative energies, as well as on the generation, distribution and effective utilization of bioenergy from renewable raw materials and biological waste material.

- **Ruhr University Bochum (36,100 students)**
  Incorporated in the Institute of Energy Technology, the Chair for Power Systems and Energy economics belongs to the Faculty of Engineering, and according to its own definition its work focuses on resource-conserving energy economics and reactor simulation and safety.

- **University of Cologne (44,700 students)**
  The Institute of Energy Economics at the University of Cologne (EWI) is borne by the University of Cologne and the Society for the Promotion of the Institute for Energy Economics. The main emphasis of research and consultancy at the EWI lies on the liberalization of the international electricity and gas markets and the regulation of the electricity and gas markets in Germany and Europe.

- **Technical University Dortmund (26,900 students)**
  Founded in 1974, the Chair for Power Systems and Energy Economics takes an interdisciplinary approach to research and teaching with systemic considerations for sustainable power supply.

- **University of Applied Sciences Düsseldorf (7,900 students)**
  One of the outstanding features here is the accredited Bachelor’s degree course in Process, Energy and Environmental Technology in the Department of Mechanical and Process Engineering.
• **University Duisburg-Essen (36,800 students)**
In the Faculty of Engineering there are numerous chairs which concern themselves with research and teaching in the fields of energy, energy technology, the environment and electrical engineering, such as the chairs for energy economics, energy transport and storage, as well as for environmental process engineering and plant engineering.

• **University of Applied Sciences Gelsenkirchen (8,200 students)**
The university offers a four-semester, modular Master's degree course in Energy Systems Technology.

• **Hamm-Lippstadt University of Applied Sciences (1,100 students)**
The Bachelor study course "Energy Technology and Resource Optimization" is a young and modern discipline which combines future-oriented technologies for the provision of energy with questions regarding the optimized utilization of resources in the various cases of energy use.

• **Münster University of Applied Sciences (10,800 students)**
Bachelor's/Master's degree courses in Energy, Building and Environmental Engineering. Since the summer semester of 2010, the Energy-Building-Environment Faculty of the Münster University of Applied Sciences has offered an interdisciplinary Master's degree course entitled "Utility Industry Network Engineer", which is aimed at students with pertinent professional experience in the grid-bound utilities sector. The Bachelor's degree course "Technical Management in Energy, Building and Environmental Engineering" offers economic modules as well as engineering content, and features lectures on the many different possibilities in energy supply (naturally including new and regenerative energies) and aspects of building technology.

**Energy research**

• **Public Private Partnership:** Companies with worldwide operations have decided in favor of undertaking R&D in the area of energy and associated areas in NRW: In November 2011 the E.ON Energy Research Center at RWTH Aachen University moved into the new, 40 million euro main building in which five institutes and 150 scientists from four faculties work together on an interdisciplinary basis. Thyssen funds material research in Bochum to the tune of 22.5 million euros with ICAMS. Hitachi is investing 30 million euros at RWTH Aachen University and at the universities in Bochum and Dortmund in the area of the very latest power plant technology. The Institute of Energy Economics at the University of Cologne is dedicated to the research and teaching of energy economics and to the production of science-based studies for the energy industry and political practice. It is receiving its funding totaling twelve million euros in the period from 2009 to 2013 from a consortium comprising the state of North Rhine-Westphalia and the companies E.ON and RWE. And by 2014, RWE intends to build a low-CO₂ power plant in the brown-coal mining area based on coal gasification with sequestration.

• **Institutional research:** RWTH Aachen University is particularly active when it comes to the subject of energy: Starting in September 2013, seven insti-
tutes in the Department of Mechanical Engineering and Electrical Engineer-
ing will operate the “Center for Wind Power Drives (CWD)” with a system
test-bed for onshore wind energy plants with the goal of significantly increas-
ing the reliability of wind turbines. RWTH Aachen University and the Jülich
Research Center have formed the “Jülich Aachen Research Alliance”
(JARA). One of its four subject areas is JARA Energy. As part of the excel-
ence cluster “Tailor-Made Fuels from Biomass”, which is subsidized by the
Excellence Initiative, RWTH Aachen University has founded a center of excel-
ence for fuel design. Together with the German Aerospace Center, the
Aachen University of Applied Sciences and the University of Leuven in Bel-
gium it is also involved in the joint Virtual Institute of Solar Thermal Power
Plants. In the Ruhr region, the universities in Dortmund, Bochum and Duis-
burg-Essen work closely together in the field of energy. Through ef.Ruhr
GmbH they conduct joint projects on topics including smart grids and CO₂
capture. The Max Planck Institute of Coal Research in Mülheim conducts
basic research in all areas of catalysis. At the “Münster Electrochemical
Energy Technology” (MEET), the new battery research center at the Uni-
versity of Münster, an international team of around 75 scientists has been
working since 2010 on the research and development of innovative electro-
chemical energy storage devices with higher energy density, longer lifespans
and maximum safety.

• With the ZBT Center for Fuel Cell Technology in Duisburg, the Research
Center Jülich and the Fraunhofer Institute for Environmental, Safety and
Energy Technology UMSICHT in Oberhausen, NRW boasts several out-
standing centers for fuel cell research. The Fraunhofer Institute UMSICHT
covers a very broad thematic spectrum of research ranging from renewable
resources through process technology, biofuels and energy efficiency tech-
nologies to resource management. With its approx. 170 employees the
Wuppertal Institute for Climate, Environment and Energy researches and
develops models, strategies and instruments for transitions to a sustainable
development on a regional, national and international level. The focus is on
resource, climate and energy challenges and their interactions with industry
and society.

• GeoTechnikum Bochum: The State of NRW supports the setting up of a
research-oriented facility, a “GeoTechnikum”, at the Geothermics Centre on
the campus of Ruhr University Bochum. In this, the largest European joint re-
search institute for the exploitation of geothermal heat, universities and
commercial companies are conducting joint technological development work.
The research focuses on drilling, reservoir and heat pump technologies. The
Ruhr University Bochum is responsible for operating and coordinating the
Geotechnologies Competence Centre; in addition the higher education insti-
tutions of RWTH Aachen University, FH Gelsenkirchen (College of Applied
Science) and University of East Westphalia-Lippe are involved. On the cor-
porate side more than 20 companies are already committed to working in the
Bochum Geothermics Centre.
The Institute of Solar Research at the German Aerospace Centre (DLR) in Cologne-Porz has further subdivisions in Stuttgart, Jülich and Almeria (Spain). On January 1, 2011 it came out of the DLR Institute of Thermodynamics as an independent institution. It is currently working on the development of concentrated solar systems for the generation of electricity, heat and fuels, thereby contributing to a sustainable energy supply based on renewable energies.

Cluster & lead market

The cluster policy of the state government of North Rhine-Westphalia promotes the cooperation of companies, research facilities, and the public sector along value-added chains in a total of 16 sectoral and technological areas. These 16 clusters possess a particularly large potential for growth and are extremely important for the economic development of the state. They are oriented to eight defined lead markets.

The activities for development in NRW’s leading energy market are bundled into two clusters: the EnergyResearch.NRW cluster and the EnergyIndustry.NRW cluster. The management of both clusters lies with the EnergyAgency.NRW, ensuring that their networks and partners will continue to form the basis for cluster work in the future.

The EnergyResearch.NRW cluster bundles North Rhine-Westphalian research, consolidates its strengths by establishing and expanding first-class research facilities, and creates transparency by visibly localizing the thematic focal points at outstanding centers. With the aim of networking the players along the entire value chain, the EnergyResearch.NRW cluster is pushing forward with coordinated collaboration between research and scientific facilities and the business community. This gives the universities, universities of applied sciences and research institutes the possibility to acquire third-party funds, to distinguish themselves as a know-how bearer, and to enhance their reputation. The three subject areas with particular emphasis are energy conversion on a fossil, nuclear and solar-thermal basis, research in the field of biological generation of energy carriers in the form of replenishable raw materials, and the field of decentral energy generation including the topics “fuel cell and hydrogen technology”, “photovoltaics” and “energy storage” as well as the cross-sectional topics “energy networks and economy”. The cluster is organized by EnergyAgency.NRW.

www.cef.nrw.de

The Cluster EnergyRegion.NRW advances the networking of the actors in the energy sector over the entire value added chain. The aim is for NRW to remain the most important energy region in Europe in the future, as well as to strengthen the national and international positioning of NRW and the expertise and excellence of the energy sector. The cluster concerns itself with the following eight topics: power plant technology, fuel cells and hydrogen, biomass, energy-efficient and solar construction, fuels and drive systems of the future, photovoltaics, geothermal energy and wind power. The cluster EnergyRegion.NRW provides the participat-
The activities concentrate on promoting innovation processes in NRW, initiating cooperations and strategic alliances, and speeding up the market launches of innovative products both nationally and internationally. By further developing existing strengths and identifying and picking up new trends and developments, strengths and core competencies will be converted into market successes. The cluster is organized by EnergyAgency.NRW. www.energieregion.nrw.de

The EnergyAgency.NRW forms the strategic and competent platform in the energy domain: From energy research, technical development, demonstration and market launch to energy consultancy and continuous vocational training it covers a broad spectrum of subject areas. In various competence networks it offers companies in the state platforms for strategic alliances. Furthermore, energy consultancy services are provided in the form of initial and contracting consulting for companies and administrations, as well as information and continuous training services for specialists and private individuals.

In the subject areas "Energy Efficiency and Renewable Energies for Companies and Local Authorities" "Energy-Efficient and Solar Construction", "Innovative Power Plants and Network Technology", "Biomass", "Fuels and Drive Systems of the Future“, "Fuel Cells and Hydrogen“, "Wind Power“ and "Solar Energy“ great efforts are being made to advance technical innovations and to forge ahead with know-how transfer between science and industry, consultancy and further training services are offered and companies from NRW are given support in matters of foreign trade. www.energieagentur.nrw.de

Regional clusters and networks

- Rhein Ruhr Power – power plant of the future; www.rhein-ruhr-power.net
  In order to cover the growing global demand for energy in a way which is environmentally compatible, economic and safe it will be necessary in the coming decades to effect the considerable further development of renewable energies and to increase the efficiency and flexibility of base-load and mid-load power plants. In the cluster Rhein Ruhr Power, leading companies and research institutes in the field of power plant technology in the Düsseldorf region have pooled their resources to meet the technological challenges – high efficiency, low exhaust emissions, high flexibility – with the "power plant of the future". The flexible, efficient, fossil-based power plant and the solar-thermal tower power plant are to be developed into products capable of impacting international markets – complemented by broad measures for training, further training and the development of skilled workers. The vision of the cluster partners – which include ThyssenKrupp, Siemens and 25 universities and universities of applied sciences – is to make Rhein Ruhr Power the leading global address for future-proof power plant technologies and the associated services. In doing so, the cluster will make a major contribution to economic, safe and low-\( \text{CO}_2 \) energy supply.
Trade fairs and events

- **E-world energy & water, Essen;** www.e-world-2012.com; **next dates:** February 5-7, 2013
  NRW is not only an important location for energy companies and research facilities, but has been also a leading industry meeting place for several years now. In all segments, the 12th E-world energy & water maintained its continuous growth in 2012. For the first time, over 20,000 visitors came to the leading sectoral meeting place in the European energy and water industries. They obtained information from 580 exhibitors from 20 countries about products and services from the electricity, gas and water industries, energy technology and energy efficiency. Against the background of the mounting challenges in the sector, the "Energy Turnaround Forum" staged for the first time at E-world proved to be a great success. At this joint stand, attention focused primarily on the generation technologies in the field of renewable energies. The exhibitors at the "smart energy" joint stand were also pleased at the high level of interest amongst the visitors. 35 companies concerned themselves with efficient application technologies and energy efficiency topics in general.

- **Batterietag NRW;** www.battery-power.eu; **next dates:** March 4, 2013 **in Aachen**
  This year's Battery Day took place in Münster at the beginning of March. The Battery Day NRW presents the products, services and achievements of companies and institutions in NRW which are active in the battery technology and application market and is a platform for interdisciplinary cooperation as it brings together actors from the energy and chemical industries, as well as from materials research. The current focus is particularly on the continued development of the lithium-ion battery for use in electric vehicles (electromobility), with special attention being given to the optimization of performance, lifespan and safety.