Research & Development Report 2007/2008

Düsseldorf, May 2008

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Executive Summary

Mission and Expenditures

At E.ON, we're committed to being a leader in the research, development, and deployment of specific new key energy technologies. We engage in research and development (R&D) along the entire value chains in power and gas. The mission of our R&D program is to make, move, and deliver energy more efficiently and at a lower cost, to conserve natural resources, and to reduce our impact on the earth's climate, the environment, and the people who live near our facilities. Across the E.ON Group, 190 full-time-equivalent employees work in R&D.

We significantly enhanced our R&D effort in 2007. Our R&D expenditures rose by more than a third, from €27 million in 2006 to €37 million in 2007.

This figure, which consists of our expenditures for activities defined as R&D for financial reporting purposes, doesn't tell the whole story. E.ON also spends millions of euros each year—€46 million in 2007—to support university research and to conduct demonstration projects that test new technologies on a commercial scale. Basic research at universities and commercial-scale testing of new technologies are essential—and in the case of the latter, often very expensive—yet aren't classified as R&D under financial reporting rules.

Using a broader measure (one that includes our R&D programs, our support for university research, and our commercial-scale demonstration projects), we spent €83 million to develop new technologies in 2007, 46 percent more than in 2006. Under our current budget, this figure will increase by another 75 percent to €146 million in 2008.

Basic Research

Innovative ideas often result from the interplay between basic research and practical experience. That's why we believe it's important for E.ON, one of the world's largest owners and operators of energy technology, to support energy research at universities and scientific institutes.

Our flagship program is the E.ON Energy Research Center (ERC) at RWTH Aachen University in Germany. We've pledged to provide the ERC, which was founded in 2006, with €40 million in funding over a ten-year period. In 2007, faculty and staff at four of the ERC's five institutes launched numerous research projects. E.ON is also a cofounder of, and major contributor to, the Energy Technology Institute (ETI), a public-private partnership that funds and coordinates research at several universities in central England.

Beyond our funding for the ERC and ETI, we also support basic research at institutions around the world through the E.ON International Research Initiative, a program under which we award about €6 million in research grants annually. In 2007, we solicited proposals for research into energy storage; the grants will be awarded in May 2008. In 2008, we're asking for proposals on research into nanotechnology applications in the energy business.

Our 2008 budget for university research is €7.4 million, a 35-percent increase from 2007.

Demonstration Projects

Today's promising technologies can become tomorrow's workhorses. To ensure that new technologies will live up to their promise, they must first be tested on a commercial scale. We conduct such tests, known as demonstration projects, through a groupwide technology initiative called innovate.on. The purpose of innovate.on is to accelerate the commercial viability—and thus, the widespread deployment—of new technologies. Our demonstration projects are often conducted in partnership with equipment manufacturers and research institutes.

Milestones

In 2007, we achieved important milestones in the development of a number of key technologies:

Enhancing the Thermal Efficiency of Coal-fired Generation

We chose Wilhelmshaven in northwest Germany as the site for the world's first coal-fired power plant to have a thermal efficiency of more than 50 percent. We also carried out related research into new materials and manufacturing techniques.

Carbon Capture and Storage

- We began planning a pilot unit that will capture carbon dioxide using chilled ammonia. The unit will be sited at Karlshamn power station in Sweden. Testing is expected to begin in October 2008.
- Research into carbon storage technology began in Germany as part of an EU-sponsored project.
- Planning and design continued on FutureGen in the United States. FutureGen will be the world's first large-scale coal-fired power plant to incorporate pre-combustion carbon capture.
- We developed a number of projects in collaboration with the world's leading equipment manufacturers with the aim of testing second-generation post-combustion capture processes and plan to operate these processes in pilot plants by 2009.

Renewables

- Six wind turbines were purchased for alpha ventus, Germany's first large-scale offshore wind farm. This facility, which is sited 45 kilometers (28 miles) off Germany's North Sea coast, is expected to enter service in 2008.
- Our biomethane demonstration plants in Schwandorf and Ketzin, Germany, began operations. The plants upgrade biogas to pipeline gas quality and inject it into the natural gas pipeline system.

Appliances

We tested a variety of natural gas heat pumps which conserve fuel by tapping a renewable resource: the heat of outside air.

Outlook

Going forward, we will continue to focus our resources on promising key technologies that will help us meet the challenge of delivering a secure supply of economically priced and environmentally friendly energy.

Introduction

Strategic Rationale for R&D

Essential to our company's success is our ability to operate efficient, high-quality assets along the entire value chain in power and natural gas. Most of our assets—power plants, power lines and substations, gas pipelines, and other types of energy infrastructure—have long service lives. Some operate for more than 40 years. When we build an asset today we can be certain that its operating environment will undergo substantial changes over the course of its service life. The availability of fuel, the state of the art in technology, the energy policy and regulatory environment: all will change during running time.

E.ON is successful today in part because we made good investment decisions several decades ago. And we need to continue to choose the right technologies for the decades ahead. The first objective of our R&D is therefore to give E.ON a competitive advantage by enabling us to identify, develop, and deploy new technologies that will increase our energy efficiency, reduce our costs, and conserve natural resources.

R&D doesn't end when an asset enters service. Many of our assets are periodically upgraded with new technology in order to improve their operating or environmental performance. The second objective of our R&D is therefore to identify, develop, and deploy technology that will enable us to modify our existing assets so that they operate in the most efficient way possible.

To meet these objectives, E.ON engages in strategic and operational R&D. Strategic R&D takes a long-term perspective, deals with technologies that aren't yet commercially available, and looks at the energy system as a whole. Knowing whether and when a new technology is likely to be deployed enables E.ON to act early, shape technology development, and make prudent investment decisions for the decades ahead. A thorough understanding of the energy system helps us mitigate the risks posed by potentially disruptive technologies and, if possible, transform these risks into opportunities.

It's often advantageous to play an active role in the development of the new technology we add to our portfolio rather than buying it off the shelf. Some technology simply can't be bought readymade, while in other cases we benefit from being able to customize technology to meet our specific needs. Moreover, being involved in the technology development process enables us to develop the skills we'll later need to operate these assets. It also positions E.ON as an innovative company to help us attract highly talented engineers and technicians.

The purpose of operational R&D is to optimize the performance of our existing assets. It's essential for us to understand and know how to improve components, systems, and entire assets. This knowledge has a direct impact on our assets' operating and maintenance costs, availability, and service lives and thus on company's profitability.

Finally, we believe that being a recognized leader in the development of cutting-edge energy technology makes E.ON more attractive to investors, customers, job candidates, and the general public.

R&D Organizational Structure

E.ON refined its R&D organizational structure in 2007. The purposes were to pool our expertise groupwide so that we can gain a competitive advantage in an increasingly European and global energy marketplace (see Figure) and to maximize the value-creation potential of having a wide variety of R&D projects at locations around Europe and around the world.

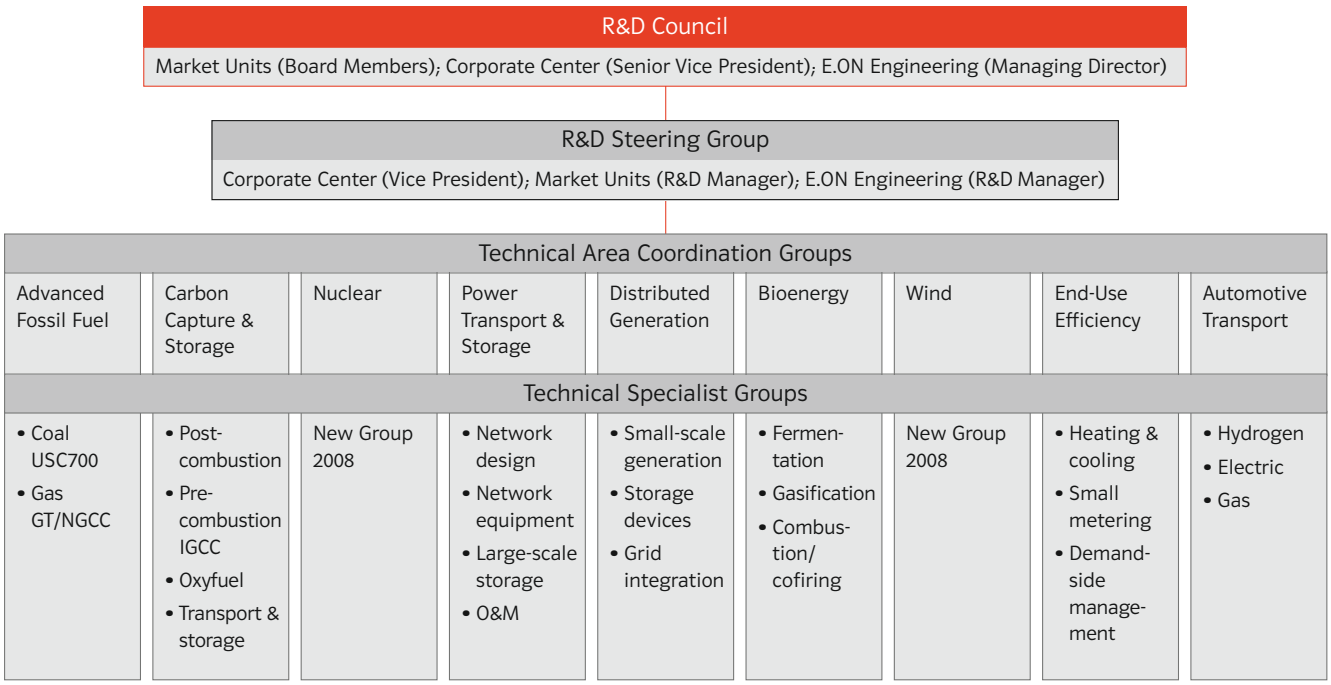
At the top of the R&D hierarchy is the R&D Council, which reports directly to the E.ON Board of Management. The Corporate Center is represented on the Council by the Senior Vice President for Corporate Development, the market unit lead companies by a member of their board of management. To reflect the changes to E.ON's organizational structure, the Senior Vice President for Upstream and Gas and the managing directors of E.ON Climate & Renewables and E.ON Engineering will join the Council in 2008. The Council meets at least twice a year. It gives strategic direction to, and approves the proposals of, the R&D Steering Group.

The Steering Group's main responsibility is to design E.ON's overall R&D strategy and coordinate R&D across the organization. Its members include the Vice President for New Technologies from the Corporate Center and R&D managers from the market units and E.ON Engineering. It meets more frequently than the R&D Council.

At the next level, Technical Area Coordination Groups (TACGs) are responsible for ensuring that R&D projects are consistent across the market units and with E.ON's broader R&D strategy. Its members, who come from all the market units involved in the development of a particular technology, meet regularly and report to the R&D Steering Group. TACGs define E.ON's position on all important technological issues, prevent duplicate development effort, ensure that E.ON isn't missing a key technology, and write position papers to disseminate information about these issues throughout the organization.

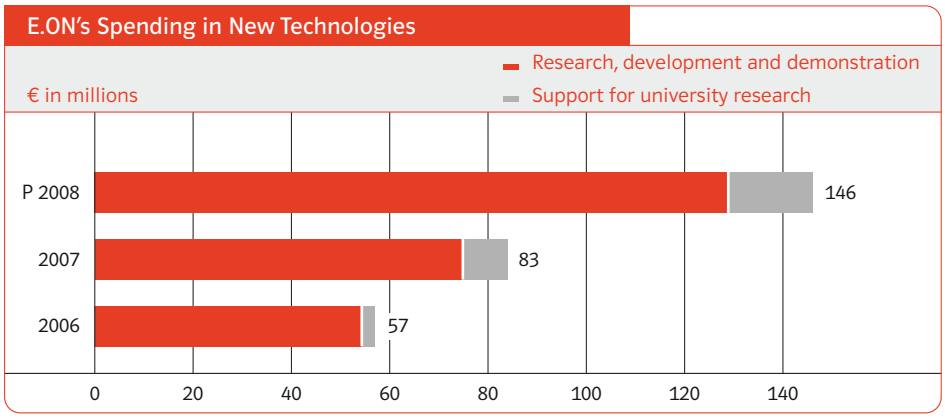
Technical Specialist Groups (TSGs) serve as forums for information sharing among the specialists within a TACG. Each TACG typically has several TSGs.

E.ON R&D organizational structure



Financial Overview

Over the past several years, E.ON has significantly increased its investments in new technologies to meet the growing demand for technical solutions to address climate change. The increases primarily reflect higher investments in large-scale demonstration projects in which key technologies are refined for commercial use. E.ON has also increased its financial support for research at universities with the aim of spurring the development of new ideas and approaches and to establish closer relationships with next-generation engineers and researchers in the energy sciences.



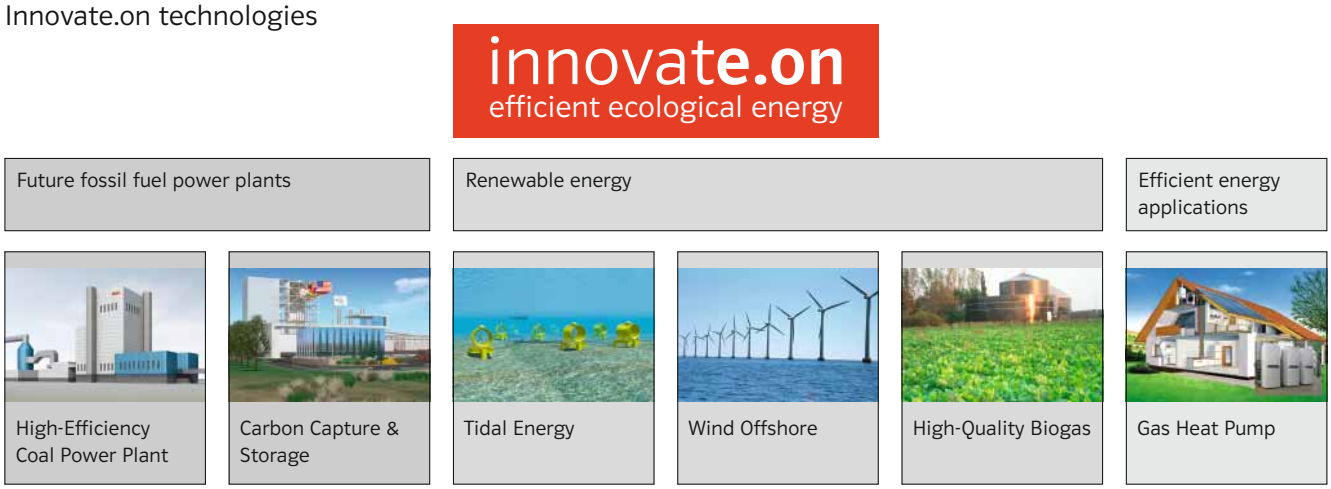
2007 Highlights

Cross-Technology Programs

Innovate.on

We continually review our large portfolio of research projects, identify promising technologies, and invest selectively in order to refine them. Such technologies must offer sufficient economic potential and be sustainable in an increasingly carbon-constrained world. We coordinate the development of these technologies through innovate.on, our groupwide technology initiative, and are actively involved in a number of projects. Our broad international presence enables us to develop technologies at locations where conditions are particularly favorable. In 2007, we added two new technologies, marine energy and natural gas heat pumps, to the innovate.on portfolio (see Figure).

Innovate.on technologies

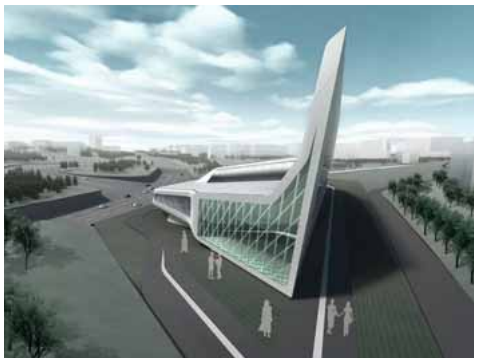


Support for Universities and Scientific Institutes

In 2007, E.ON increased its support for basic research at universities and scientific institutes to €5.5 million.

E.ON Energy Research Center (ERC)

E.ON will provide the ERC, a partnership between E.ON and RWTH Aachen University, with €40 million in research funding over a ten-year period. In 2007, faculty and staff in four of the ERC's five institutes launched a number of projects. The ERC's research budget in 2007 totaled €7.5 million, of which E.ON contributed €2.5 million.



Energy Technology Institute (ETI)

E.ON has partnered with other major corporations and the U.K. government to found the ETI, which supports and coordinates energy research at several universities in central England. The ETI will receive about €1.4 billion in funding over the next ten years, €66 million of which will come from E.ON UK. All corporate funding will be matched by the U.K. government.

Other Support for Universities

E.ON UK has also formed a partnership with the Engineering and Physical Science Research Council (EPSRC), the U.K. government's leading funding agency for research and training in engineering and physical sciences. E.ON UK will provide €6.6 million in financial support for projects over the next five years. The research funded by E.ON UK will focus on transition pathways, energy efficiency, distributed generation, and post-combustion carbon capture and storage.

In addition, our market units have numerous other programs through which they support basic research at universities and scientific institutes.

E.ON International Research Initiative

The purpose of the E.ON International Research Initiative is to provide universities and scientific institutes around the world with financial support to conduct research in areas that have applications in the energy industry. Under the ten-year initiative E.ON will award about €6 million in grants annually. It represents the first time E.ON has offered grants to universities on this scale.

The initiative began in 2007 with a call for proposals for research into energy storage. We received about 50 proposals from 11 countries and awarded just over €5.9 million to ten projects based at institutions in the United States, the United Kingdom, Denmark, France, and Germany. Five of the projects focus on battery technology. Work is expected to begin in Spring 2008. The winning projects will be announced at a media event in Berlin in May 2008. This year, we'll solicit proposals for research into "Applications of Nanotechnology in the Energy Business". Further information at www.eon.com/research_initiative.

Technical Area Coordination Groups

Below is a review of the current status, the technical highlights of 2007, and the outlook for 2008 for each Technical Area Coordination Group.

Advanced Fossil-Fuel Generation

Current Status

Several supercritical pulverized fuel (SCPF) generating units are currently at various stages of planning and construction: a series of 1,100 megawatt (MW) units and a series of 800 MW units in Europe and the Trimble County 2 unit in the United States. The units in Europe are state of the art and designed to operate with steam at 600 degrees Centigrade (about 1,100 degrees Fahrenheit) and 300 bars of pressure (about 4,350 pounds per square inch). We're also involved in the design and construction of 50-plus, an even more advanced SCPF generating unit that will have a net electrical capacity of 500 MW, operate under higher steam conditions (700 degrees Centigrade and 350 bars of pressure), and have a thermal efficiency of more than 50 percent. The first of its kind in the world, this unit is expected to enter service in 2014. In addition, the 18-month test program for the Siemens SGT5-8000H, an advanced combined-cycle gas turbine (CCGT), began at Irsching power station in Germany in late 2007.

2007 Highlight

Wilhelmshaven on Germany's North Sea coast was chosen as the site for the 50 plus unit.

Outlook for 2008

There will be significant R&D for the 50 plus project to ensure that production processes are in place and to test components and procedures for the demonstration plant. E.ON went out to tender in February 2008. Gate-two approval is required by the end of 2008 for the unit to enter service in 2014. The 600-degree class of SCPF units will also see increased R&D on materials to ensure it can achieve high levels of availability and integrity. Over the next five to ten years, E.ON could have 8,000 to 12,000 MW of this class of plant in its portfolio. Testing will continue on the Irsching unit which will be incorporated into a new CCGT that will have a thermal efficiency of 60 percent. We'll also define areas for R&D beyond 50 plus technology.

Carbon Capture and Storage (CCS)

Current Status

Depending on how advanced CCS technology becomes, it could become economically viable if the cost of carbon increases to €30 to €50 per metric ton. Currently, only small-scale test plants of a few MW are in operation. The main tasks ahead are to develop large-scale commercial units and reduce the efficiency losses from carbon capture. The CCS TACG will focus on four main technologies (the anticipated thermal efficiency of each is indicated in brackets which will be further improved):

- A high-efficiency coal generating unit with post-combustion carbon capture (33 to 36 percent)
- Combined Cycle Gas Turbine (CCGT) with post-combustion capture (49 to 50 percent)
- Integrated Gasification Combined Cycle (IGCC) with pre-combustion capture (37 to 38 percent)
- Oxyfuel coal combustion, where combustion occurs in a mixture of oxygen and recycled flue gas (34 to 37 percent).

Methods of transporting and storing carbon dioxide (CO_2) also need to be developed for each CCS technology.

2007 Highlights

Investments in E.ON UK's Combustion Test Facility have made it possible to demonstrate how CO_2 can be captured by optimizing oxyfuel firing.

The decision was made to go forward with a post-combustion capture project at Karlshamn power station in Sweden. The process to be tested uses chilled ammonia. The budget for the project is €8 million, with E.ON Nordic to invest a maximum of €4 million.

We made progress identifying and assessing other advanced post-combustion capture processes. We also narrowed the field of potential partners for collaborative projects to refine and scale up these processes.

E.ON engineers became involved in the development of FutureGen, a 275 MW IGCC unit that will use pre-combustion capture.

Outlook for 2008

Since no leading CCS technology has yet emerged, E.ON is taking a broad approach. E.ON U.S. will focus on IGCC pre-combustion technology through its participation in the FutureGen Alliance. E.ON UK will continue to develop detailed plans for a carbon-capture demonstration plant as part of a competition announced by the U.K. government. It will also continue to research oxyfuel firing. E.ON Energie will conduct detailed design studies and select sites for several pilot-scale post-combustion capture units at its existing hard-coal-fired power stations. It will also be involved in PR initiatives to gain public support for carbon transport and storage. E.ON Nordic will build and begin operating the post-combustion capture pilot unit in Karlshamn and conduct other CCS R&D.

Power Transport and Storage

Current Status

Utilities significantly expanded and improved their electric transmission and distribution systems in the 1960s and 1970s. These systems now require targeted and carefully managed maintenance and will gradually be replaced by the latest generation of equipment. Our R&D will look for opportunities to install innovative equipment and network management technology rather than like-for-like replacement. We've established four specialist groups to target key areas of research in system design, equipment, operation and maintenance, and large-scale electricity storage. In these four areas, 60 projects have been completed or are under way, demonstrating the breadth of technology we're examining.

2007 Highlight

We conducted a review of AC/DC power conversion technologies, paving the way for a feasibility study.

Outlook for 2008

We'll continue work on a wide range of projects across the four specialist groups. The projects include low-loss networks, increased network flexibility and resilience, increased conductor current carrying ability, a benefits profile for distributed storage, a quantification of the advantages of electricity storage, and a storage demonstration project at an E.ON distribution system.

Distributed Generation

Current Status

As we identify new products through technology tracking and the partner identification process, we continually review and update the list of technologies for laboratory testing and field trials. We're also cataloging the status of ongoing tests and evaluation projects. Right now, we're focusing mainly on the following technologies: Stirling engines (Microgen, Whisper Tech), organic Rankine cycle (Energetix), and fuel cells (Acumentrics/MTS Group, CFCL, Hexis, Baxi).

2007 Highlights

Field trials organized by E.ON Ruhrgas began with seven WhisperGen Stirling units, along with lab testing of WhisperGen micro CHP units for both the U.K. and German markets.

There was also ongoing testing, progress, and field upgrades of WhisperGen units in the United Kingdom. E.ON UK concluded an agreement with CFCL, an Australian manufacturer of solid-oxide fuel cells (SOFC), to develop and deploy a prototype fuel cell CHP unit for the U.K. market.

Stadtwerke Hannover, a municipal utility in north-central Germany, and E.ON Energie ran 500 hours of operational tests on a new, 100-kilowatt high-temperature fuel cell.

Outlook for 2008

The German government's National Innovation Program (NIP) calls for a series of field tests involving several hundred fuel cell units between 2008 and 2015. Several German energy suppliers and fuel cell manufacturers have formed a consortium to launch an extensive demonstration project as part of the NIP. E.ON Ruhrgas and E.ON Energie will join this consortium. Technology tracking in the United Kingdom will focus on identifying developments with the potential to enhance performance and/or reduce costs. Early laboratory testing of near-market-ready devices will continue as a precursor to marketing commercial devices in 2009 and beyond. It's also likely that we'll join a consortium to run a demonstration project for fuel cells built by Massachusetts-based Acumentrics Corporation. The consortium intends to develop a standardized model for evaluating the economics of micro CHP technology. We'll begin a partnership with Acumentrics and Italy-based MTS Group to develop a SOFC. We'll also design a roadmap and business plan for the U.K. and German markets.

Bioenergy

Current Status

E.ON is focusing on three bioenergy technologies: fermentation, combustion/cofiring, and gasification. Fermentation technology is commercially available but must be made significantly cheaper and more efficient. The combustion or cofiring of biomass is commercially viable today but requires additional R&D since it can put downward pressure on fossil-fuel prices, improve plant availability, and boost thermal efficiency. The gasification of biomass is of great interest to us because of the higher electric output of biogas compared with biomass and because biogas can be upgraded to pipeline gas quality and injected into the natural gas pipeline system.

2007 Highlights

Our activities centered around conversion technologies. Operations began at demonstration facilities in Schwandorf and Ketzin, Germany, to upgrade biogas to pipeline gas quality. Planning began for a biogas production facility in Falkenberg, Sweden.

Work on a feasibility study continued for a large-scale biogas production facility for Malmö, Sweden, which would generate up to 300 gigawatt-hours of energy a year. Waste wood combustion was tested in a 125 MW boiler.

Outlook for 2008

Gasification is an emerging technology and must be demonstrated on nearly a commercial scale before we can make a decision about whether to build commercial-scale plants. E.ON Nordic is planning to build a 35 MW demonstration plant. Access to raw material is a strategic question (because biomass use is increasing) and a technical question (because further testing is needed to find ways to combust inferior-quality biomass).

Wind

Current Status

Germany's first offshore wind farm, alpha ventus, took an important step closer to becoming a reality with the purchase of six wind turbines with an aggregate capacity of 30 MW. Significant technical challenges result from the fact that North Sea wind farms must be sited well offshore to protect the Wadden Sea, the waters and coastal mudflats that lie between the Frisian Islands and the coasts of the Netherlands, Germany, and Denmark. Alpha ventus, a joint project of E.ON and two other energy companies, will be sited 45 kilometers (28 miles) off Germany's North Sea coast in depths of about 30 meters (100 feet) of water, putting on the cutting edge of offshore wind power engineering.

Outlook for 2008

Alpha ventus is scheduled to enter service in 2008. Going forward, our focus will be on developing additional offshore wind farms in the North Sea and Baltic sea.

End-Use Efficiency

Current Status

E.ON is focusing on three areas:

- Heating and cooling: we're working to further optimize electric and gas heat pumps in order to strengthen our market position, increase sales, and improve end-use efficiency. We also plan to initiate R&D projects for cooling technologies.
- Passive demand-side management: we're engaged primarily in technology tracking and assessment projects with the aim of acquiring knowledge about our R&D needs and overcoming our information deficit in this area.
- Active demand-side management: because the scope of possible applications for smart metering is unclear, our main objective is to research the possible scope of smart metering for electric and natural gas appliances.

Outlook for 2008

E.ON Ruhrgas will conduct several field tests in Germany to refine gas heat pump technology with the aim of marketing devices in 2010. Among Germany's energy suppliers, E.ON Ruhrgas expects to achieve technical and commercial leadership for this technology. It also plans to conduct a project that analyzes the general applicability of heat pumps in single-family and multi-family homes.

Automotive Transport

Current Status

Hydrogen is used widely in the chemical industry but not in the energy industry. Across Europe, a number of projects are under way to produce hydrogen with a variety of methods for use in the transport sector. The E.ON hydrogen fueling station in Malmö was one of the first in Europe. A number of installations are under construction, which will speed up the introduction of hydrogen. Applications for hydrogen in the stationary sector will come much later.

Outlook for 2008

In Germany, E.ON expects to rank among the utility-industry leaders in the transport sector. With the exception of gasoline-based products, E.ON can supply most of the new fuels. A number of projects will be undertaken in 2008, most notably a new hydrogen fueling station in Sweden and a field trial with electric hybrid plug-in vehicles in Germany. With plug-in hybrids expected to play a significant role in the automotive transport of the future, E.ON Energie intends focus on electric vehicles. As an energy utility, E.ON will be one of the important stakeholders in this trend.

Other Technical Highlight

Malibu, a joint venture between E.ON and Bielefeld-based Schüco, the world's leading supplier of building envelopes, is establishing a research lab to refine the production of thin photovoltaic cells. It will launch a development program in 2008 with the aim of reducing production costs and increasing the efficiency of amorphous silicon cells and combined amorphous/microcrystalline silicon cells.

Budget

E.ON's spending in 2007 and budget for 2008 for research, development, and demonstration (RD&D) and for funding for universities (UNI) are shown below. These spendings include the cross-technology programs with universities, innovate.on projects as well as all RD&D activities of the entire value chain from generation to end-use efficiency mentioned above.

Budget 2007

€ in millions	Total	RD&D[1]	UNI[2]
Nuclear	9.0	9.0	0.0
Fossil Power Plants	31.5	31.2	0.3
Distributed Generation	9.1	9.1	0.0
Renewables	14.5	14.4	0.0
Transportation and Distribution	5.2	5.2	0.0
Utilization and Application	2.7	2.5	0.2
Environmental Issues	1.4	1.4	0.0
General university support, others	9.8	4.9	4.9
Total	**83.3**	**77.9**	**5.5**

[1]Research, development and demonstration.
[2]Funding of universities.

Budget 2008 plan

€ in millions	Total	RD&D[1]	UNI[2]
Nuclear	11.1	11.1	0.0
Fossil Power Plants	30.8	30.8	0.1
Distributed Generation	11.2	8.7	2.5
Renewables	64.7	64.7	0.0
Transportation and Distribution	9.1	9.1	0.0
Utilization and Application	4.6	4.4	0.2
Environmental Issues	2.3	2.3	0.0
General university support, others	11.9	7.3	4.6
Total	**145.8**	**138.4**	**7.4**

[1]Research, development and demonstration.
[2]Funding of universities.

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