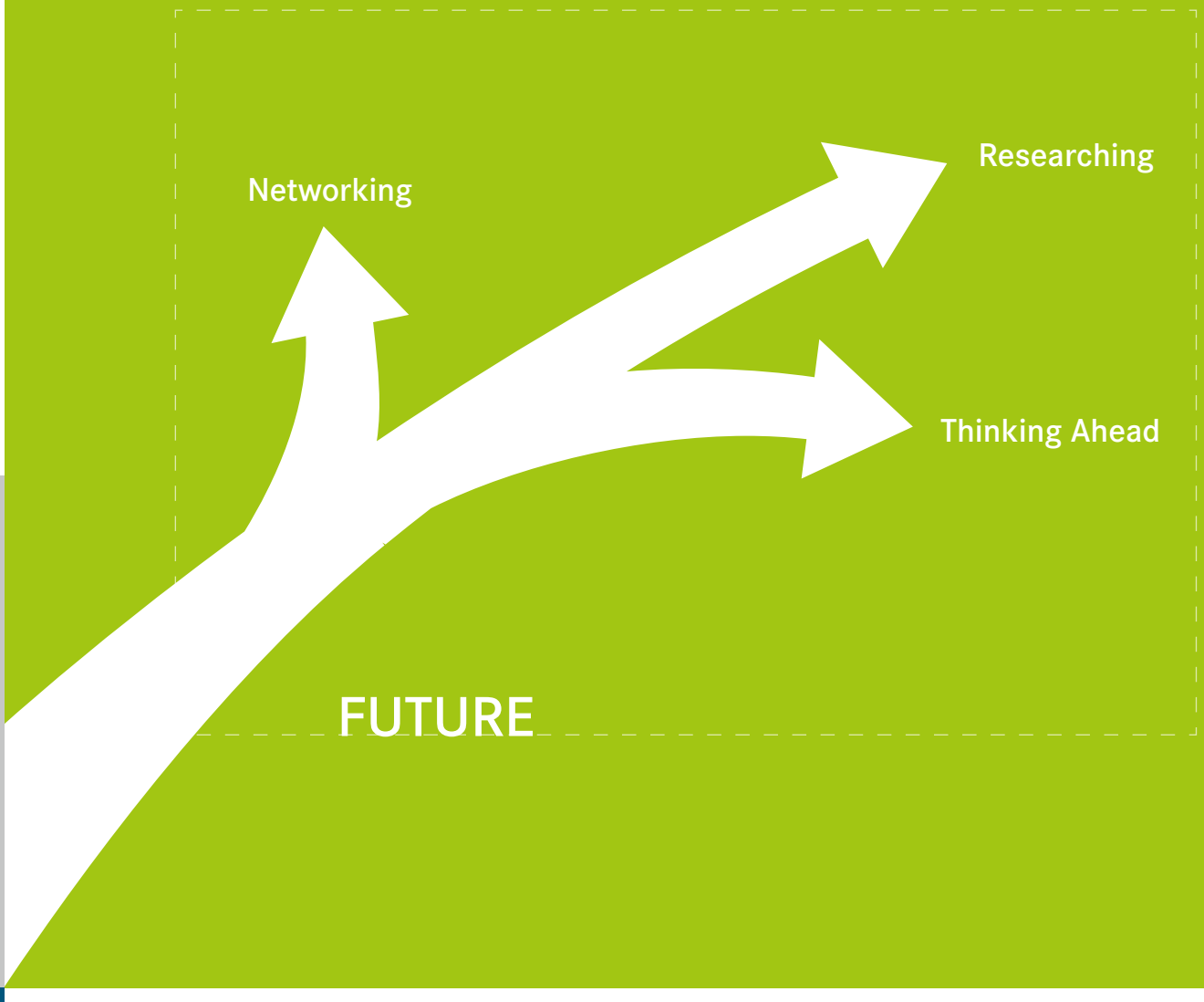


Sustainability Report 2012/2013

Networking, Researching, Thinking Ahead

Zukunfts Campus

JÜLICH
FORSCHUNGSZENTRUM

What is your contribution to the sustainable development of our society?

Answer:

From:

Title, first name(s), surname

Company/institution/private individual

Street, no.

Postcode, town/city, country

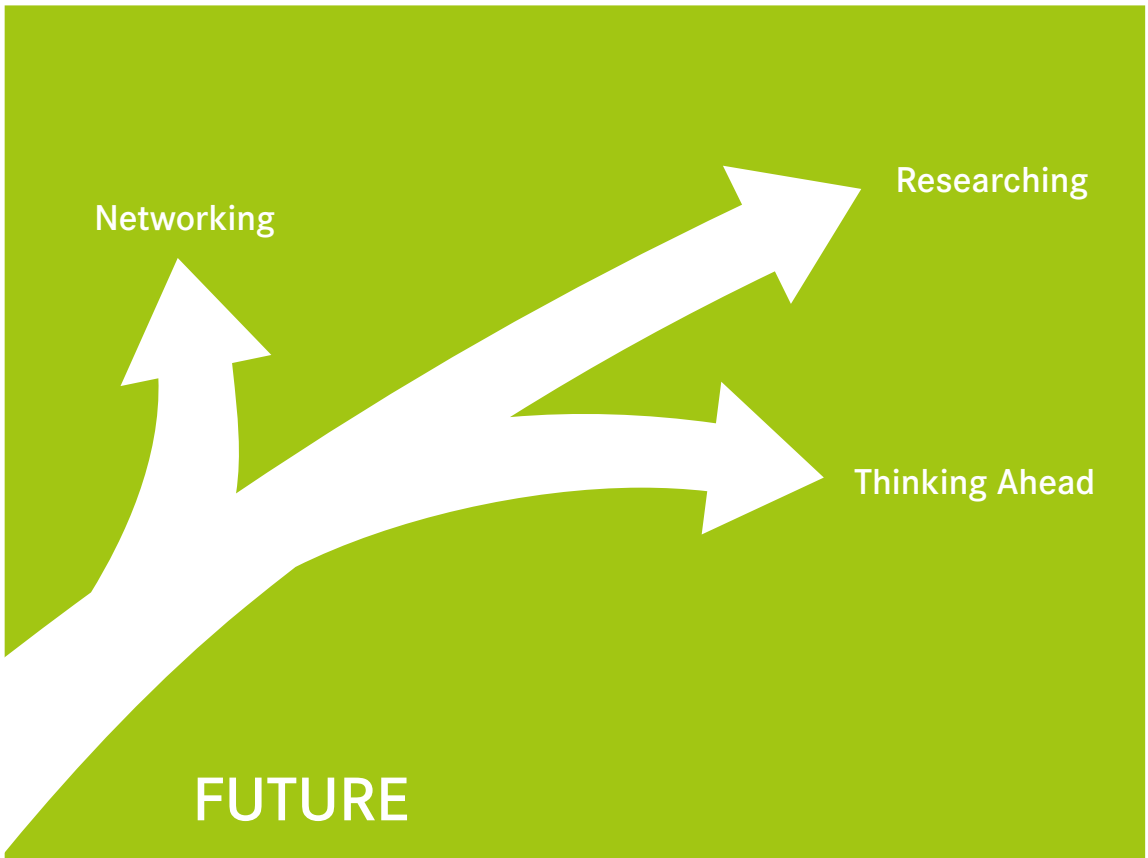
Please attach the correct postage

Answer

Peter Burauel
Sustainable Campus
Forschungszentrum Jülich GmbH

52425 Jülich
Germany

Email your reply to p.burauel@fz-juelich.de



FUTURE

“Every generation must solve their own problems and not leave them for the next generation to deal with.”

Basic rule of Germany’s National Sustainability Strategy

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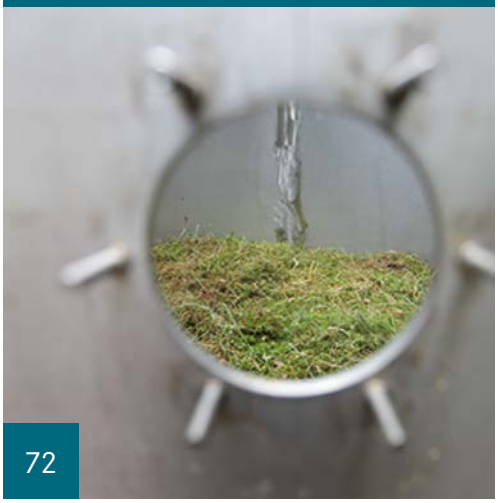
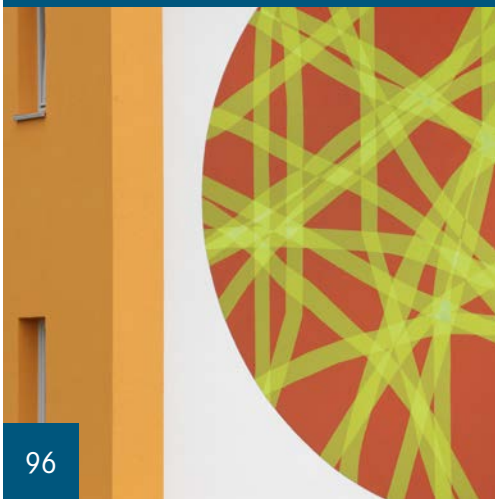
ECONOMIC RESPONSIBILITY

ENVIRONMENTAL RESPONSIBILITY



SOCIAL RESPONSIBILITY



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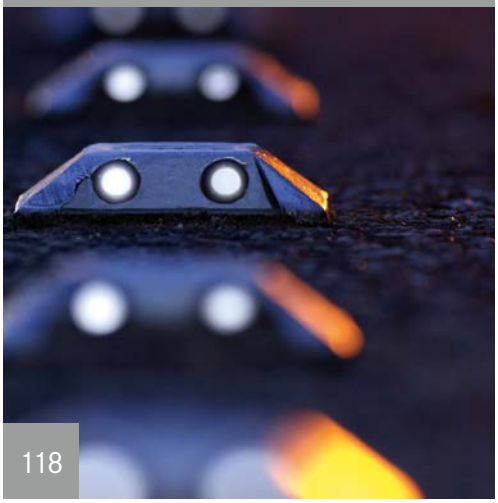
APPENDIX



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Prof. Dr. Achim Bachem

Karsten Beneke

Prof. Dr. Sebastian M. Schmidt

Prof. Dr.-Ing. Harald Bolt

1 *"For those working today to pave the way for the transformation of the energy system, our research aims to open up new options for sustainable and feasible solutions."*

2 *"How can we make working conditions at Jülich even more attractive? What can we offer highly qualified women executives? How can we recruit and retain outstanding young talent at Forschungszentrum Jülich at an early stage of their careers? What will Jülich's sustainable campus look like in 2050? These are just four of the many questions that will have an influence on the future of Forschungszentrum Jülich over the coming years. We must therefore set a sustainable course for the future. Over the past few years, we have already taken three important steps in this direction. With juelich_horizons, our new support programme for young talent, we aim to target young people at all important stages – from kindergarten to young investigators groups – in order to encourage their interest in research and offer them attractive working conditions. We would also like to offer attractive conditions to employees with families, and in 2013 we were successfully re-audited for the 'berufundfamilie' certificate for family-friendly staff policy. We have drafted an urban development master plan for the Jülich campus that incorporates building complexes as well as roads and routes in a sustainable overall concept. We are not merely content to rest on our laurels, however – we must continually strive for improvement so that Forschungszentrum Jülich can retain its position among the world's leading research institutions in future. I look forward to the challenge!"*

3 *"For me, sustainable research means finding visionary solutions to the major issues of the future without losing sight of the efficient use of resources. In addition to its ecological significance, the concept of sustainability must also include the continuous development of methodological expertise, as the success of large-scale research projects depends primarily on technological infrastructure. Jülich is already a world leader in the field of physics as regards the development of accelerator technology and instruments for neutron research. At the same time, the Helmholtz Nanoelectronic Facility and developments in the field of supercomputing ensure that we are pioneers in the area of future information technologies. We also invest in the area of green IT in order to counteract the increasing energy consumption of information technology. In health research, we use state-of-the-art imaging techniques and simulations to understand the brain and diagnose diseases at an early stage so that treatment can be started even before the onset of the disease. Last but not least, sustainability also concerns employees. My vision is that the sustainable campus will enable people to interact with each other, thus connecting different disciplines in a natural way. Sustainable planning takes into account the need to keep distances short and accessible, as well as to design energy-efficient and ergonomic workstations – in short, it ensures that people enjoy coming to work and feel as though they are being motivated and respected."*

4 *"For me, sustainability means living well and comfortably in future on Earth with nine to ten billion people. A related major challenge for society is the steady increase in energy and food requirements. On top of this, strict climate protection targets must also be achieved. Sustainability is therefore a central topic within the Helmholtz Association and at Forschungszentrum Jülich. The successful restructuring of the Institute of Energy and Climate Research and the Institute of Bio- and Geosciences has laid the foundation for this task. Large collaborative projects such as the Bioeconomy Science Center (BioSC) pool the extensive expertise of the universities with that of Jülich. This successful collaboration will also be intensified in the field of energy: two new Helmholtz institutes have been successfully evaluated and are currently in the initial phase. At the Helmholtz Institute Erlangen-Nürnberg, research activities on thin-film solar cells and hydrogen production by means of electrolysis will be conducted in close cooperation with Friedrich-Alexander-Universität Erlangen-Nürnberg and Helmholtz-Zentrum Berlin. The Helmholtz Institute Münster will focus on battery research and is a cooperation with the University of Münster and RWTH Aachen University. In the field of earth and environment, the Geoverbund has created a strong geospheric research network between Jülich, RWTH Aachen University, the University of Cologne, and the University of Bonn. Finally, in the field of atmospheric research, various large-scale campaigns using aircraft such as HALO, IAGOS, and zeppelins were successfully continued. These and many other contributions form the fundamental pillars of sustainable research on the topics of energy (and the transformation of the energy sector) and climate (and climate change mitigation) at Jülich."*

Preface

We are expected to support society in solving urgent problems in such a way that even our grandchildren will still approve of the decisions we make today. Sustainability is therefore of central importance to Forschungszentrum Jülich. In this Sustainability Report – the first of its kind – we outline how we envision performing our work in a sustainable manner on our large and mostly self-contained campus, a real "research town".

The question we must therefore ask ourselves is how we manage our resources, for instance our employees – whose creativity, energy, and motivation define our success. However, we must also consider the energy and raw materials required for our research and the waste produced in our daily work. We must be well-equipped for finding and implementing sustainable solutions in these areas. This is why we have developed a vision for a sustainable campus at Jülich, and will work together with all of our employees to make it a reality.

What do we want the Jülich campus to look like in the coming decades? Where will electric power come from? How will we heat the buildings? How will our offices and laboratories be designed? What about mobility – on our way to work, on campus, on business trips? The Urban Development Master Plan 2050 will enable us to make significant progress towards answering these questions. The plan will be instrumental in paving the way for sustainable development. The Sustainable Campus staff unit will collate and oversee the activities of Jülich's employees, develop new activities, and provide new impetus.

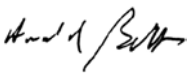
This Sustainability Report, which is based on the guidelines of the Global Reporting Initiative (GRI), is a further core component of the activities to realize a sustainable campus. The report will document the economic, environmental, and social performance of Forschungszentrum Jülich and enable it to be compared and reviewed, so that our partners, employees, and policy-makers can understand and take part in the process of change. At the same time, the report will help to define sustainability goals.

We hope it makes for interesting reading!

Prof. Dr. Achim Bachem
(Chairman of the Board of Directors)

Karsten Beneke
(Vice-Chairman of the Board of Directors)

Prof. Dr. Sebastian M. Schmidt
(Member of the Board of Directors)



Prof. Dr.-Ing. Harald Bolt
(Member of the Board of Directors)

The team from the Sustainable Campus staff unit promoting their plant-a-tree drive on campus during Open Day 2013

Dr. Peter Burauel
Head of Sustainable Campus staff unit

Dr. Ellen Clare Kammula
Scientific assistant at Sustainable Campus

Report parameters

The present report is the first comprehensive sustainability report by Forschungszentrum Jülich GmbH. It is also the first sustainability report to be compiled within the Helmholtz Association (HGF). The period under review in the report covers the years 2012 and 2013, although the majority of the data in the individual sections of the report date from 31 December 2012.

The aim of this report is to provide the shareholders of Forschungszentrum Jülich as well as its partners, employees, and the general public with an insight into the manner in which work is conducted and values are put into practice at Forschungszentrum Jülich. The general boundary of the report covers all organizational units working on the Jülich campus. Branch offices at other sites are only considered in passing.
The guidelines of the Global Reporting Initiative (GRI), version G3.1, were followed when compiling the report. It is worth noting that, as yet, there have been no adaptations or interpretations of the GRI Guidelines specifically for research organizations. Forschungszentrum Jülich, as part of HGF, is therefore cooperating with its fellow Helmholtz centres and other non-university research institutions on developing a binding framework for compiling sustainability reports in the research context.

The report covers the key aspects from the areas of research, working conditions, and the construction and operation of infrastructure on the Jülich campus. It is therefore divided into sections on strategy as well as economic, environmental, and social responsibility. Employee data were generated by the Personnel division. The key environmental data and the data on CO_2 emissions are derived from Forschungszentrum Jülich's annual internal records and measurements. The audited economic figures were taken from Jülich's progress report.

When compiling the Sustainability Report, particular care was taken to present a balanced account of the key positive and negative aspects of how sustainable Forschungszentrum Jülich is. In publishing the report, Forschungszentrum Jülich would like to lay the foundation for a regular comparison and revision of its activities in the context of sustainability. In order to ensure this verifiability and comparability, every effort was made to ensure the qualitative and quantitative accuracy of facts and figures as well as the clarity of the language when compiling the report.

The Sustainability Report will be published every two years. The Sustainable Campus staff unit is the first point of contact for all matters related to the Sustainability Report.

Forschungszentrum Jülich pursues cutting-edge interdisciplinary research on pressing issues facing society today. With its competence in materials science and simulation, its expertise in physics, nanotechnology, and information technology, as well as in the biosciences and brain research, Jülich is developing the basis for the key technologies of tomorrow. In this way, Forschungszentrum Jülich helps to solve the grand challenges facing society in the fields of energy and the environment, health, and information technology. Jülich is also exploring new avenues in strategic partnerships with universities, research institutions, and industry in Germany and abroad.

Overview of Forschungszentrum Jülich

Guiding principles

Forschungszentrum Jülich pursues cutting-edge interdisciplinary research on pressing issues facing society today. With its competence in materials science and simulation, its expertise in physics, nanotechnology, and information technology, as well as in the biosciences and brain research, Jülich is developing the basis for the key technologies of tomorrow. In this way, Forschungszentrum Jülich helps to solve the grand challenges facing society in the fields of energy and the environment, health, and information technology. Jülich is also exploring new avenues in strategic partnerships with universities, research institutions, and industry in Germany and abroad.

Forschungszentrum Jülich's guiding principles drive all of its decisions. They set not only the research areas Jülich is involved in, but also its interdisciplinary and networked approach to work, its commitment to achieving high standards of quality, and the high value placed on its employees.

We work towards providing comprehensive solutions for the grand challenges facing society in the three fields of health, energy and environment, and information technology, thus laying the foundation for future key technologies.

We provide impetus and are engaged as a partner throughout the entire value-adding process of research from basic research up to actual innovations.

We focus our expertise programmatically and break new ground in strategic partnerships with universities, research institutions, and industry.

We intend to demonstrate that our research findings, our operation and utilization of complex infrastructures, and also our management achievements are among the best in the world.

We regard the creativity and motivation of our staff as the greatest asset of our research centre. We therefore offer equal opportunities and encourage training and further professional development.

Guiding principles of Forschungszentrum Jülich

Organizational profile

Forschungszentrum Jülich was established on 11 December 1956 by the German Federal State of North Rhine-Westphalia. On 5 December 1967, it was converted into a GmbH (limited company) with the Federal Republic of Germany and the Federal State of North Rhine-Westphalia assuming the role of partners. The share capital is € 520,000. The Federal Republic of Germany holds 90 % of the shares and the Federal State of North Rhine-Westphalia 10 %. As a member of the Helmholtz Association, Forschungszentrum Jülich, which has more than 5,000 employees, is one of the large interdisciplinary research centres in Europe. The organization and purpose of Forschungszentrum Jülich GmbH are established in its Articles of Association. The current version of the Articles of Association is dated 14 November 2012.

Bodies and committees

Forschungszentrum Jülich is governed by three company bodies: the Partners' Meeting, the Supervisory Board, and the Board of Directors, which fulfils the function of a management board. The Partners' Meeting is the principal decision-making body. It comprises representatives of the Federal Republic of Germany and the Federal State of North Rhine-Westphalia and is responsible for all matters that are not delegated to another body by law or by the Articles of Association. These include, in essence, amendments to the Articles of Association, joining and leaving employers' associations, the appointment of members of the Supervisory Board, and the approval of annual financial statements. The Partners' Meeting is convened at least once a year.

www.fz-juelich.de/supervisory-board

The Supervisory Board supervises the lawfulness, expedience, and economic efficiency of the Board of Directors. It consists of a maximum of twelve members and makes decisions on important research-related and financial issues of the company. The Supervisory Board may issue instructions to the members of the Board of Directors. The Supervisory Board must be convened at least once in a six-month period. It constitutes a quorum if at least two thirds of its members are present or represented. Article 9 of the Articles of Association regulates the composition of the Supervisory Board. A list of current members of the Supervisory Board is available on Forschungszentrum Jülich's website.

The Board of Directors as the management board conducts Forschungszentrum Jülich's business pursuant to the Articles of Association. It consists of four members and reports to the Supervisory Board. Members of the Board of Directors must be scientists or engineers to become a scientific board member and be qualified for the senior administrative service to become an administrative board member. The members of the Board of Directors are appointed by the Supervisory Board for a term of no more than five years. Reappointment is permissible for another period of no more than five years. The most important tasks of the Board of Directors include the preparation of the business plan and the legal representation of Forschungszentrum Jülich. The Office of the Board of Directors is the first point of contact for all matters related to the Board of Directors.

The Board of Directors of Forschungszentrum Jülich

The Scientific and Technical Council (WTR) and the Scientific Advisory Council are committees of Forschungszentrum Jülich. The Scientific Advisory Council advises Forschungszentrum Jülich on all scientific and technical issues of fundamental importance. These include, for example, Jülich's strategy and planning of research and development activities, promoting the optimal use of research facilities, and issues related to cooperations with universities and other research institutions. The Scientific Advisory Council comprises international members who are not employees of Forschungszentrum Jülich and presents the results of its deliberations to the Supervisory Board and the Board of Directors. As a rule, the members are appointed by the Supervisory Board for a period of five years. The Scientific Advisory Council is chaired by a member of the Supervisory Board.

In addition to this committee, which consists mainly of external members, Forschungszentrum Jülich also has the Scientific and Technical Council (WTR), which constitutes the scientists' self-governance committee. The Scientific and Technical Council has a plenary assembly and a Main Committee. It advises the bodies of Forschungszentrum Jülich on all issues associated with the strategic orientation of the company and on all scientific and technical issues of fundamental importance. It represents the interests of scientific employees to the Board of Directors and the Supervisory Board. These concern the key research objectives and tasks of German society, Jülich's contributions to research programmes, its organizational structure, and cooperation with universities and other research institutions. Plenary sessions are usually convened three times per financial year. The Main Committee usually meets once a month. The Scientific and Technical Council fulfils an important function in the internal communication of scientific and technical developments.

The following groups of people are members of the Scientific and Technical Council:

- Directors of the Jülich institutes
- Elected representatives of the scientific and technical employees of Forschungszentrum Jülich
- One representative each of the universities with which joint professorial appointments have been made, nominated by the universities
- A member of the Works Council or his/her deputy, both of them scientific or technical employees
- Other members, who need not be employees of Forschungszentrum Jülich

The members are elected for a period of two years and may be re-elected.

Institutes

The scientific and technical work of Forschungszentrum Jülich is performed by institutes. All institutes are subject to the Framework Regulations for Institutes of Forschungszentrum Jülich in their current version dated November 2013, which were compiled by the Scientific and Technical Council. They govern the organization of the institutes as well as the co-determination rights of their scientific and technical employees. The Framework Regulations for Institutes are based on the guiding principles of Forschungszentrum Jülich and ensure that the knowledge and experience of all employees are taken into account.

The institutes consist of subinstitutes entrusted with specific tasks. Each institute and each subinstitute have their own head. The subinstitutes also have a subinstitute advisory committee (IBLA), a subinstitute assembly (IBV), and a delegate to the Representatives' Assembly. However, institutes may also choose to hold institute assemblies (IV) instead and to elect an advisory committee (ILA) for the entire institute.

The institutes and subinstitutes are managed by more than one individual. They take decisions within the scope of the power assigned to them by the Articles of Association of Forschungszentrum Jülich and the procedures defined in them. In significant scientific and technical matters, they must consult with the relevant subinstitute advisory committees.

Subinstitute advisory committees are made up of the heads of the subinstitutes and the same number of elected members of staff. They also include other members appointed by the subinstitutes' management due to the role they play at their subinstitute. These include, for example, department heads or team leaders. Subinstitute advisory committees advise on all issues related to the programme of work and the use of the available resources concerning the scientific and technical planning of the subinstitute and must be informed and heard in any material matters. Subinstitute advisory committees convene at least every three months.

Subinstitute assemblies are composed of employees of the respective subinstitutes. All employees who have been working at the institute for a period of at least six months and either have an employment relationship with Forschungszentrum Jülich or have their regular place of work at the subinstitute for a period of at least one year are eligible to vote. Subinstitute assemblies must be informed and heard in any material matters concerning the subinstitute and Forschungszentrum Jülich.

The representatives of the scientific and technical employees are elected every two years and are entitled to participate in the subinstitute advisory committees. On the request of those they represent, they present scientific and technical issues to the subinstitute advisory committee, the institute advisory committee, the Board of Directors, and the Scientific and Technical Council.

Organizational structure

The organizational structure of Forschungszentrum Jülich is defined in the "Guidelines on the Organizational Structure of Forschungszentrum Jülich GmbH". It is divided into different units and subunits with their own specialized and/or disciplinary responsibilities. The tasks of these individual units must be defined in such a way that they do not overlap.

www.fz-juelich.de/organizational-structure

The following subunits exist at Forschungszentrum Jülich:

- Board of Directors
- Institute
- Subinstitute
- Technical Infrastructure
- Infrastructure division
- Staff unit
- Department
- Division
- Team

These different units are assigned to four different levels of management. In individual cases, it is possible, with the approval of the Board of Directors, to establish additional subunits below the fourth management level. First- and second-level subunits constitute organizational units. They are assigned at least one cost centre.

Staff functions play an advisory role in the management process and are allocated directly to one of the management levels. If staff functions are assigned directly to the Board of Directors, they can be given the status of an organizational unit of the second management level and are referred to as staff units.

At Forschungszentrum Jülich, there are a total of 15 infrastructure divisions, 9 institutes, 3 staff units, and 2 project management organizations. The entire organizational structure is recorded in the form of organization charts updated by Organization and Planning. The organization chart as of March 2014 can be found in the appendix to this report. The current version can be accessed on the website of Forschungszentrum Jülich.

The campus and beyond

The campus of Forschungszentrum Jülich provides an ideal infrastructure for cutting-edge research. More than 5,000 employees worked on the 2.2 km^2 campus as of the end of 2012. On campus, they can use unique large-scale equipment, such as the JUQUEEN supercomputer and state-of-the-art nanotechnology tools. The campus structure also provides researchers with excellent conditions for the interdisciplinary collaboration encouraged by Forschungszentrum Jülich – for example in the two institutes of Heinrich Heine University Düsseldorf located on the Jülich campus. However, cooperation spans not only different fields of research, but even extends beyond borders. Numerous researchers from abroad work on the campus of Forschungszentrum Jülich.

At the same time, Jülich scientists are also active beyond the Jülich campus. They operate research instruments at other locations in Germany and throughout the world. One of them is the research reactor in Garching near Munich, the location of the Jülich Centre for Neutron Science (JCNS). The Jülich researchers also work at the SNS spallation neutron source at Oak Ridge National Laboratory in the USA and at the high-flux reactor at Institut Laue-Langevin (ILL) in Grenoble, France. Forschungszentrum Jülich is a shareholder in the high-flux reactor, thus ensuring that the entire German neutron research community can participate in the operation of ILL.

In addition, Jülich is active in supporting early-career scientists. For example, Forschungszentrum Jülich has an independent affiliate in Aachen: the German Research School for Simulation Sciences (GRS). GRS is a joint graduate school of Forschungszentrum Jülich and RWTH Aachen University and offers programmes for master's and PhD students.

RWTH Aachen University is also the other member of the Jülich Aachen Research Alliance (JARA) and therefore among Forschungszentrum Jülich's key cooperation partners. Forschungszentrum Jülich's networking with universities is based primarily on cooperation agreements. The most important examples of collaborations include Geoverbund ABC/J with the universities in Aachen, Bonn, and Cologne, and Solarcampus Jülich, which was established jointly with FH Aachen University of Applied Sciences. The joint appointment of professors is another level of cooperation with universities. As of the end of 2012, 95 professors were appointed jointly with 11 universities, including those in Cologne, Bochum, and Münster.

Technology Transfer runs the head office of the German biotechnology cluster BIO.NRW in Düsseldorf. This office initiates cooperations between research institutions, companies, investors, and politics on the regional, national, and international level. As a member of the Helmholtz Association (HGF), Forschungszentrum Jülich is represented on an international level by HGF offices in Brussels, Moscow, and Beijing.

Project Management Jülich, a largely independent organization within Forschungszentrum Jülich GmbH, has branch offices in Berlin and Warnemünde near Rostock in addition to its location at Jülich.

Facts and figures

The following figures are correct as of 31 December 2012.
At the time of going to press, the data for 2013 had not yet been adequately verified.

Partners
Federal Republic of Germany (90 %)
Federal State of North Rhine-Westphalia (10 %)

Share capital
€ 520,000

Taxpayers' ID
213 / 5700 / 0033

VAT registration number
DE 122624631

Forschungszentrum Jülich exclusively and directly pursues the non-profit purposes stipulated in Article 2 of the Articles of Association, in particular the advancement of science and research in the meaning of the section on tax-privileged purposes of the German Fiscal Code (§§ 51–68 AO) as amended on 16.03.1976 (BGBl. I, p. 613).

Area
2.2 km²

Revenue: € 557 million
More information on Forschungszentrum Jülich's balance sheet, on its profit and loss statement, and on revenues in 2012 can be found in the 2012 Annual Report and on Forschungszentrum Jülich's website.

Third-party funding
In 2012, Forschungszentrum Jülich's third-party funding totalled € 172,200,000, representing an increase of € 11,900,000 compared to 2011 (€ 160,300,000). Most of this third-party funding resulted from research and development activities for industry, the acquisition of funding from Germany and abroad, plus project management activities on behalf of the Federal Republic of Germany and the Federal State of North Rhine-Westphalia.

In 2012, Forschungszentrum Jülich also received subsidies including changes in provisions amounting to € 427,800,000 to cover expenses and to finance fixed assets from the federal and state governments. These subsidies include € 66,100,000 for dismantling projects. Without these funds for provisions, subsidies from the federal and state governments amount to € 384,700,000.

20 STRATEGY

Forschungszentrum Jülich as a research establishment aims to increase society's ability to take action for sustainable development. This requires a strategic approach that takes into consideration the principle of sustainability both in research and corporate governance. As a member of the Helmholtz Association, Forschungszentrum Jülich is part of an overall strategy that identifies and deals with pressing issues in society, science, and industry as and when they become apparent. The results of this research are also taken into account in the Board of Director's responsible corporate governance strategy. In summary, research for a sustainable society, research that will prove sustainable, and sustainable and therefore resource-efficient research are the priority goals in day-to-day work on the Jülich campus.

Research for sustainable development – sustainable research

Helmholtz Association – cooperation for a sustainable future

Dialogue and exchange of ideas with stakeholders

Corporate strategy and governance

A Strategy for Research

Forschungszentrum Jülich as a research establishment aims to increase society's ability to take action for sustainable development. This requires a strategic approach that takes into consideration the principle of sustainability both in research and corporate governance. As a member of the Helmholtz Association, Forschungszentrum Jülich is part of an overall strategy that identifies and deals with pressing issues in society, science, and industry as and when they become apparent. The results of this research are also taken into account in the Board of Director's responsible corporate governance strategy. In summary, research for a sustainable society, research that will prove sustainable, and sustainable and therefore resource-efficient research are the priority goals in day-to-day work on the Jülich campus.

Helmholtz Association – cooperation for a sustainable future

As a member of the Helmholtz Association, Forschungszentrum Jülich's strategic orientation is part of the Association's overall strategy. The Helmholtz Association pursues the long-term research objectives of the Federal Republic of Germany and German society with a view to preserving and safeguarding natural resources. To this end, it identifies and deals with major pressing issues affecting society, science, and industry by conducting strategic and programmatically oriented world-class research in the following six research areas: Energy, Earth and Environment, Health, Key Technologies, Structure of Matter, and Aeronautics, Space and Transport. With almost 36,000 employees, the Helmholtz Association is the largest science organization in Germany. It consists of an alliance of 18 research centres with a focus on scientific, technical, medical, and biological research that perform interdisciplinary and international research across centres and with external partners.

The centres that form part of the Helmholtz Association have been implementing numerous sustainability strategies for many years. In 2011, the Helmholtz Association established a working group on sustainability. It has been addressing the topic of sustainability across centres ever since and has initiated a roadmap for sustainability that applies to all centres. This roadmap is based on an extension of the conventional sustainability approach for companies to accommodate the special features of research organizations. For the Helmholtz Association, the roadmap constitutes both a concept and a project plan on the road to becoming a research organization that acts in a sustainable manner.

www.helmholtz.de/en/ Further information on the Helmholtz Association and its structure can be found on its website.

Research for a sustainable development – sustainable research

For Forschungszentrum Jülich, sustainability means taking economic, environmental and social responsibility in research and day-to-day work.

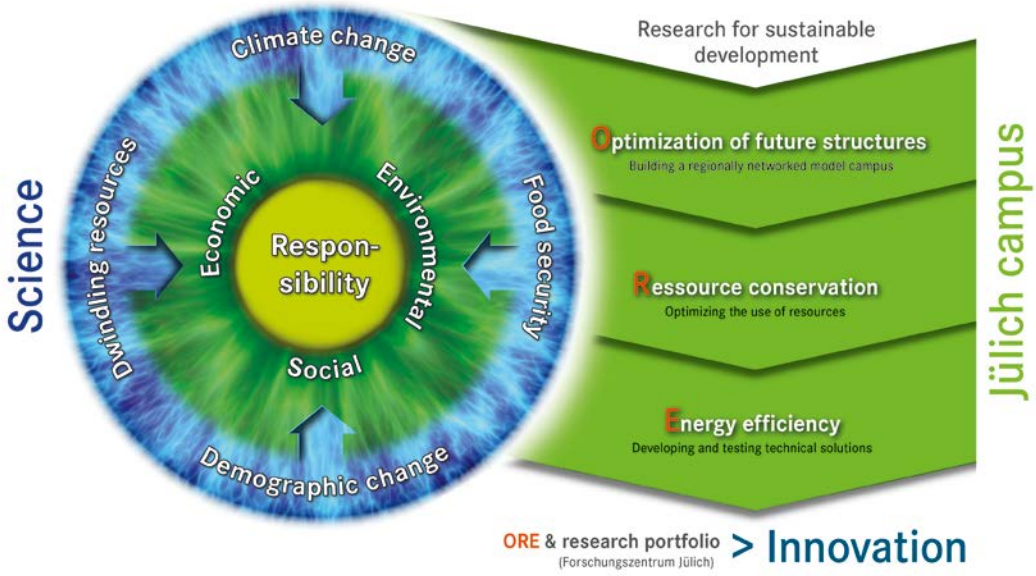
Within the Helmholtz Association, Forschungszentrum Jülich is involved the development of important key technologies in the fields of health, information technology, and energy and environment. Forschungszentrum Jülich is thus working proactively on solutions for the grand challenges facing society in the fields of intergenerational equity, quality of life, social cohesion, and international responsibility – aspects that also play an important role in the federal government's National Sustainability Strategy. Jülich's scientific work as well as its numerous cooperations with partners in Germany and abroad are based on an interdisciplinary approach. Forschungszentrum Jülich encourages collaboration and aims to realize outstanding partnerships

for its scientists. Jülich's results as a whole are intended to increase society's ability to take action for sustainable development.

However, Jülich believes that sustainable development is not only the way forward in science. The importance of sustainability in all its facets is becoming more and more important on campus. The Board of Directors and the heads of the organizational units therefore committed themselves to making Forschungszentrum Jülich a more future-proof and sustainable organization in 2012. Research for a sustainable society, i.e. working on specific problems of sustainable development in order to offer society knowledge-based options for dealing with these problems; research that will prove sustainable, i.e. addressing topics with continuity; and researching sustainably and therefore in a resource-efficient manner – these are the goals Forschungszentrum Jülich has set itself.

The Sustainable Campus staff unit, which was established in July 2012 under the Helmholtz Association's sustainability roadmap, centrally coordinates all activities related to sustainability issues. It is part of the Science and External Relations scientific division. The Sustainable Campus is to provide a model for sustainable working and living at Forschungszentrum Jülich and will be implemented in the medium term.

In the next few years, the staff unit's task will therefore be to catalyse a process of change that will gradually make the institutes and divisions, and therefore Forschungszentrum Jülich as a whole, more sustainable from the economic, environmental and social perspective and thus ready for the future. This process will focus on the following priority areas: "Optimization of future structures – building a regionally networked model campus", "Resource conservation – optimizing the use of resources", and "Energy efficiency – developing and testing technical solutions". Since its foundation in 2012, the Sustainable Campus staff unit has collated all activities for sustainability at Forschungszentrum Jülich, given advice and support to those implementing them, initiated new developments, and ensured that science and infrastructure work closely together.



Strategically, this is implemented in parallel top-down and bottom-up processes. The Sustainable Campus staff unit makes a point of involving all employees, which is one of the reasons why it has established the Sustainable Campus Arena, a discussion platform on the intranet of Forschungszentrum Jülich. It gives employees the opportunity to become actively involved in making the model a reality.

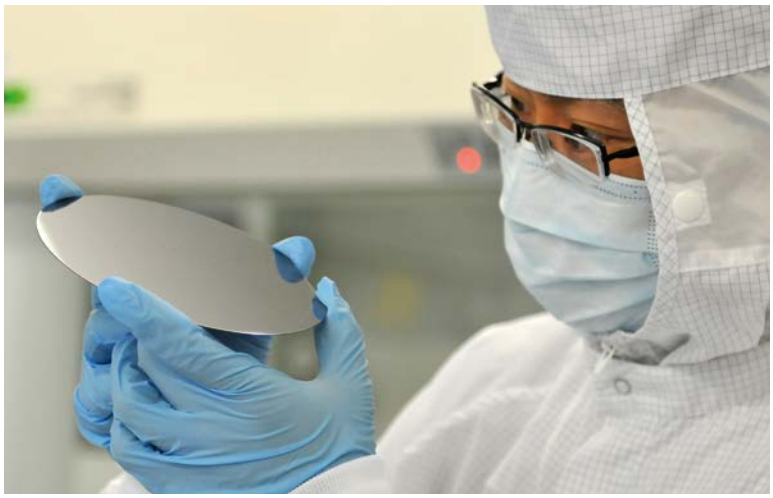
Corporate strategy and governance

Forschungszentrum Jülich has a number of management systems that support responsible research and corporate governance. As a company owned by the government, Forschungszentrum Jülich is also subject to the Public Corporate Governance Code (PCKG) of the German federal government.

Public Corporate Governance Code

On 1 July 2009, the federal government introduced principles for good corporate governance and best practices for the management of company shares held by the government. The federal government's Public Corporate Governance Code forms part of these guidelines. It contains important regulations applicable to the governance and control of companies that are not quoted on a stock exchange and in which the Federal Republic of Germany holds a majority of shares. In addition, the code also comprises national and international standards of responsible corporate governance. It aims to make corporate governance and control more transparent and to clearly define the federal government's role as a shareholder. At the same time, awareness of good corporate governance should be enhanced.

Forschungszentrum Jülich is committed to the federal government's Public Corporate Governance Code and to the obligation to provide a report annually in Article 3 of its Articles of Association. During the period under review in this Sustainability Report, the 2012 report on the federal government's Public Corporate Governance Code of Forschungszentrum Jülich GmbH was therefore submitted. In the report, the Board of Directors and the Supervisory Board declare that the recommendations of the federal government's Public Corporate Governance Code were adhered to in the 2012 financial year and that they intend to continue to follow these guidelines in the future. In addition, the Public Corporate Governance Code report discloses the income of each individual member of the Board of Directors and lists the members of the Supervisory Board. The report has been published permanently in the electronic version of the Federal Gazette.



Quality management

Forschungszentrum Jülich has a decentralized quality management system that safeguards and increases process quality. Instead of a management system that is controlled by top management, individual organizational units introduce quality management systems at their own initiative. They are supported in implementing and operating these systems by Quality Management, an organizational unit that reports directly to the Infrastructure division of the Board of Directors. It is headed by Forschungszentrum Jülich's quality management officer.

A total of five quality management and quality assurance standards are currently employed at Forschungszentrum Jülich: the DIN EN ISO standards 9001, 13485, and 17025, and the guidelines for Good Manufacturing Practice (GMP) and Good Laboratory Practice (GLP). Eleven organizational units have already been certified to one of these different standards by external auditors, including TÜV Rheinland and TÜV SÜD. Another five organizational units are ready to be audited. The organizational units themselves are responsible for deciding whether and when they subject themselves to a certification audit. The requirements of the framework directive on quality of Forschungszentrum Jülich are met when an organizational unit has reached a level where it can be certified.

Existing QM systems at Forschungszentrum Jülich

Organizational unit	Standard	Certification
Project Management Jülich	DIN EN ISO 9001	2005
Waste Management (G-UA)	DIN EN ISO 9001	2006
Quality Management (VS-S)	DIN EN ISO 9001	2009
Engineering and Technology (ZEA-1)	DIN EN ISO 9001	2012
Organization and Planning (O)	DIN EN ISO 9001	2012
Electronic Systems (ZEA-2)	DIN EN ISO 9001	2012
Agrosphere (IBG-3)	DIN EN ISO 9001	2014
Officially Recognized Incorporation Measurement Office (S-BI)	DIN EN ISO 17025	2006
Alpha/Beta Analysis (S-BA)	DIN EN ISO/IEC 17025	2012
Nuclear Chemistry (INM-5)	GMP	1990
Agrosphere (IBG-3)	GLP	1994

Organizational units at Forschungszentrum Jülich that are ready to be certified

Organizational unit	Standard
Analytics (ZEA-3)	DIN EN ISO 9001
Medical Service (P-M)	DIN EN ISO 9001
Vocational Training Centre (P-Z)	DIN EN ISO 9001
Central Library (ZB)	DIN EN ISO 9001
Medical Imaging Physics (INM-4)	DIN EN ISO 13485

Sustainability management

Existing international and cross-sector considerations on sustainability management do not lend themselves to application in a research environment. Forschungszentrum Jülich and other members of the Helmholtz Association are currently pursuing the topic of sustainability management of research organizations in cooperation with other non-university research establishments. These activities are being undertaken in close collaboration with experts from science, administration, and research management.

The project aims to develop a clear and methodologically sound approach for the three areas of research, personnel, and construction, thus creating the first framework for implementing sustainability management at non-university research organizations.

The project focuses on the following topics:

- Identification and analysis of instruments, methods, standards, and guidelines that are relevant for sustainability reporting in research organizations
- Systematization of identified levels of activity, spheres of activity, and courses of action
- Analysis of courses of action in identified spheres of activity in cooperation with relevant stakeholder groups
- Development of a proposal for an adaptation or interpretation of sustainability or interpretation of the internationally recognized sustainability reporting standards of the Global Reporting Initiative (GRI) that is viable for research organizations
- Development of a strategic approach for integrating sustainability aspects into the management of Helmholtz centres
- Systematization and substantiation of "Social responsibility in research" as a sphere of activity, taking into account the material, temporal, and social dimensions and their interactions

Despite the current lack of a structured management approach, the 18 centres in the Helmholtz Association have been pursuing measures that take sustainable development into consideration for many years. For example, scientific projects at Forschungszentrum Jülich make an important contribution to society's innovative and sustainable use of resources. These approaches will be combined and expanded within the Sustainable Campus concept. The Helmholtz-Zentrum Berlin für Materialien und Energie (HZB) is planning to study Helmholtz-specific aspects of sustainability at research centres as part of the Campus 2030 project. The other Helmholtz centres will contribute to this process in the form of comparative studies and models of best practices.

Environmental management

Forschungszentrum Jülich has no certified environmental management system. However, since this is increasingly becoming a prerequisite in applications for research funding, a discussion got under way during the period under review on whether an environmental management system should be introduced and certified. In 2014, the Sustainable Campus staff unit and Quality Management will jointly develop a roadmap for the introduction of an environmental management system.

Of course, Forschungszentrum Jülich is already addressing the topics that are usually dealt with by an environmental management system despite the fact that no such system is currently in place. Key elements of Forschungszentrum Jülich's efforts to protect the environment include the protection of the aquatic environment, waste management, and pollution control. An officer is appointed by Forschungszentrum Jülich for each of these areas, who fulfils important duties and is responsible for meeting legal requirements.

Infrastructure management

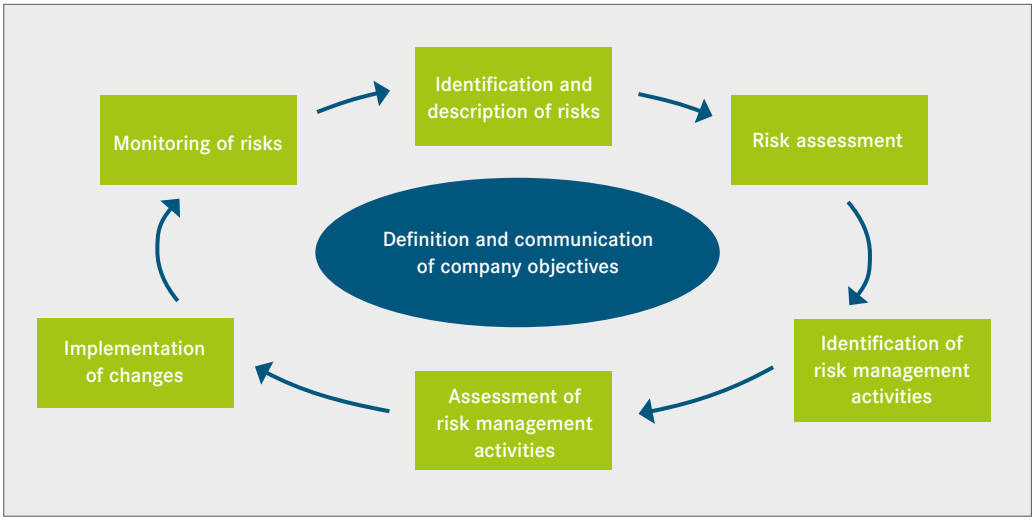
Building and Property Management is responsible for technical management, commercial facility management, service management, supply management, and operational safety management. It thus makes a decisive contribution to creating and maintaining Forschungszentrum Jülich's unique infrastructure. In addition, it is also working continuously on making the campus of Forschungszentrum Jülich more energy-efficient based on sustainable facility management.

The key service tasks of Building and Property Management include the installation, monitoring, maintenance, and modernization of the media networks, the technical equipment of buildings on campus, supply and disposal systems of buildings, and supply facilities. This infrastructure division is involved in all phases of property life cycle, from concept development to waste recovery. (More on this topic in the chapter "Economic Responsibility" from p. 56.)

In addition, Building and Property Management is responsible for Forschungszentrum Jülich's vehicle fleet, waste management, the construction of custom facilities, operational safety, catering at events, and the Seecasino canteen for employees.

Risk management

The risk management system of Forschungszentrum Jülich, which was introduced in 2004, aims to minimize any risks involved in the operation of the research centre. Forschungszentrum Jülich therefore meets the requirements of the German Control and Transparency in Business Act (KonTraG) and the Federal Ministry of Education and Research's request for the members of the Helmholtz Association to introduce a control system.
The risk management system includes all organizational regulations and measures for risk identification, communication, and assessment, and for the handling of risks arising from the activities of Forschungszentrum Jülich. The structure and organization as well as framework conditions, regulations, and definitions for risk management are laid down in the risk management handbook. It is applicable to all locations and all employees, and serves both informational and instructional purposes.



The risk management process

Forschungszentrum Jülich's risk management serves several purposes, among them fulfilling Jülich's legal duty of care and safeguarding its own existence. In addition, risk costs, i.e. the costs for reducing and avoiding risk, are to be reduced and damage to be minimized. The risk management system is also intended to protect those who work at Forschungszentrum Jülich. At the same time, it aims to raise each individual's awareness of risks and therefore promotes a sense of responsibility in dealing with risks.

Knowledge and ideas management

As a research establishment, Forschungszentrum Jülich places great significance on strategic knowledge management. Its central aspects are generating, sharing, and sustainably conserving knowledge. By providing the ability to fall back on existing knowledge, knowledge management contributes to more sustainable work in research, administration, and infrastructure. More efficient processes free up time for individual organizational units to focus on their core processes and main tasks.

Practical knowledge management at Forschungszentrum Jülich affects the dimensions of technology, organization, and individuals. Technical systems such as databases are necessary for archiving and processing information; organizational processes are required to frame the generation, transfer, and use of knowledge; individuals act as knowledge carriers and are therefore key to the entire process. This provides numerous points of contact with other organizational units, for example in the fields of information and communications technology, personnel management, and organizational planning. It is against this background that information and knowledge management was established at the Office of the Board of Directors and International Affairs staff unit. Its tasks include the shaping of processes and participation in the development of software solutions for knowledge management in the areas of visiting scientists, contract management, and customer relationship management. In 2015, a more comprehensive strategy concept for knowledge management at Forschungszentrum Jülich will be developed and efforts will be made to closely network existing knowledge managers. The intention is to bring together existing initiatives in the context of organizing formal and informal knowledge and to develop campus-wide concepts.

Forschungszentrum Jülich's ideas management scheme relies on the know-how of its employees to improve working conditions on campus. This is realized through a platform for submitting suggestions. These suggestions and ideas are reviewed and assessed by a committee and, if implemented, those who submitted them will receive a bonus. A total of 4,084 ideas have been submitted since ideas management was introduced in 2006. In the period under review, 415 suggestions were submitted and 77 of them were presented with bonuses totalling € 65,000. Many of the ideas submitted are related to the sustainable development of Forschungszentrum Jülich, with the topics of traffic and bicycles receiving particular attention in the past few years.

Personnel strategy and management

Personnel management focuses on recruiting qualified and motivated employees for the scientific institutes and facilities as well as all other areas of Forschungszentrum Jülich. This priority is only to a limited extent due to the lack of specialists caused by demographic change.

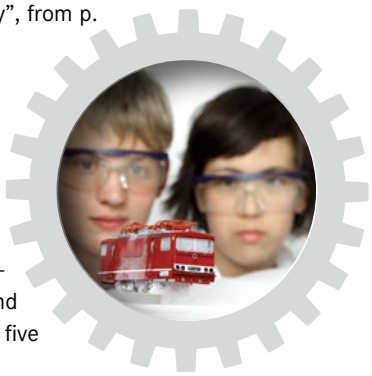
Forschungszentrum Jülich has been working with the JuRS e-recruitment system since 2012 to speed up and streamline the search for suitable candidates. The electronic recruitment system has been tailored to the needs of Forschungszentrum Jülich and was initially tested at pilot scale with training places before it was introduced for the other areas. JuRS has standardized recruitment processes for different occupational groups – all applications are now submitted through a website, the only exceptions being PhD students and undergraduates. Most of the internal processes related to application procedures are now also electronic. This also means that all those involved in the application process at Forschungszentrum Jülich have access to the relevant documents at all times.

For the Personnel division, the introduction of JuRS means greater efficiency and lower costs for processing applications. The electronic procedure involving all organizational units has also considerably accelerated the recruitment procedure. Thanks to JuRS, fewer resources are used because the number of paper applications and printouts has been reduced. The system enables a more detailed analysis, for example of applicant response to print and online advertisements.

The electronic recruitment process makes applications to Forschungszentrum Jülich faster, simpler, and cheaper for job seekers. As many as 9,180 applications for 337 positions were processed in 2012. In 2013, there were 8,785 applications for 288 advertised positions. In addition, there were 2,092 and 2,621 applications for 115 and 112 training places in 2012 and 2013, respectively.

Increasing Forschungszentrum Jülich's attractiveness as an employer also requires support for young talent, which is realized through a number of initiatives. Forschungszentrum Jülich introduced the juelich_horizons scheme for young talent in 2013 in order to encourage young people's interest in science and attract early-career scientists and highly qualified specialists to Jülich. The numerous options and perspectives at all stages of education aim to generate excellence in education, vocational training, and on all stages of the career ladder, as well as to compete internationally in attracting and retaining the brightest minds. The four elements of Forschungszentrum Jülich's concept for promoting young talent – juelich_impulse, juelich_tracks, juelich_chances, and juelich_heads – address the key target groups at all stages of education.

More information on the services provided are listed in Chapter 6, "Social Responsibility", from p. 96.



Encouraging young people's interest in science at an early age with juelich_impulse

With juelich_impulse, Forschungszentrum Jülich addresses children from kindergarten age and school students and encourages their interest in science. Every year, about 4,500 of them visit the scientists at Jülich. A key role is played by Forschungszentrum Jülich's own Schools Laboratory JuLab, which invites children and school students to come to Jülich and perform scientific experiments during visits with their schools or parents, or during holiday programmes. In order to promote their interest in science and technology in a sustainable manner, JuLab also invites selected school students from its five

cooperating schools to perform research and experiments for a number of days every year. The goal of these long-term cooperations is to make the students fit for training programmes and to motivate them to take up vocational training or a course at university in a scientific or technical field. JuLab also organizes experimental days for children and their parents as well as holiday activities for different age groups.

In addition, about 320 school students per year are given the opportunity to get their first taste of working life on campus during a placement in one of Forschungszentrum Jülich's institutes or infrastructure divisions. "Girls' Day" and "Girls and Technology Day" are intended specifically to jump-start girls' and young women's interest in STEM subjects (i.e. science, technology, engineering, and mathematics). Forschungszentrum Jülich promotes excellence from an early age, offering holiday activities for children and teenagers who are particularly interested and talented. JuLab also hosts the regional heat of the annual "Jugend forscht" competition for young experimenters. Identifying talent, even at this early stage, is one of the key objectives of juelich_horizons. The scheme provides advice and support during their development and offers career guidance. In addition, JuLab makes a contribution to early child development – from offering training courses for disseminators to establishing comprehensive training units for pre-school teachers.

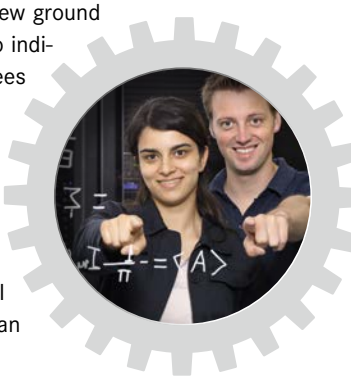
Forschungszentrum Jülich is planning to take even more measures to foster the interest of boys and girls in kindergarten and primary schools in STEM subjects as part of the juelich_impulse scheme. Even young children are already in the process of developing mathematical and scientific competences that should be encouraged as early as possible. The planned company kindergarten is therefore being designed as the first module in Jülich's concept for promoting young talent at all stages of education. It is envisaged that the company kindergarten will be based on the educational concept of the "Little Scientists' House" Foundation. The foundation aims to awaken young children's interest in technical and scientific questions from kindergarten age.

www.fz-juelich.de/ausbildung

Creating perspectives in vocational training and dual study courses with juelich_tracks

Vocational training and dual study programmes have been at the heart of juelich_tracks, the second pillar of juelich_horizons, since 2013. Candidates can apply for training in 20 different occupations and six different dual study programmes. The quality of vocational training is based on the 10 Guidelines for Vocational Training at Forschungszentrum Jülich. These guidelines commit Forschungszentrum Jülich to excellent specialist qualifications that enable trainees to start off their careers at Forschungszentrum Jülich or at another organization. In addition, the integration of disabled persons and commitment to equal opportunities are also laid down in these guidelines. All of them can be accessed in German at www.fz-juelich.de/ausbildung. Forschungszentrum Jülich is a successful and well-connected partner and enjoys an excellent reputation all over the region. Professional instructors ensure that vocational training takes place on a high level of quality in order to meet the specific requirements in research and infrastructure.

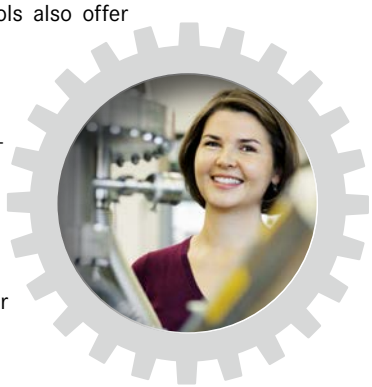
In future, proactive recruitment and marketing strategies will be needed to attract outstanding specialists not only in the region, but from all over Germany and beyond. This also applies to the international networking of vocational training. Moreover, Forschungszentrum Jülich intends to break new ground in terms of training methods and is introducing an online course system. In addition to individual support and the existing range of training opportunities, this will enable employees to acquire new knowledge at a time and place of their choosing.



University degrees and PhDs as a stepping stone with juelich_chances

Forschungszentrum Jülich offers students and postgraduates a wide range of opportunities as part of the third pillar, juelich_chances. At Jülich, young scientists benefit from the opportunity to work on projects early on. Numerous institutes supervise students as part of work placements as well as longer-term projects, such as the practical part of bachelor's and master's dissertations. This makes Forschungszentrum Jülich an excellent stepping stone for students at universities and PhD candidates.

Forschungszentrum Jülich and the universities are close partners when it comes to training and supervising PhD students. Thanks to reliable framework conditions and well-structured training programmes, the majority of candidates complete their PhD within the scheduled period. These early-career scientists benefit not only from the fact that experts in the institutes provide intensive supervision, but also that the Doctoral Committee closely monitors their research project. Graduate colleges and schools also offer subject-specific training as well as training in soft skills.



Young executives for cutting-edge research with juelich_heads

Early-career scientists in their postdoc phase receive personalized support in close cooperation between institutes and universities. The centrally coordinated support programmes subsumed under juelich_heads assist excellent minds in actively planning their careers. For example, Forschungszentrum Jülich helps postdocs to establish independent young investigators groups that cooperate closely with universities. This affords young scientists the opportunity to qualify for a university career, for example as a junior professor.

The Helmholtz postdoc programme, in which Forschungszentrum Jülich is also involved, allows promising scientists to expand their own area of research after successfully completing their PhD.

In order to create further incentives and raise external awareness of excellence at Forschungszentrum Jülich, nominations are invited for the Jülich Excellence Prize every year. It is awarded to early-career scientists who, in the opinion of internationally respected experts, are among the best of their peers in their area of research and who have received visible recognition for their scientific achievements at an international level.

Special services will be introduced in future to provide even better support for all of these young executives and to prepare them for an international career in science.

Dialogue and exchange of ideas with stakeholders

A continuous exchange of ideas with internal and external stakeholders is of great significance for Forschungszentrum Jülich and an important element of its stakeholder strategy. By engaging in continual dialogue, Forschungszentrum Jülich intends to improve its performance in terms of sustainability while at the same time taking into consideration the interests of its stakeholders in its day-to-day activities.

Internal stakeholders

The employees working on campus are among the most important internal stakeholders. They will enable Forschungszentrum Jülich to continue to secure its position as a top international research organization in the future. The partners are also of great significance.

Employees

Forschungszentrum Jülich strives to provide attractive working conditions for its employees. Apart from factors such as the scientific framework conditions, flexible working hours, and payment in accordance with collective agreements, this also includes maintaining a close dialogue with employees and taking their interests into account. Forschungszentrum Jülich therefore offers a wealth of opportunities to become involved in numerous decision-making processes of its bodies, committees, and other agencies within its organizational structure.

A Works Council represents the interests of employees at Forschungszentrum Jülich. In addition, there are many other interest groups whose members sit on numerous committees or who are active on behalf of particular groups in the workforce. In this context, the Scientific and Technical Council plays an important role as the scientists' self-governance committee and is involved in all issues associated with the strategic orientation of Forschungszentrum Jülich. Top executives, such as institute heads and heads of other organizational units, regularly attend meetings, seminars, and conventions with the Board of Directors. The Board of Directors is available for an exchange of ideas with specific target groups as part of "fireside chats". A detailed overview of the various opportunities of Jülich employees for co-determination is provided in the chapter "Social Responsibility" starting on page 96.

Forschungszentrum Jülich keeps its employees up to date with recent developments and upcoming events in its quarterly magazine for employees, *intern*, and a regular newsletter. Retired staff and former employees can request to receive a copy by post by contacting the editorial team or registering on the alumni network JuLumni-Net. Forschungszentrum Jülich's intranet is a platform that allows all employees to keep up with what is going on at Forschungszentrum Jülich. At the same time the intranet is also a place where employees can come together in a virtual space to engage in discussions with their colleagues. It is therefore a medium that allows all employees to arrange to meet for a company sports course, to form car pools, or to discuss the sustainable development of Forschungszentrum Jülich in the Sustainable Campus Arena.

Partners

The partners of Forschungszentrum Jülich are also very important internal stakeholders. The Federal Republic of Germany and the Federal State of North Rhine-Westphalia hold 90 % and 10 % of shares, respectively. Forschungszentrum Jülich maintains a close relationship with its partners, in particular through the Supervisory Board.

External stakeholders

In addition to its internal stakeholders, Forschungszentrum Jülich is also in close contact with numerous external stakeholders, the most important being the scientific community, industry, and the general public.

Scientific community

An exchange of ideas with other research establishments and institutes is essential for the sustainable research performed at Jülich. In order to foster this kind of exchange, Forschungszentrum Jülich cooperates with numerous institutions and is a member in more than 100 institutes and associations, either as a whole establishment or through individual employees. The Board of Directors regularly meets strategically important partners such as Oak Ridge National Laboratory or the French Alternative Energies and Atomic Energy Commission (CEA). All institutes and divisions are involved in professional societies in their respective disciplines. In addition, various institutes are involved in interdisciplinary or even transdisciplinary organizations and associations that will make an important contribution to the sustainable development of our society.

The results published by the scientists as part of their day-to-day work are also a major element of scientific dialogue. They provide the general public with information on new discoveries and inventions in print and increasingly in electronic form. In 2012, Jülich scientists produced 2,233 publications, of which 1,452 were papers in scientific journals, 93 doctoral theses and habilitation theses, and 688 books and other publications.

Forschungszentrum Jülich regularly hosts events for specialist communities and takes parts in events elsewhere. In this way, it is in close contact with other scientific actors and organizations. For example, the Sustainable Campus staff unit, in conjunction with the Hans Böckler Foundation and the federation of trade unions Deutscher Gewerkschaftsbund NRW hosted a conference at Jülich in March 2013 on innovations and employment effects in the renewables sector, which was attended by 100 participants. In addition, numerous workshops, seminars, training courses, and summer schools are organized on campus. Regular events organized by Forschungszentrum Jülich include its end-of-year ceremony. This takes place annually in November and every year focuses on one of the hot topics in Jülich's research portfolio. In 2012 and 2013, Jülich scientists held lectures in the Rhineland Regional Museum (LVR-LandesMuseum) in Bonn on the topics of "Supercomputers and Simulation – Bridging the Limits of Knowledge" and "Research in 3D: From Understanding Molecular Machines to Developing Targeted Treatment".

Another important instrument of external stakeholder dialogue is the many publications made available by Forschungszentrum Jülich through different channels. These include the annual report, the structure and development plan, the facts and figures brochure, magazines featuring individual fields of research, as well as the *Research in Jülich* series of magazines, and the *Exascale* newsletter on supercomputing.

Helmholtz Association

Forschungszentrum Jülich is a member of Helmholtz Association and is therefore in close contact with the research organization through numerous institutionalized committees and programmes. These include the Executive Committee of the Helmholtz Association, the Senate, various steering committees, the meetings of the scientific and technical directors, and the Helmholtz closed meeting. The Helmholtz Association's Assembly of Members convenes once a year.

Forschungszentrum Jülich reports to the Helmholtz Association. This requirement is met primarily through the annual progress report. It is the key report documenting the performance of Forschungszentrum Jülich and the application of funds. The annual reports for the individual research programmes and the annual report of the Joint Initiative for Research and Innovation are also of great importance. Forschungszentrum Jülich provides information on its plans for the future annually through its structure and development plan, which is submitted to the Supervisory Board.

Politics

Forschungszentrum Jülich is an institution that is primarily funded by the public sector, which is why continuous dialogue with national and international political actors is so important. On the one hand, this takes place both in an institutionalized form, for example through the Supervisory Board of Forschungszentrum Jülich, the Senate and Senate Commission of the Helmholtz Association, and various dialogue platforms on a management level and on the level of individual research fields. On the international level, ideas are exchanged in EU committees and with members of the EU Commission. On the other hand, management-level and working-level meetings regularly take place with the relevant ministries. These include coordination discussion, discussions on the business plan and on construction measures, and the annual financial statement committee. An exchange of ideas also takes place during numerous ad hoc meetings on individual issues and projects. Forschungszentrum Jülich welcomes politicians from all levels of government as visitors to Jülich throughout the year. Of course,

politicians are also invited to Jülich's end-of-year ceremony. Representatives of Forschungszentrum Jülich attend so-called "parliamentary breakfasts" on selected topics with parliamentary groups of the Bundestag and the state parliament.

Economy

The private sector is also an important external stakeholder. Numerous companies and associations are Forschungszentrum Jülich's partners in research projects and provide third-party funding for the commercialization of research findings. Building and maintaining these important ties is among the tasks of Technology Transfer at Forschungszentrum Jülich. This infrastructure division has established formats such as a round table for the important dialogue between experts from science and industry. Forschungszentrum Jülich is also regularly involved in the Innovation Days conference and the Research Days that take place several times each year. Since 2012, Innovation Days have been providing an opportunity for non-university research in Germany to showcase the best application-oriented technologies and spin-off projects. At Research Days, in contrast, scientists present the results of application-oriented research and technologies to individual businesses. Another tried and tested strategy of technology marketing that allows Forschungszentrum to establish a dialogue with industry is to present exhibits on application-oriented research topics and results from the scientific institutes at trade fairs.

General public

Forschungszentrum Jülich considers itself a responsible and reliable neighbour in the Jülich region. It has therefore decided to make its activities as transparent as possible to the general public.

As one of the largest employers and companies providing vocational training, Forschungszentrum Jülich is firmly rooted in the region. The population appreciates Forschungszentrum Jülich as one of the large research institutions in Europe. Inhabitants of the Jülich region show great positive interest in scientific work on campus. Forschungszentrum Jülich therefore regularly invites all those interested to open days. In September 2013, around 20,000 visitors came to the Jülich campus, where they gained an idea of the diverse activities of the scientists as well as the extraordinary research facilities located on campus. More than 1,000 employees from 49 institutes and infrastructure divisions as well as external partners answered the visitors' questions and presented their research in a hands-on, engaging manner. In addition, there were numerous presentations on the sustainable campus and sustainability in general.

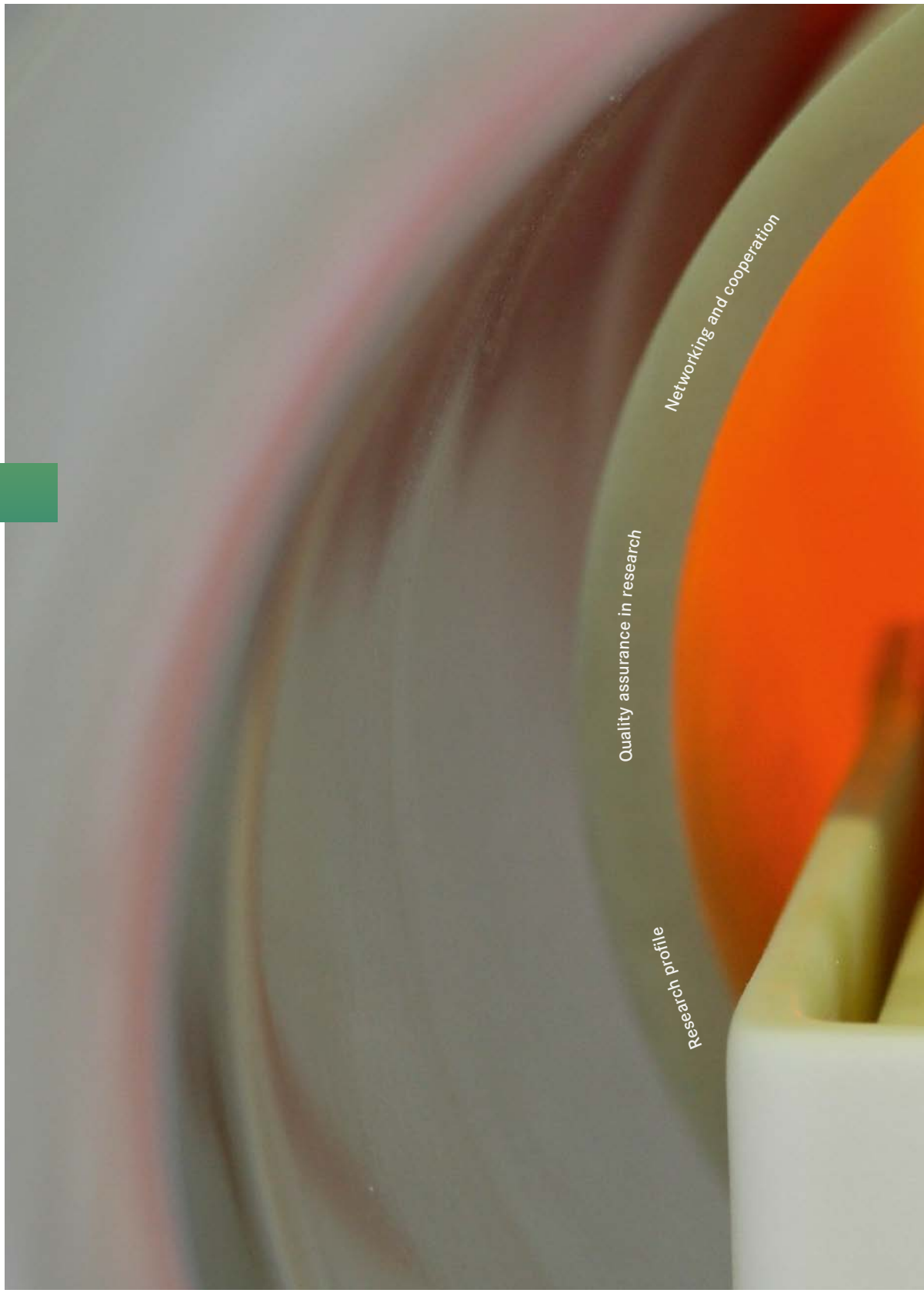
Forschungszentrum Jülich is open to members of the public. It invites all those interested to discover its research on guided tours of the campus. Every year, the Visitor Service of Forschungszentrum Jülich welcomes 5,000 to 6,000 guests. Guided tours are organized free of charge from Monday to Friday for registered groups of at least ten people. In addition to general tours of the campus, tours on specific research topics, such as health, were also introduced in 2012. One of the highlights among the tours on offer is a "sustainability tour" all about energy and the climate, which takes place on bikes. Guided tours are organized by Corporate Communications.

The Science Night, a discussion forum which takes place in Jülich in autumn every year, also attracts general public interest. This is a series of events hosted by Forschungszentrum Jülich that aims to foster communication between society and science. The topic in October 2012 was the research field of photovoltaics and its future uses. In September 2013, the Science Night was all about research on Alzheimer's, possible uses of plants for food and energy, and climate research. On both occasions, a film was shown, followed by a panel discussion that allowed visitors to ask the scientists questions on their respective areas of research.

Other events specifically address children and young people, for example the Vocational Training Centre's annual open days for prospective trainees, the JuLab Schools Laboratory, and special events, such as Girls' Day. Science days and research weeks during the holidays and training opportunities for teachers and educators are all intended to spark young people's interest in science as early as possible. The same applies to the "Jugend forscht" competition. JuLab at Forschungszentrum Jülich regularly hosts the regional heat of the competition for school students.

A topic that frequently draws public criticism is Forschungszentrum Jülich's history: it was originally established as nuclear research centre. In the past, Forschungszentrum Jülich operated two research reactors and was involved in technological development for the Arbeitsgemeinschaft Versuchsreaktor (AVR) high-temperature reactor situated in the direct vicinity. Today, Jülich no longer operates research reactors. The Merlin research reactor has already been dismantled to re-establish a greenfield site, and the Dido research reactor was decommissioned in 2006 and is currently in the process of being dismantled. The AVR reactor, which was operated in Forschungszentrum Jülich's direct vicinity and decommissioned in 1988, is also no longer in operation. The facility is being dismantled independently by AVR GmbH, the company that operated the reactor. Forschungszentrum Jülich supports AVR GmbH in this process. It will accept the reactor vessel and take care of the proper disposal of the radioactive waste arising from the dismantling process. In addition, the AVR fuel elements are in interim storage at Forschungszentrum Jülich. Apart from these ongoing dismantling and waste management projects, Jülich is still active in research areas where nuclear technology plays a key role, such as nuclear medicine. Forschungszentrum Jülich takes responsibility for the proper storage and disposal of the radioactive waste in its custody in conformity with the relevant legislation.

Forschungszentrum Jülich sees it as its duty to provide the general public, particularly those in its direct vicinity, with well-informed, reliable and transparent information on the dismantling, storage, and management of nuclear facilities and waste. It has significantly intensified these efforts in the past few years. From 2010, the Jülich town council, the Düren district council, the local members of the state parliament and the Bundestag have discussed their questions on the relevant projects and topics with experts from Forschungszentrum Jülich. On Forschungszentrum Jülich's website, there is a dedicated section on nuclear topics where current information is made available and a list of frequently asked questions is maintained and regularly updated. In 2012, a public discussion was organized at Jülich Technology Centre on the handling of the AVR fuel elements. Another public meeting took place at Jülich's town hall in 2013. In 2011, Forschungszentrum Jülich and AVR GmbH also commissioned a group of independent experts to examine the operating history of the AVR reactor. The group, which was headed by Christian Küppers from the Institute of Applied Ecology in Darmstadt, presented its critical report in April 2014. The report has been published by Forschungszentrum Jülich and is available online. In June 2014, the public will have the opportunity to discuss their questions regarding the report with the experts themselves at a public event at Jülich Technology Centre.


Networking and cooperation
Quality assurance in research
Research profile

With a total of nine institutes, Forschungszentrum Jülich has an extensive portfolio of scientific fields of work, ranging from particle physics and bio- and geosciences to medicine and energy research. Building on a unique research infrastructure, Jülich's interdisciplinary, transdisciplinary, and highly international working approach enables its researchers to achieve breakthroughs to new horizons of knowledge. In this way, Forschungszentrum Jülich works towards solving the grand challenges facing society, and its research mission makes a major contribution to the federal government's sustainability strategy. The foundation for this efficacy is the outstanding excellence safeguarded both today and for the future by various quality assurance instruments.

Research for a future worth living

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Research profile

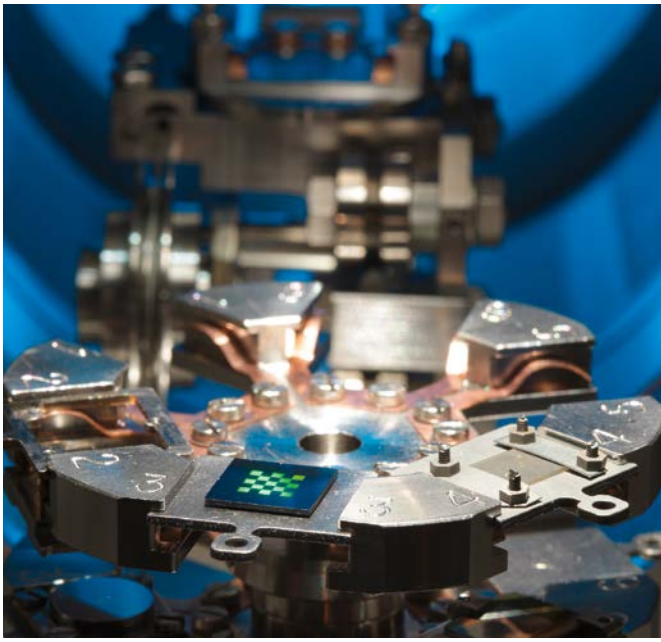
Forschungszentrum Jülich develops key technologies in the areas of energy and environment, information, and health. It is in a position to open up new industries, such as the bioeconomy, on the basis of its fundamental scientific research. A unique infrastructure and unrivalled expertise in physics, materials science, nanotechnology, and information technology ensure that Jülich has the potential to develop new solutions in the areas of health, energy and environment, and information.

Forschungszentrum Jülich is proud of the tools with which its researchers work: simulations with supercomputers, research with neutrons at the best neutron sources in the world, state-of-the-art multimodal imaging techniques for medicine and environmental research, nanotechnology tools – these modern instruments continually facilitate breakthroughs in each research area. This infrastructure, valued and used by researchers all over the world, characterizes Jülich as the home of key technologies.

An extensive portfolio of scientific fields of work and an interdisciplinary, transdisciplinary, and highly international working approach set Forschungszentrum Jülich apart. Excellent researchers who cooperate across the borders of institutes, research centres, and even countries are Jülich's greatest strength. To allow them to work together with leading partners throughout the world, Forschungszentrum Jülich participates in strategic alliances both in Germany and abroad.

1 *Prof. Dr. Simon Eickhoff (INM-1)*

1 *"At the Institute of Neuroscience and Medicine, we are developing a completely novel 3D model of the human brain. The model represents a vital basis for current and future investigations of the healthy ageing process as well as diseases such as dementia, depression, and Parkinson's disease. This may make it possible to diagnose mental illnesses earlier, predict their progression more accurately, and develop more specific treatment methods."*



Developing new energy systems

Transforming the energy sector brings with it major challenges for research. To meet these, Forschungszentrum Jülich has positioned itself as a national centre for the exploration of energy materials. This is built on an understanding of materials and systems on all levels and across disciplines. Jülich's research projects cover the entire value chain – from basic research to industrial innovation. The aim for the coming years is to further expand activities in this area. Accordingly, both the research projects and the administrative and infrastructural support will be intensified. Strategic measures include initiating collaborations and setting up new research infrastructures as well as establishing new subinstitutes and concentrating financial resources in the field of energy. Laboratories, working areas, and offices will also be expanded.

2 *"I believe that the energy sector must be transformed – there is no alternative. As a scientist, I am fascinated by the challenge of laying the scientific foundations for carrying out this transformation prudently."*

The Institute of Energy and Climate Research (IEK) was established in 2010 as the cornerstone of Jülich energy research and has grown in size from an initial six subinstitutes to ten today. Its more than 800 employees address the scientific and technological fundamentals of transforming the energy sector and mitigating climate change. Beyond this, researchers at the Peter Grünberg Institute (PGI) and the Jülich Centre for Neutron Science (JCNS) also pursue projects in the field of energy. The Central Institute of Engineering, Electronics and Analytics (ZEA) is an important partner for all subinstitutes.

3 *"At the Central Institute of Engineering, Electronics and Analytics, the issue of sustainability is becoming increasingly important. This applies not only to research topics in the field of energy, but also to developments in general. It is vital that we plan the development process better in advance and continuously review it while work is in progress."*

Energy research at Jülich encompasses numerous areas – from developing new energy materials and exploring new technologies for electricity generation and energy storage up to researching energy systems and increasing energy efficiency in the IT sector.

4 *"Using nuclear fusion as an energy source provides society with a primary energy source that is accessible throughout the world and will not be exhausted in the foreseeable future. Selecting suitable materials for a fusion reactor, which is the subject of work at the Institute of Energy and Climate Research, will make fusion a sustainable energy source with a negligible impact on the environment. For example, no CO_2 is emitted by nuclear fusion, and after 100 years the radioactivity of the activated materials decays to a level that allows them to be reprocessed in conventional industrial processes."*

2 *Prof. Dr. Rüdiger-A. Eichel (IEK-9)*

Highlight: Research for the transformation of the energy sector

If the transformation of the German and global energy sectors is to succeed, we must push ahead with energy research across many fields both today and in future. Priorities at Forschungszentrum Jülich include developing cost-efficient processes for fabricating silicon thin-film solar cells using printing techniques and developing marketable, efficient electrolysis systems that are capable of dealing with changing loads and are stable in the long term.

3 *Prof. Dr. Stefan van Waasen (ZEA-2)*

Jülich's scientific work in the fields of solar energy and hydrogen places particular emphasis on partnerships. Two of the most important of these are Solarcampus Jülich and HYPOS. Solarcampus Jülich is a planned platform for joint research, exhibition, and demonstration projects in collaboration with Aachen University of Applied Sciences Campus Jülich (JHA), the German Aerospace Center (DLR), and RWTH Aachen University. Features of the Solarcampus will include examples of the architecturally innovative integration of photovoltaic modules in building façades and industrial-scale solar systems solutions. Furthermore, the Solar-

4 *Prof. Dr. Christian Linsmeier (IEK-4)*

Prof. Dr. Detlef Stolten (IEK-3)

campus will be a centre for application-oriented further education and training in solar energy topics. HYPOS, meanwhile, is an initiative with around 90 partners from industry and research that focuses on connecting electrochemical hydrogen production with the existing infrastructure of natural gas pipelines and gas storage facilities.

5 *"Our work at the Institute of Energy and Climate Research supports the federal government's objectives regarding sustainability in the energy supply. It is vital that we recognize and promote the key factors for sustainably transforming our energy supply and use. An important part of this is coupling the technologies of wind power with water electrolysis and electromobility."*

A prerequisite for the success of new technologies in the energy sector is their integrability in the energy system. Jülich systems researchers are responsible for analysing this integrability. They examine structural issues of future energy systems such as the optimum degree of decentralized supply or the modification of supply networks and grids. Another topic of interest is infrastructures for electricity, gas, and fuels. On the basis of the analyses, lead scenarios are developed and advisory services provided for policy-makers and society.

Prof. Dr. Martin Riese (IEK-7)

Understanding and protecting our climate

Anthropogenic emissions not only pollute the air but also alter the composition of the atmosphere. To predict the impacts of human activity on the climate even more accurately and to refine existing climate models, we must gain a better understanding of the complex chemical interactions in the atmosphere, as much remains unknown. For climate forecasts, understanding how particles are formed – a process known as aerosol formation – currently poses the greatest challenge.

Climate researchers at the Institute of Energy and Climate Research therefore investigate physical and chemical processes in the troposphere and stratosphere, which have a strong effect on the overall composition of the atmosphere. They analyse the release of trace substances at the Earth's surface, energy production, transport, and industry; the chemical conversion of trace substances in the atmosphere; and the distribution of greenhouse gases by the transport sector. Experiments involving aircraft and balloons are used for data acquisition. This is complemented by the use of satellite data.

6 *"International ozone research, to which the Institute of Energy and Climate Research has made major contributions, has succeeded in protecting the ozone layer for future generations in the long term by means of the Montreal Protocol and its subsequent protocols. Our biggest challenge for the future is investigating the upper troposphere and the lower stratosphere, as this is where anthropogenic and natural greenhouse gases have the largest impact on the climate. Our goal is to make a significant contribution to improving global and regional climate predictions, which are urgently needed to provide a reliable basis for sustainable adaptation and climate protection measures."*

Highlight:
Outstanding infrastructure for climate research
With its competence in climate research, Forschungszentrum Jülich is involved in several projects and collaborations. One such collaborative initiative is the Pan-European Gas–Aerosols–Climate Inter-

action Study (PEGASOS), which aims to quantify regional and global feedback between atmospheric chemistry and a changing climate. A further objective of PEGASOS is to identify mitigation strategies and policies for improving air quality, taking into account its impact on climate change. Forschungszentrum Jülich's contribution to the study involves observing the atmosphere's self-cleaning capacity and its interaction with aerosol formation.

The PEGASOS experiments make use of Forschungszentrum Jülich's unique infrastructure – for instance, the large atmospheric simulation chamber, SAPHIR. This simulation chamber enables the mechanisms of atmospheric chemistry to be studied under reproducible conditions. SAPHIR is particularly suitable for studying the degradation of biogenic and anthropogenic trace substances and examining the accompanying production of secondary pollutant gases and particles. Also in use is the Zeppelin NT, which has been employed as a flight platform for atmospheric measurements in the planetary boundary layer since 2006. The Zeppelin NT is particularly attractive for troposphere research in that it allows a large payload of instruments to be manoeuvred at both low and high altitudes in the planetary boundary layer.

Another part of the superb infrastructure employed at Jülich for climate research is the In-service Aircraft for a Global Observing System (IAGOS). Coordinated by Jülich scientists, IAGOS combines the expertise of partners from research, weather forecasting, the aviation industry, and airlines in order to establish a unique instrument for global Earth observation. To achieve this, instruments for recording the chemical composition of the atmosphere are installed on board commercial airliners. Every day, all over the world, IAGOS provides spatio-temporal high-resolution information in the upper troposphere and lower stratosphere as well as vertical profiles in the troposphere. Trace gases, aerosols, and cloud particles are measured in the process. Measurements at even higher altitudes are conducted by the German research aircraft HALO (High Altitude and Long Range Research Aircraft), which is used for atmospheric studies over large distances and at altitudes of up to 15 km. The Gimballed Limb Observer for Radiance Imaging of the Atmosphere (GLORIA) was installed on board HALO in August 2012. GLORIA is a new infrared camera that maps the large-scale movements of gases and aerosols.

The know-how of Jülich researchers is not only in demand within the scientific community – it is also called for at a political level. For instance, Jülich employees support the Intergovernmental Panel on Climate Change (IPCC) by acting as reviewers for its reports. The results incorporated in the IPCC assessment report include analyses of global water vapour distribution, methane trends in the stratosphere, and the role of clouds and aerosols.

Investigating diseases and helping patients

More than a third of the European population suffers from mental disorders. This was the finding of a 2011 study by the European College of Neuropsychopharmacology (ECNP) and the European Brain Council (EBC). When neurological disorders are added to the equation, the total figure is considerably higher. With demographic change, the number of people affected by diseases of the brain is set to increase even further. The related costs are estimated at almost € 800 billion per year. However, the suffering of patients and their relatives, which often stretches over many years or even decades, is impossible to quantify.

7 *"At the Institute of Neuroscience and Medicine, we investigate molecular and dynamic aspects of cerebral signal transduction as well as disturbances in this transduction in the case of neurological or psychiatric disorders. In doing so, we identify molecular signatures that make it possible to diagnose a disease long before the first symptoms appear. In this way, countermeasures can be taken at an early stage in order to delay the onset of the disease and limit its extent."*

Research on the brain and the search for new methods to improve diagnostics and treatment for diseases are therefore among the most important challenges facing health research. Neuroscience research at Jülich comprises a wide spectrum of activities – from the biochemical study of patho-

7 *Prof. Dr. Andreas Bauer (INM-2)*

gens and clinical and cognitive neuroscience to the development of imaging techniques. A major future priority is the modelling and simulation of the human brain from the molecular to the network level using supercomputers. The specific medical research fields addressed at Forschungszentrum Jülich include tumour diagnostics, Parkinson's disease, stroke diagnosis, ADHD, and various forms of dementia. This research benefits from Forschungszentrum Jülich's outstanding infrastructure. With the aid of state-of-the-art imaging techniques, this enables new approaches to be developed for understanding and treating these disorders.

8 Prof. Dr. Dieter Willbold (ICS-6)

8 *"Alzheimer's disease is a central research topic at the Institute of Complex Systems – Structural Biochemistry (ICS-6). Aggregates of the beta-amyloid peptide are held responsible for triggering the disease. This is why we work on highly sensitive, quantitative methods to detect the aggregates and identify substances that target toxic beta-amyloid aggregates so that we can develop therapeutically active substances. In this way, we play an important part in meeting the challenges facing an ageing society."*

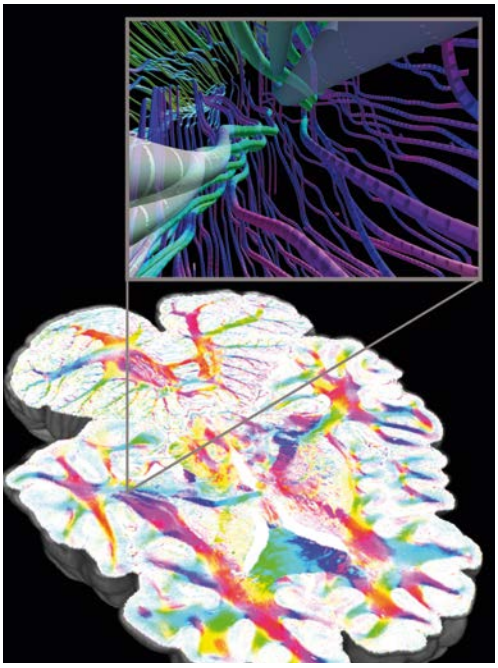
Highlight:
The human brain

The focal point of research activities in the field of neuro- and simulation sciences is the Human Brain Project (HBP). This large-scale project was selected by the EU as a Future and Emerging Technologies Flagship Initiative and will receive funding of € 1.19 billion from the EU and the project partners over a ten-year period. The goal of HBP is to simulate the complete human brain within the next ten years using a supercomputer of the future in as much detail as possible – from genetics and the molecular level to the interaction of whole cell clusters. HBP brings together 80 partners from more than 20 countries, and others will join as the need arises through separate calls for proposals. Jülich is represented by the Institute of Neuroscience and Medicine (INM) and the Institute for Advanced Simulation (IAS).

9 Prof. Dr. Paolo Carloni (IAS-5)

9 *"Despite considerable financial commitments by the pharmaceutical industry and pharmaceutical research, the number of new drugs has stagnated. This is due to our inadequate molecular understanding of the causes of diseases. At the Institute for Advanced Simulation, we work on simulations based on supercomputing in order to improve this understanding. Our research focuses on cancer and neurological diseases such as Parkinson's – two of the most significant illnesses in an ageing society."*

HPB comprises thirteen subprojects – and Forschungszentrum Jülich is involved in six of these. Moreover, Jülich leads the subprojects Strategic Human Brain Data and High Performance Computing Platform. The aim of Strategic Human Brain Data is to obtain data on the human brain and establish systematic links. Strategically important data will be identified so that fundamental organizational principles of the human brain can be determined. The finished product will be a kind of database consisting of different brain maps and descriptions of individual aspects of brain organi-



zation, including connections and routes of transmission. The task of the High Performance Computing Platform is to provide the European research partners with world-class infrastructures for supercomputing, big data, and cloud computing. One of the main challenges concerns visualization tools. These will enable medical researchers and neuroscientists to observe the objects of their research from every perspective and on every level.

10 *"In collaboration with the Department of Neurology at University Hospital Cologne, we at the Institute of Neuroscience and Medicine offer a specialist outpatient clinic for memory defects and dementia. We are working towards diagnosing the diseases at an early stage, before memory defects develop, so that we can delay them."*

Materials for key challenges

Understanding materials is the key to solving global challenges. At Jülich, therefore, materials are investigated in the context of systems and processes on different scales, from the atomic to the global level. In this way, our research is embedded in the wider context, taking into consideration not only scientific questions, but also social, economic, and ethical issues.

11 *"Scattering methods such as synchrotron X-ray and neutron scattering provide unique insights into the atomic structure of matter and tell us where atoms are located, how they move, and which magnetic properties they have. These probes are indispensable for developing new materials and processes for future energy generation and conversion."*

Neutrons are an important tool for investigating materials. Neutron scattering makes it possible to locate atoms within materials and show how they behave. No other method is capable of covering such a large spectrum of topics. In future, research with neutrons is expected to make significant contributions to the key challenges facing society, including environmental protection, health, information technologies, and energy technology.

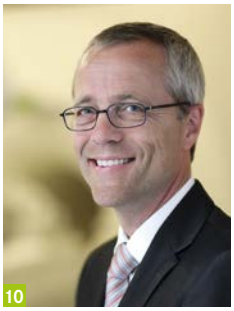
The energy sector is another central topic in materials research at Jülich. Materials in this area are exposed to extreme load conditions, for example in power plants. Materials also play a crucial role in electronic and electrochemical applications such as fuel cells. In addition to the energy sector, a further field of application of materials research is the design of future information systems that will be implemented in areas such as supercomputing.

Highlight:
New materials for a new energy system

In its work on materials science, Forschungszentrum Jülich focuses on developing new materials for the energy sector that could be used in power plants, photovoltaics technologies, fuel cells, or information technologies. One of the key challenges Jülich therefore faces is providing answers to questions on the damage sustained by materials during operation as well as on the lifetime of components. The Helmholtz Energy Materials Characterization Platform (HEMCP) is a cornerstone of energy materials research at Jülich. It intensifies Jülich's cooperation in this area with the Helmholtz centres of Berlin, Dresden-Rossendorf, and Geesthacht as well as the DESY accelerator centre, the German Aerospace Center (DLR), and Karlsruhe Institute of Technology (KIT).

12 *"The knowledge gained from basic physical research with sophisticated techniques provides future generations with the opportunity to initiate sustainable developments."*

Work at the Helmholtz Institute Erlangen-Nürnberg Renewable Energy Production (HI ERN) focuses specifically on materials for the field of renewable energies. HI ERN is a collaboration between Forschungszentrum Jülich, Friedrich-Alexander-Universität Erlangen-Nürnberg, and Helmholtz-Zentrum Berlin für Materialien und Energie (HZB). Scientists at HI ERN develop new materials for the generation and storage of energy from renewable sources, with an emphasis on the use of materials



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Prof. Dr. Gereon Rudolf Fink (INM-3)

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Prof. Dr. Thomas Brückel (JCNS-2)

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Prof. Dr. Rudolf Maier (IKP)

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Prof. Dr. Dr. Thomas Lippert (JSC)

in solar cells and on hydrogen production from electrolysis and photocatalysis. HI ERN works closely with industrial partners in these activities.

Cross-centre key technologies

Key Technologies is a central research field in the Helmholtz Association and one that is the subject of research across several of its centres. Forschungszentrum Jülich is involved in four programmes in this field. It is the lead centre in the Supercomputing programme and is involved to varying degrees in the programmes Fundamentals of Future Information Technology, BioSoft: Macromolecular Systems and Biological Information Processing, and Technology, Innovation and Society. Moreover, since late 2006, the overall coordinator of the entire research field has been from Jülich.

The aim of the Supercomputing programme is to make essential instruments and infrastructures for high-performance computing (HPC) available to the German and European scientific community. Supercomputing represents a strategic key technology for both theoretical and experimental research and for the optimization of industrial products and manufacturing. Forschungszentrum Jülich is currently home to Europe's most powerful supercomputer, JUQUEEN. It has a computing power of over 5 petaflop/s – which is equivalent to over five quadrillion arithmetic operations per second.

14

Prof. Dr. Rudolf Merkel (ICS-7)

13 *"Supercomputers have high energy requirements. The Technology department at the Jülich Supercomputing Centre is working to reduce energy demand even as computing power increases. The only way to maintain operating costs at acceptable levels is by helping to develop and implement energy-efficient computer components, smart cooling systems, and optical communications networks. We and our partners on campus hope to fully transform the energy supply for computer systems to renewable energy in the near future."*

The future of supercomputing is dependent on another key technology. The goal of the programme Fundamentals of Future Information Technology is to increase the efficiency of information technology systems – an important factor in reducing global energy consumption in general and that of supercomputing in particular.

In the programme BioSoft: Macromolecular Systems and Biological Information Processing, Jülich scientists work at the interface between physics, chemistry, and biology. This is where research areas are currently emerging that lay the foundation for new technological applications and new treatment strategies. The programme therefore aims to gain a quantitative, theoretical understanding of the potential complex structures and mechanisms. These include synthetic and biological macromolecules – such as polymers, proteins, lipids, and colloids – as well as their aggregates, for example multi-domain proteins, membranes, networks, and gels.

14 *"With our research on controlling living cells and on the interplay between cells and mechanics, we work on principles, methods, and processes for medicine and bionanotechnology at the Institute of Complex Systems. In this way we play our part in addressing the challenges facing an ageing society and in consolidating a knowledge-based biotechnological economy."*

The Technology, Innovation and Society programme helps to shape innovation processes in a targeted and responsible manner. Its main aim is to investigate potential applications of key technologies and to develop ways of implementing a sustainable energy supply. To this end, questions related to the system are examined, connections between Helmholtz research resting on the natural and engineering sciences and its social context are investigated, and the opportunities and risks associated with technological innovation are assessed. The results

of the research programme will be exploited outside the scientific arena as part of political decision-making processes and public debate on scientific and technological progress.

Highlight: Efficient architectures for information technologies

The steadily growing complexity of the systems and processes being investigated places ever greater demands on computer architecture and simulation methods. A particular challenge for the future is posed by the continuously increasing volumes of data and the data flows generated in large-scale experiments. The research field of supercomputing thus presents a central platform for both theoretical and experimental research.

The Human Brain Project (HBP) plays a special role in this research field. Firstly, supercomputing supports research within HBP by providing infrastructures for supercomputing, big data, and cloud computing, which are exploited for tasks such as the visualization of the brain. Secondly, one of HBP's aims is to obtain new insights for the future of supercomputing. Scientists therefore aim to use neuroscientific findings as a guide for their work on future supercomputers, such as JUQUEEN at Jülich. To cope with the enormous volumes of data involved in large-scale projects, current supercomputing architectures require several megawatts; the human brain, in contrast, needs only 30 watts. The efficiency of the brain in processing information is to be a model for the construction of new energy-saving computers.

15 *"In 2007, Germany was already using around 10 % of its energy for information and communications technologies – and this figure is on the rise. As a result of the meteoric economic growth in developing countries, global energy consumption will also continue to rise rapidly unless information and communications technologies become considerably more efficient. This is why we at the Peter Grünberg Institute are working on making future computers, sensors, screens, and other technologies more efficient."*

Prof. Dr. David DiVincenzo (PGI-2)

Energy efficiency is the focus of attention in areas other than supercomputing. While the development of semiconductor technology has been characterized until now by increases in computing power, in the capacity density of data storage, and in data transfer rates, future research must concentrate to a greater extent on exploring and testing energy-efficient systems. This is particularly relevant given the extent to which technological systems have permeated our society. As a programme, Fundamentals of Future Information Technology therefore addresses the question of the degree to which energy efficiency can be increased by using ever smaller components that are theoretically more efficient, and whether entirely new approaches are needed to complement this.

Learning from nature

The world's population is growing, and so too is the demand for food, raw materials, and energy. As arable land and fossil resources are limited, alternative strategies must be found to meet the growing demand. This is complicated by climate change, which makes it necessary to develop systems for renewable energy.

The interdisciplinary, transdisciplinary concept of a sustainable, knowledge-based bioeconomy offers possible solutions by combining various research approaches from the natural sciences, engineering, agricultural science, and social science as well as research and development activities in related sectors. This economically, environmentally, and socially sustainable approach to providing solutions for the central problems of today's fossil-fuel-based economy is regarded as extremely pioneer-

ing all over the world. National and international policy has also already acknowledged the significance of the bioeconomy. For example, the German federal government has established the National Research Strategy BioEconomy 2030 and the Biotechnology 2020+ strategy process as part of its High-Tech Strategy for research and innovation policy.

Achieving the objectives of the bioeconomy requires strong links to be forged between diverse disciplines and research fields. At Forschungszentrum Jülich, this primarily concerns plant sciences, soil research, and biotechnology. The Institute of Bio- and Geosciences (IBG) is a key player in this regard. An important goal at IBG is developing more robust high-yield plants.

Imaging techniques such as magnetic resonance imaging (MRI) are used to monitor plants' reactions to stress factors – such as water or nutrient deficiency. Research activities include observing root structures in an MRI scanner, analysing plant growth and photosynthesis, and determining the water balance of crops in the field.

The focus of soil research at IBG, in contrast, is on biogeosystems and terrestrial processes. In the Terrestrial Environmental Observatories project (TERENO), a large infrastructure of Earth observation stations provides extensive data across the whole of Germany, from the plains in the north to the Bavarian Alps. These stations enable researchers to monitor the impact of climate change, changes in land use, and interactions between soil, vegetation, and the atmosphere over the long term. IBG's approach combines observation with experiments and mathematical modelling.

Industrial use of renewable raw materials is another priority at IBG. At present, the chemical industry is based chiefly on oil. In order to reduce our dependence on this finite resource, an increasing number of technologies are being developed that enable chemicals and other valuable substances to be produced from renewable raw materials with the aid of biological systems. Enzymes are used for this, as are all microorganisms whose metabolisms can be reprogrammed to produce a desired product. Jülich researchers aim to improve the efficiency of microbial cell factories and continuously expand their product range. They also want to accelerate the development of microorganisms used in production processes for technical applications. Other projects focus on simulating the conditions of microbial production processes in large industrial bioreactors in the laboratory in order to facilitate and accelerate the subsequent transfer of new production strains to industrial applications.

Highlight:
Research to combat hunger

As the land that can be used for agricultural purposes is limited, another way must be found of increasing crop yield per unit area so that the world's population can be provided with enough food. Two crucial methods are the breeding of high-performance plants and resource-conserving cultivation.

A particular priority in solving this task is the development of new sensor technologies for the real-time monitoring of hydrological and biogeochemical processes. This enables researchers to use stable isotopes, for instance, to investigate the length of time for which individual chemical elements such as carbon or oxygen remain in the soil. In collaboration with the Jülich Supercomputing Centre, the scientists also perform simulations on supercomputers. By means of experimental and numerical simulations, they predict the development of agricultural systems and develop measures for efficient soil management. The transfer to practical applications is a key strategic aspect. The researchers cooperate closely with growers and farmers and provide advice to politicians and administrators.

16 *"Plants are the basis of all life on Earth. They are the basis of human nutrition and are increasingly being used as a replacement for fossil fuels. As well as this, plants close carbon and nutrient cycles, without which sustainable material flows would be impossible. This makes plants essential biological resources that will determine whether or not economic activity can be conducted sustainably in future."*

16 *Prof. Dr. Ulrich Schurr (IBG-2)*

In order to quantitatively determine the structural and physiological properties of plants, IBG collaborates with the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben and Helmholtzzentrum München (HMGU) in the German Plant Phenotyping Network (DPPN). At these three locations, facilities are constructed and methods developed for analysing and measuring plant characteristics on a large scale. The resistance of plants to stress and the concentration of important substances are some of the aspects investigated. The network is being supported by the Federal Ministry of Education and Research (BMBF) with funding worth € 34.6 million over five years. The DPPN is the hub of German research activity within the European Plant Phenotyping Network.

Jülich is also actively involved in various large-scale scientific projects in the field of soil research. The Terrestrial Environmental Observatories project (TERENO) is a collaboration between six Helmholtz centres. The project aims to catalogue the long-term environmental, social, and economic impacts of global climate change on a regional level. Its basis is a network of Earth observation stations that collect data from all over Germany. TERENO is a long-term programme that provides statistical system variables for analysing and predicting climate impacts and delivers adaptation strategies on this basis.

Research into the dynamic human-Earth system is also the focus of attention in Geoverbund ABC/J. The aim of this collaboration is to identify pressing future issues with respect to the Earth's evolution, environmental dynamics, georesource management, and geological risks to humans, and then to develop possible solutions that apply not only to the region but much further afield. Geoverbund ABC/J is an alliance between the geoscience institutes at RWTH Aachen University, the University of Bonn, the University of Cologne, and Forschungszentrum Jülich.

17 *"At Agrosphere (IBG-3), we work towards understanding hydrological and biogeochemical processes and their dynamics in terrestrial systems. Through the use of state-of-the-art methods combined with the operation of experimental platforms, we develop multi-scale terrestrial models. These models enable us to make quantitative statements about the impact that changes in land use and in the climate have on ecosystems. This establishes a scientific basis for management recommendations on the use of soils and water in a resource-conserving manner."*

Prof. Dr. Harry Vereecken (IBG-3)

Research infrastructures

As a consequence of its diverse range of research topics, Jülich has a wide variety of extraordinary large-scale research infrastructures for generating new knowledge and new technologies. These include large-scale facilities, instruments, knowledge resources such as collections, archives, structured information, and data processing systems, as well as many other unique facilities used for research purposes. In addition to its own medium- and large-scale facilities operated on campus, Forschungszentrum Jülich is involved in the construction and operation of the world's top facilities, including the Spallation Neutron Source (SNS) in Oak Ridge, USA, and the European Spallation Source (ESS) in Lund, Sweden. What makes Jülich unique is, on the one hand, the sheer variety of facilities available, and, on the other, its ability to construct the majority of the facilities itself. Forschungszentrum Jülich's interdisciplinarity allows it to adapt technologies developed for a given field relatively quickly so that they can be used for other research projects.

Part of Jülich's strategy is making its facilities accessible to external users. For this reason, a number of facilities are operated in cooperation with universities. An overview of Jülich's research infrastructures is provided in the appendix to this Sustainability Report. It contains a list of those infrastructures that play an essential role in national and international research. In addition to existing facilities, important financial contributions to external infrastructures are listed as well as projects envisaged for 2014 and beyond.

Quality assurance in research

World-class research not only entails the commitment of outstanding scientists and the provision of materials and devices. It also requires a continuous analysis process, long-term strategies, and support for young scientists. The Helmholtz Association (HGF) believes in achieving this through programme-oriented funding. This approach ensures that the research conducted within HGF and thus at Jülich is among the best in the world.

Programme-oriented funding

Funding within HGF is provided in accordance with the principle of programme-oriented funding. HGF no longer invests its resources in individual institutions, but rather in competing research programmes usually involving several Helmholtz centres. The necessary research policy targets are determined by the funding agencies after being discussed by the Helmholtz centres, the Helmholtz Senate, and policy-makers. In keeping with the core objectives laid down in the Pact for Research and Innovation, the focus here is on outstanding achievements through collaboration and competition. This enables HGF to find holistic solutions not only to isolated problems, but also to complex issues that are relevant for science, society, and industry.

Distributing HGF resources is subject to an extensive evaluation process. Scientists at the Helmholtz centres first plan the content of their research in each research area within strategic programmes – cooperating with each other beyond the boundaries of institutions and disciplines and competing with each other for research funding. These programmes are then strategically evaluated by acclaimed experts from all over the world. Their evaluations form the basis for the federal and state governments' decision on the amount and breakdown of the funding that each programme will receive. An evaluation is carried out every five years, and the resulting recommendations and comparisons with top institutions help to ensure that HGF research findings are on par with the world's leading institutions. Programme-oriented funding was instituted in 2003. The second funding period began in 2009/2010, and the third period will begin in 2014/2015.

Forschungszentrum Jülich already reallocated considerable resources across programmes and research fields for the second period of programme-oriented funding. In the course of the preparations for the third period, further far-reaching changes will be made to the allocation of resources in order to bring Forschungszentrum Jülich's strategy in line with the programme-oriented funding system. The overall process is quite extensive for Forschungszentrum Jülich due to the large number of research areas in which it is involved. Jülich is the Helmholtz centre with the most wide-ranging contribution to Helmholtz programmes and research fields. In the current second period of programme-oriented funding, Jülich is participating in thirteen programmes in five research fields. In the third period, the number of programmes will rise to sixteen, but the number of research fields will be reduced from five to four, as the research field of Health will be omitted.

Clusters of excellence

Generating excellence in its work is a key task that Forschungszentrum Jülich has set itself. It lays the foundation for maintaining Jülich's position as one of the leading research institutions worldwide. An important aspect in achieving this is Forschungszentrum Jülich's participation in the Excellence Initiative of the federal government and the federal states. This initiative aims both to support cutting-edge research

and to enhance the quality of German university education and science in the long term, improve its international competitiveness, and raise the profile of outstanding accomplishments by universities and research institutions. The Excellence Initiative is managed by the German Research Foundation (DFG) and the German Council of Science and Humanities.

In addition to graduate schools and institutional strategies for the project-oriented expansion of top-class university research, one of the Excellence Initiative's three funding lines is the formation of clusters of excellence. The clusters of excellence will enable German universities to establish internationally visible and competitive research and training facilities, fostering scientific networking and cooperation. The clusters are intended to form an important part of a university's strategic and thematic planning, significantly raise its profile, and encourage priorities to be set.

Clusters are also designed to create excellent funding and career opportunities for early-career scientists. Together with graduate schools and institutional strategies for expanding top-class university research within projects, the clusters of excellence help to consolidate Germany as a location for science in the long term and to make it more competitive internationally.

In the third phase of the Excellence Initiative, for which funding was decided in 2012, Forschungszentrum Jülich continues to be an important strategic partner for universities. For example, Jülich is involved in the approved cluster of excellence with the universities of Düsseldorf and Cologne – Cluster of Excellence on Plant Sciences (CEPLAS) – as well as in the cluster of excellence Tailor-Made Fuels from Biomass at RWTH Aachen University.

Networking and cooperation

The future of networked research lies in addressing the key challenges facing society. For this reason, Forschungszentrum Jülich's scientific strategy places particular emphasis on regional, national, and international cooperation. In 2012, Forschungszentrum Jülich worked together with numerous partners from science and industry on 262 nationally funded projects and 155 EU projects. A total of 50 national and international collaborative projects were coordinated by Jülich. This section of the report presents the key partnerships in the period under review that aimed to provide long-term solutions to the challenges facing society.

Regional partnerships

In its cooperation strategy, Forschungszentrum Jülich attaches great significance to regional partnerships. This includes first and foremost the universities in North Rhine-Westphalia. The research topics of these cooperations are not limited to regional aspects, however, but rather combine regional capacities to address issues that extend far beyond regional boundaries.

Jülich Aachen Research Alliance (JARA)

The Jülich Aachen Research Alliance (JARA) is Forschungszentrum Jülich's most significant university cooperation. This research partnership, which is unique in Germany, was established in 2007 and pools the partners' expertise in selected scientific fields. The partnership offers the 173 currently participating institutes a unique scientific working environment combining research and education. The strategic pooling of scientific expertise is also a core measure within RWTH Aachen University's institutional strategy. The aim is to achieve an internationally respected research profile in selected scientific fields. This increases the attractiveness of Jülich and Aachen as a location for top scientists beyond institutional boundaries.

JARA's sections reflect both the core competences of Forschungszentrum Jülich and the scientific priorities of the research partnership. Forschungszentrum Jülich and RWTH Aachen University are currently collaborating within five sections, each addressing a different topic: JARA-BRAIN (Translational Brain Medicine), JARA-FIT (Fundamentals of Future Information Technology), JARA-HPC (High-Performance Computing), JARA-ENERGY (Sustainable Energy Research), and JARA-FAME (Forces and Matter Experiments).

With its opportunities for cooperation and research at multiple locations, JARA is involved in several programmes within the German Research Foundation (DFG) and in collaborative projects as part of calls for proposals published by the Federal Ministry of Education and Research (BMBF). Examples include the International Research Training Group Schizophrenia and Autism at JARA-BRAIN and the collaborative research centre Nanoswitches within JARA-FIT. As regards Helmholtz funding, a further example is the Helmholtz Graduate School for Energy and Climate Research (HITEC). The international Graphene project and the Human Brain Project were approved as part of the EU's FET flagship programme, and JARA is well represented in both.

The number of jointly appointed professors (salary grade W) increased from 11 in 2006 to 44 in 2012 (as of 31 December 2012).

The institutes involved in JARA had a total of 1,662 peer-reviewed publications in 2012. The number of joint publications in 2012 was 383 at the time of data collection (May 2013).

JARA finances 2012

Budget	€ 500 million
Amount invested	€ 60 million
Funds from the Excellence Initiative	approx. € 13.6 million

Solarcampus

In July 2013, Forschungszentrum Jülich joined forces with Aachen University of Applied Sciences and the German Aerospace Center (DLR) within the framework of Solarcampus Jülich to jointly address the challenges involved in transforming the energy sector. The project is currently in the planning phase. In addition to shared offices and laboratories, the Solarcampus is intended to provide a highly visible platform for joint exhibition and demonstration projects in future. Planned examples range from the architecturally innovative integration of photovoltaic modules in building façades up to solutions for industrial-scale solar power systems. The Solarcampus will be built close to the solar tower in Jülich.

The Solarcampus will be a unique platform for application-oriented research and will combine regional scientific excellence in photovoltaics and the use of solar energy at a joint location. Furthermore, the Solarcampus will become a centre for application-oriented further education and training in solar energy topics.

Bioeconomy Science Center

Since it was established in 2010, the Bioeconomy Science Center (BioSC) has been conducting research on key issues in the field of a sustainable bioeconomy for nutrition, the use of biomass for material production and energy generation, and for renewable raw materials in biological systems and bio-based processes. To this end, Forschungszentrum Jülich, RWTH Aachen University, the University of Bonn, and Heinrich Heine University Düsseldorf work together at a number of sites on a joint strategy to find innovative and applicable solutions for a sustainable bioeconomy. The four institutions conduct joint research in scientifically excellent networks within BioSC as well as with academic and industrial partners outside it.

The aim of BioSC projects is the resource-conserving, sustainable production of foodstuffs, plant biomass, energy, chemicals, pharmaceuticals, and materials on the basis of biological raw materials, products, processes, and principles, while taking economic and social processes into account. At the same time, the necessary conditions will be created for training a new generation of experts and skilled professionals who will work interdisciplinarily and conduct research at the interface between science and industry. BioSC has been funded by the state of North Rhine-Westphalia as a state strategy project since 2013.

BioSC researchers from Forschungszentrum Jülich and RWTH Aachen University are currently collaborating with eleven other partners from research and industry in the collaborative AUFWIND project, in which they are investigating the suitability of biomass made from microalgae as a basis for the production of kerosene. AUFWIND, which focuses on the economic efficiency, sustainability, and demonstration of algae production and its conversion to aviation fuel, is supported by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) and coordinated by Forschungszentrum Jülich. In AUFWIND, BioSC researchers analyse the feasibility of the entire value-added chain from economic and ecological viewpoints. The aim is to develop a sustainable process, from the production of algae right up to the finished product – a biogenic fuel.

Geoverbund

The aim of Geoverbund ABC/J is to establish large collaborative projects which will explore the dynamics and changes in the Earth-human system with respect to terrestrial systems and to intensify joint research and training in the region by improving direct cooperation between geoscientific institutes at RWTH Aachen University, the University of Bonn, the University of Cologne, and Forschungszentrum Jülich.

National partnerships

Meeting the challenges posed by climate change, the transformation of the energy sector, and global food shortages requires considerable research efforts that can only be achieved through collaboration between several research institutions. For this reason, Forschungszentrum Jülich also participates in a number of national collaborations in these areas.

Energy collaborations

The federal government's joint funding initiative Energy Storage supports technological breakthroughs that cut costs and promote rapid market introduction. The programme focuses on two principal elements: the first is wind and hydrogen, and the second is batteries. Within the EKOLYSER project on wind-hydrogen coupling, which began in 2012, cost-effective and sustainable materials are being developed for proton exchange membrane (PEM) electrolysis for the production of hydrogen from renewable energies. EKOLYSER is coordinated by Forschungszentrum Jülich in cooperation with the Max Planck Institute for Chemical Energy Conversion and industrial partners FuMA-Tech, SolviCore, and Gräbener Maschinentechnik. The project aims to launch PEM electrolysis technology on the mass market, realistically after 2020. To this end, new types of membranes will be developed. In addition, the use of platinum group metals, which are generally employed today for catalytic reactions, will be reduced and ideally completely replaced. During the period under review in this report, various measurement and characterization techniques for mem-

branes, catalysts, catalyst-coated membranes (CCMs), and metallic separator plates were put in place and developed in 2012. In 2013, the first promising catalysts were identified that reduce the catalyst loading of CCMs with no performance loss.

To optimize thin-film solar modules, 18 leading industrial and research partners have joined forces in an EU Fast Track project. Thin-film solar modules are an inexpensive and versatile alternative to solar cells made of crystalline silicon. The aim is to produce a marketable prototype with an efficiency of 12 % by 2014. The project is coordinated by Forschungszentrum Jülich and will receive funding of € 9.3 million from the EU.

The success of renewable energies depends partly on solving the problem of storage, as current technology has not yet been sufficiently developed to help electric vehicles achieve the same range as current petrol or diesel cars. This requires lithium batteries with a higher energy density, but these are not yet available. The project Materials and Components to Meet High Energy Density Batteries (Meet HiEnD) aims to change this. The goal of the project, which was launched in October 2012, is to develop new materials for the coming generations of lithium batteries. In addition to its scientific objectives, one of the project's main purposes is to establish an information and training platform. This will enable results to be put to use quickly. Activities for optimizing lithium batteries focus on the areas of lithium metal anodes, ion-conducting protective coatings, high-voltage cathode materials, and cathodes with 3D structures. Further topics addressed in the project include the fast charging capability of materials and the development of safer electrolytes for next-generation batteries. Component development is supported by industry. The project, which will run until 2015, is coordinated by the University of Münster's battery research centre MEET. RWTH Aachen University, Forschungszentrum Jülich, Karlsruhe Institute of Technology, and Mie University in Japan are some of the other institutions involved.

The joint project METPORE II examines the capture of carbon dioxide from flue gases using ceramic membranes, with the aim of storing carbon dioxide more efficiently in the CCS process. This strategy for capturing CO_2 from gas mixtures can in principle also be applied to other processes such as biogas treatment. The Institute of Energy and Climate Research and the Central Institute of Engineering, Electronics and Analytics at Forschungszentrum Jülich, as well as Helmholtz-Zentrum Geesthacht, Karlsruhe Institute of Technology, and numerous industrial partners, are working together to derive design strategies for optimized membranes.

Helmholtz Interdisciplinary Doctoral Training in Energy and Climate Research (HITEC) is a Helmholtz graduate school of Forschungszentrum Jülich and five partner universities in Aachen, Bochum, Cologne, Düsseldorf, and Wuppertal focusing on energy and climate research. PhD students at the Institute of Energy and Climate Research and the partner universities acquire the expertise and the methodological and communication skills necessary for scientific work of the highest international level. Furthermore, HITEC provides well-founded interdisciplinary know-how on the scientific, technical, and social dimensions of energy and climate, such as the complex relations between the energy supply and its impact on climate change.

Plant sciences

Plant sciences are a key pillar of bioeconomy research at Forschungszentrum Jülich. Through its participation in joint research projects, Jülich is involved in basic scientific investigations aiming to provide solutions to global challenges in plant breeding.

Current global developments pose new challenges for modern plant sciences that can only be addressed by finding innovative solutions and combining expertise, both within and outside of conventional cooperation networks. Forschungszentrum Jülich, the Leibniz Institute of Plant Genetics and Crop Plant Research Gatersleben (IPK), and Helmholtz-Zentrum München – German Research Center for Environmental Health (HMGU) joined forces to create a strong alliance in the German Plant Phenotyping Network (DPPN). Since 2013, they have been working together to develop new concepts and technologies for phenotyping, uniform phenotyping standards, a more productive and efficient infrastructure, and a tested, sound portfolio of phenotyping approaches.

Possible applications range from the identification of gene-function relationships in basic research to support for applied plant breeding. DPPN aims to quantify the structure and function relationships of plants in relation to development and environmental factors. The relationship between a plant's genes, environment, and phenotype determines its structure, its function, and how efficiently it uses resources. Understanding this relationship is essential for meeting future challenges in the areas of food supply, plant resources and materials, climate change mitigation, and energy supply.

CROP.SENSe.net, the competence network for phenotyping research, is coordinated by Forschungszentrum Jülich and the University of Bonn, who work together with a large number of partners from science and industry to develop and use non-destructive methods for the qualitative and quantitative determination of plant characteristics in plant breeding and inventory management. The latter encompasses all of the steps from sowing to harvesting that help to achieve optimal productivity. Research activities concentrate on the use of sensors and sensor combinations for determining plant properties with temporal and spatial resolution, including the non-invasive imaging of root and shoot growth and the identification and quantification of leaf diseases. Another focus is the testing and adaptation of sensor technology for the high-resolution detection of soil properties and site characterization as well as the development of practical applications for increasing efficiency in plant breeding, crop research, and precision agriculture.

International partnerships

Global challenges cannot always be addressed on a local level. Dealing with these challenges often requires capacities, infrastructure, and know-how that can only be made available in collaborations between several partners. Forschungszentrum Jülich attaches great significance to its position as part of an international research network, and contributes its expertise to a large number of projects. Jülich is involved in a total of 155 EU projects approved as part of the EU's Seventh Framework Programme for Research, in research fields such as medicine, bioeconomy, nanomaterials, energy, and environment.

Human Brain Project

The Human Brain Project (HBP), with its budget of over € 1 billion, is one of the flagship projects of the EU programme Future and Emerging Technologies. It pools European scientific expertise with the aim of simulating the human brain on a supercomputer of the future in order to understand it on all levels – from the molecular level up to the interplay of entire regions of the brain.

The project brings together researchers from more than 80 scientific institutions in 23 countries. A key role is played by Forschungszentrum Jülich and its research partners in the region – the Jülich Aachen Research Alliance (JARA), the universities of Düsseldorf and Wuppertal, and the German Research School for Simulation Sciences (GRS) – in the areas of supercomputing and the neurosciences.

HPB is made up of thirteen subprojects – and Forschungszentrum Jülich is actively involved in six of these. Moreover, Jülich leads the subprojects Strategic Human Brain Data and High Performance Computing Platform.

For example, Jülich experts and their cooperation partners are developing both new supercomputers that will be able to perform more than a quintillion arithmetic operations per second (exaflop/s) as well as suitable software. Such computers are needed to process the huge amounts of data on the brain that are available worldwide, and they will play an important role in achieving new findings. A dedicated supercomputer will be installed by 2020.

In this way, Jülich researchers hope to obtain new information on the structure and function of individual neurons, entire neuron clusters, and large networks. The aim is to create a virtual human brain that maps the spatial organization of the brain from the molecular level right up to the complex system of functions – a multi-modal brain atlas that will serve as HBP's navigation system.

Within HBP, research will also be conducted at the interface between medical research and simulation technology. Part of this work will focus on the processes in the brain or, in other words, the activity of neurons and the communication between them. Understanding the principles governing how the human brain works will help scientists to combat disease and develop even more powerful and extremely energy-efficient computers. After all, for its highly complex information processing the brain requires less energy than a 30-watt incandescent bulb.

Supercomputers

In performance tests in November 2012, Jülich's new supercomputer JUQUEEN with its configuration of 24 racks at that time achieved a theoretical peak performance of 5,033 petaflop/s and a LINPACK benchmark performance of 4,141 petaflop/s. JUQUEEN was expanded to 28 racks in gradual stages from 2012 until early 2013, increasing its peak performance to 5.9 petaflop/s. About 200 research teams are granted access to one of the Jülich supercomputers each year, and only a fraction of them have access to JUQUEEN. In principle, researchers all over Europe can make use of the Jülich supercomputers; however, five to seven times more applications are received than the computing time available.

In 2012, Forschungszentrum Jülich joined forces with Argonne National Laboratory (ANL) in the USA to form a supercomputing collaboration. Together, the two research partners will look for pathways to exascale computing. The two institutions have laid plans for an exchange programme as well as a joint young scientists programme.

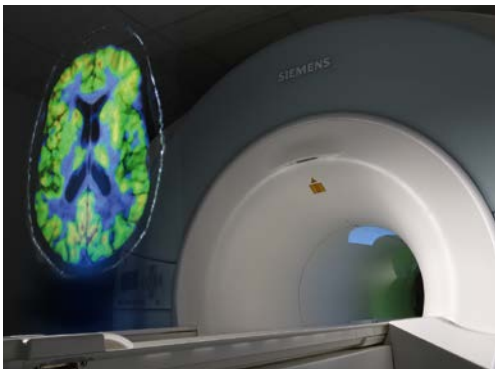
2012 also saw the launch of a supercomputing cooperation with China's National Supercomputing Centre in Tianjin and the Computer Network Information Center of the Chinese Academy of Science (CNIC) in Beijing. The first trilateral workshop entitled Changes with CNIC and the University of Illinois took place at Jülich in September, and brought together supercomputing experts from Europe, China, and the USA.

Bioeconomy: LABEX

In 2012, Forschungszentrum Jülich began setting up the "LABEX Germany in Brazil" laboratory at EMBRAPA, Brazil's largest agricultural research company. The partners develop joint research projects in the areas of agriculture, plant phenotyping, and bioinformatics. Brazil is one of the most important countries for the bioeconomy.

Cooperation with industry

Forschungszentrum Jülich frequently collaborates with the private sector and with industry at early stages of research. A large number of companies are thus partners in large-scale research projects and help to develop marketable infrastructures or industrial applications.



9komma4

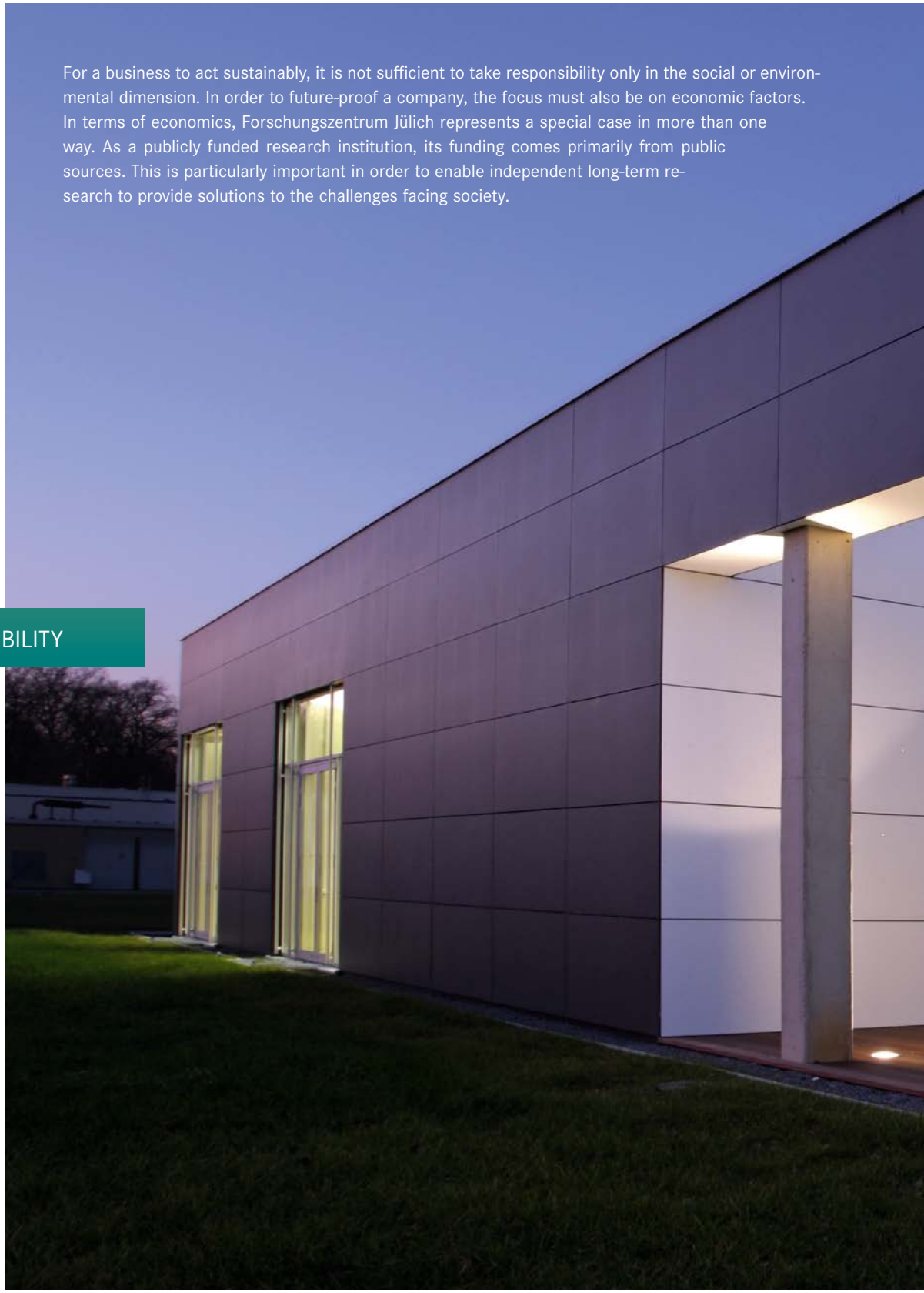
An insight into the human brain – without anaesthetic or scalpel, but more detailed than ever before: this is made possible at Jülich's Institute of Neuroscience and Medicine using a unique device not available anywhere else in the world. The device combines a 9.4-tesla magnetic resonance imaging scanner (MRI) with an integrated positron emission tomography scanner (PET). This combination enables Jülich scientists to develop new techniques for diagnosing and treating neurological brain diseases.

The 9komma4 device provides images of the human brain with a previously unobtainable resolution. The MRI technique visualizes the tissue of the brain. The simultaneous PET analysis makes the metabolism in the cells visible by means of a very weak radioactive substance. The magnetic field of the MRI scanner has a field strength of 9.4 tesla, making it up to six times higher than conventional MRI devices.

EFFESYS

From 2009 to 2012, together with industrial partners such as Airbus (formerly EADS) and Diehl Aerospace GmbH, Forschungszentrum Jülich developed fuel cell systems that enable energy to be converted and water and inert gas to be produced on board aircraft using a single system. This makes water tanks, conventional turbine-powered auxiliary power units (APUs), and fuel tank inerting systems (FTIS) superfluous and allows generators and batteries to be downsized. These measures reduce fuel consumption, increase the overall efficiency of an aircraft, and enable the low-emission operation of aircraft on the ground. From an economic perspective, cost-intensive airport equipment such as that required for refilling water tanks would no longer be necessary. Furthermore, eliminating the above-mentioned systems is expected to cut the costs of purchasing, maintaining, and operating aircraft. The project was successfully brought to a close during the period under review in this report. At the end of the project, an integrated fuel cell system with an electrical output of five kilowatts was demonstrated effectively.

For a business to act sustainably, it is not sufficient to take responsibility only in the social or environmental dimension. In order to future-proof a company, the focus must also be on economic factors. In terms of economics, Forschungszentrum Jülich represents a special case in more than one way. As a publicly funded research institution, its funding comes primarily from public sources. This is particularly important in order to enable independent long-term research to provide solutions to the challenges facing society.




Economic scope
Research spending

Economic Responsibility

For a business to act sustainably, it is not sufficient to take responsibility only in the social or environmental dimension. In order to future-proof a company, the focus must also be on economic factors. In terms of economics, Forschungszentrum Jülich represents a special case in more than one way. As a publicly funded research institution, its funding comes primarily from public sources. This is particularly important in order to enable independent long-term research to provide solutions to the challenges facing society.

Research spending

Subsidies from the Federal Republic of Germany and the Federal State of North Rhine-Westphalia make up the largest part of Forschungszentrum Jülich's income. In addition, Jülich also receives third-party funding from industry, project funding from federal and state ministries, and research funds from the European Union.

At the time this Sustainability Report went to press, only the data for 2012 had been verified. The year 2013 will be covered in the next report.

Balance sheet 2012 (millions of €)

Assets	2012	2011
A. Fixed assets	**510.4**	**465.9**
I. Intangible assets	3.4	2.8
II. Tangible assets	506.8	462.9
III. Financial assets	0.2	0.2
B. Current assets	**852.8**	**806.3**
I. Inventories	39.9	37.2
II. Accounts receivable and other assets	30.9	21.6
III. Government equity to balance the books	760.6	708.2
IV. Cash on hand and on deposit with Deutsche Bundesbank, deposits with credit institutions, cheques	21.4	39.3
C. Accruals and deferrals	**13.6**	**25.3**
Total assets	**1,376.8**	**1,297.5**

Liabilities	2012	2011
A. Equity capital	**0.5**	**0.5**
B. Special items for subsidies	**585.9**	**543.3**
I. on fixed assets	509.9	465.4
II. on current assets	76.0	77.9
C. Provisions	**725.5**	**698.2**
I. Decommissioning and disposal of nuclear installations	432.2	452.5
II. Pensions and miscellaneous	61.6	57.1
III. Provisions for taxation	231.7	188.6
D. Accounts payable	**63.8**	**54.9**
E. Accruals and deferrals	**1.1**	**0.6**
Total liabilities	**1,376.8**	**1,297.5**

Profit and loss account

The profit and loss account compares the revenues and expenses of Forschungszentrum Jülich. The difference normally corresponds to the company profit or loss. In the case of Forschungszentrum Jülich, the partners are obliged to balance the books. Like institutional funding, this extra revenue is part of the additional subsidies. The profit and loss account is therefore always balanced. Forschungszentrum Jülich generates significant revenue through project management activities, a large number of research and development projects, and the provision of research facilities. The remaining operating income mainly consists of income from the provisions put aside for the decommissioning of nuclear facilities.

For the profit and loss account in a tabeluar form see Appendix, p. 121

Research funding

In 2012, the revenue of Forschungszentrum Jülich was approx. € 550 million. Some € 384 million, which corresponds to 69 %, was subsidies from the Federal Republic of Germany and the Federal State of North Rhine-Westphalia. These funds were available to cover expenses, i.e. running costs and investments. They also included € 66.1 million for dismantling projects. When income from the provisions put aside for the decommissioning of nuclear facilities is added to this figure, subsidies from the federal and state governments amounted to around € 428 million. Third-party funding acquired by Forschungszentrum Jülich accounts for € 172 million or approximately 31 % of overall revenue. In comparison to 2011, this is an increase of almost € 12 million. Most of this third-party income resulted from research and development activities for industry, the acquisition of funding from Germany and abroad, plus project management on behalf of the Federal Republic of Germany and the Federal State of North Rhine-Westphalia. This proportion of third-party funds illustrates the sustainable benefit that society and economy receive from Jülich research. The third-party funding acquired by the centres involved in the research programme Renewable Energies decreased by 31 % in 2012, from € 42.7 million to € 29.5 million. The main reasons for the much higher third-party funding available in 2011 were the investment projects Solar Tower Jülich, amounting to around € 7.5 million, and funding to the tune of € 5.8 million for the second construction phase for Bioliq (entrained flow gasifier). Since these were one-off items, third-party funding in 2012 was back on the level of 2009 and 2010.

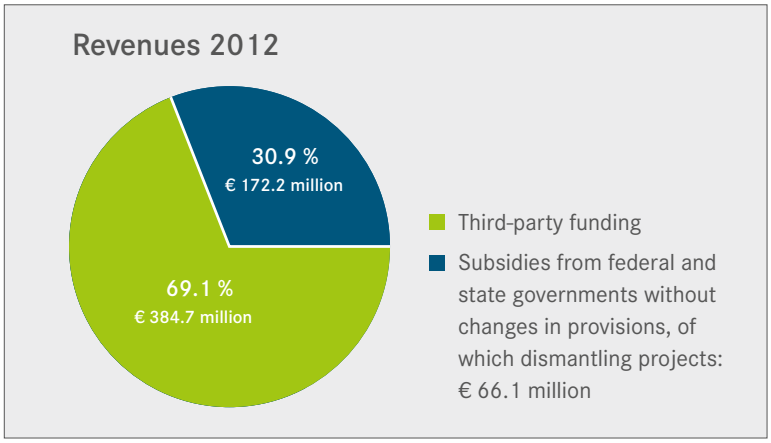
Other outstanding examples of third-party funding acquired include the EU projects Treatment and Disposal of Irradiated Graphite and other Carbonaceous Waste (CARBOWASTE), Global Monitoring for Environment and Security (GMES), and Actinide Recycling by Separation and Transmutation (ACSEPT), as well as the VESPA project on the behaviour and retention of long-lived fission and activation products in the vicinity of repositories for radioactive waste, which receives funding from the federal and state governments. An important external client is the Thermodynamic Database Project of the Nuclear Energy Agency (NEA-TDB). Another share of the third-party funding is acquired by the Product Quality Control Office for Radioactive Waste (PKS).

Project funding from national and international public sources (thousands of €)

2008	62,058
2009	139,785
2010	75,346
2011	91,757
2012	**86,674**

DFG project funding (thousands of €)

2008	2,813
2009	3,297
2010	4,166
2011	5,472
2012	**6,592**



Business plan determines funding requirements

Since 2003, the research centres that are members of the Helmholtz Association (HGF) have been subject to the programme-oriented funding scheme. With their research programmes, the centres take part in a competition for funding within the Helmholtz Association, with the applications being evaluated by external experts from Germany and abroad. Funding is allocated according to the programmes that the Senate has recommended for funding based on the results of the evaluation and that have been approved by the funding agencies. The overall funding required by each centre is determined on the basis of the sum of programmes approved and is shown in the business plan.

Revenues in 2012 without changes in provisions (thousands of €)

	Research areas acc. to shares in HGF programmes					Total		
Area	Structure of Matter	Earth and Environment	Health	Energy	Key Technologies	Research areas	Other revenues	Total
EU funding	1,172	3,208	480	5,409	3,963	14,232	905	**15,137**
National project funding (excl. DFG)	2,162	2,617	2,104	16,104	21,674	44,661	20,284	**64,945**
of which transferred subsidies	0	168	69	530	117	884	19,752	**20,636**
DFG funding	291	1,654	81	1,207	3,294	6,527	65	**6,592**
Sum project funding						65,420		**86,674**
Contracts, abroad	14	295	1	1,191	577	2,078	319	**2,397**
Contracts, Germany	1,077	1,443	586	4,618	1,764	9,488	15,782	**25,270**
Project management organizations							57,843	**57,843**
Sum third-party funds	**4,716**	**9,217**	**3,252**	**28,529**	**31,272**	**76,986**	**95,198**	**172,184**
Subsidies from federal and state governments								**384,684**
of which dismantling projects								**66,120**
Total								**556,868**

National project funding excl. DFG (thousands of €)

Total	64,945
• from federal government	44,949
• from state government	8,640
• from other sources (in Germany)	11,356
of which	
• transferred subsidies	20,636
• national project funding excl. DFG adjusted for transferred subsidies	44,309

The lack of agreement between the figures in the profit and loss statement and the overview of revenues from third-party project funding from the EU as well as the federal and state governments as national funding agencies is due to the following reasons:

The total sum of EU funding (€ 15,137,000) under "Revenues" includes work in progress amounting to € 968,000 in the sum of all fields. The deduction of this work results in the rounded item (€ 14,168,000) in the profit and loss statement under "Third-party project funding from EU".

The total national project funding from the federal and state governments and other sources (in Germany, not including DFG funding) amounts to € 64,945,000. In the profit and loss statement, the sum includes the individual items of the federal government, the state government, and others (see table "National project funding excl. DFG").

Total full costs of research fields according to HGF programmes

In 2012, € 348 million were spent on the research fields. These funds were distributed as follows to the individual research fields covered at Jülich.

Basic full costs (actual) per research field [thousands of €]	2012	2011
Energy	56,755	51,623
Earth and Environment	37,020	31,811
Health	28,441	26,922
Key Technologies*	100,428	81,965
Structure of Matter	48,223	48,529
Total**	270,867	240,850

Basic full costs (actual) and third-party funding per research field [thousands of €]	2012	2011
Energy	85,284	83,363
Earth and Environment	46,237	42,070
Health	31,693	28,840
Key Technologies	131,700	102,340
Structure of Matter	52,939	52,607
Total	347,853	309,220

* In 2012, biotechnology is subsumed under the research field of Key Technologies, which is not the case for 2011.

** This sum across research fields does not include performance category IV (special tasks).

Operating expenses and investments

Forschungszentrum Jülich invests a share of its income in the infrastructure on campus and at other European locations in which it is involved. Another share includes salaries paid to employees as well as investments in early-career scientists, who are one of the critical success factors of Forschungszentrum Jülich.

Maintenance of buildings and technical facilities

The outdated technical installations, such as ventilation, heating, lighting, and water supply and disposal in a total of more than 10,000 facilities increasingly pose financial, energetic, and technical challenges. The lack of modernization in existing buildings leads to higher maintenance costs and expenses for emergency and ad hoc repairs. The focus is shifting more and more towards security of supply and operational safety: € 4 million was spent for these purposes during the period under review.

In 2012, a total of approx. € 7.7 million was made available and disbursed for building maintenance measures, of which € 4.7 million was spent by Planning and Building Services on buildings, large-scale measures for the technical equipment of buildings, and infrastructure measures. About € 3 million was spent by Building and Property Management for relatively small technical equipment measures.

The funding made available is not nearly enough to carry out all the necessary repairs. The considerable backlog of essential modernization measures cannot be reduced effectively with the funds available to cover operating expenses. Instead, repairs are more frequently necessary due to the increasing age of the buildings and technical equipment, which in turn increases costs for ongoing maintenance. The estimated costs for the modernization of existing buildings on the Jülich campus to clear this backlog amount to more than € 300 million. As part of an urban development master plan, concepts are therefore being developed for gradually reducing the modernization backlog over the coming years.

Construction measures in the nuclear liabilities area

Construction measures for the expansion of the weatherproof shelter for containers with low-level radioactive waste were completed at the end of 2011. It was put into operation in early 2012. The REBEKA expansion with facilities for conditioning waste for final disposal was largely completed in 2012, and final acceptance took place in the first quarter of 2013. Cold commissioning of the plant then got under way.

European research infrastructures

Every year, Forschungszentrum Jülich invests in European research projects. The total volume as well as annual instalments are listed in the progress report of Forschungszentrum Jülich. In terms of these investments, a distinction is made between investments of more than and less than € 2.5 million.

Investments of more than € 2.5 million were made in the research fields of Energy, Earth and Environment, Health, Key Technologies, and Structure of Matter. These were for projects with funding running over a period of several years. For example, € 1.9 million was made available for the extension of the hydrogen laboratory and € 1.7 million was

spent on a new laboratory wing for the PET Centre in 2012. The installation of a new supercomputer costing € 14.5 million was the major investment at Forschungszentrum Jülich in 2012. In total, funds spent on investments of more than € 2.5 million amounted to € 32.7 million in 2012. Of these, 23.96 % was for infrastructure measures.

Annual spending on investments of less than € 2.5 million was € 51 million in 2012. Here, only 4.64 % were spent on infrastructure measures.

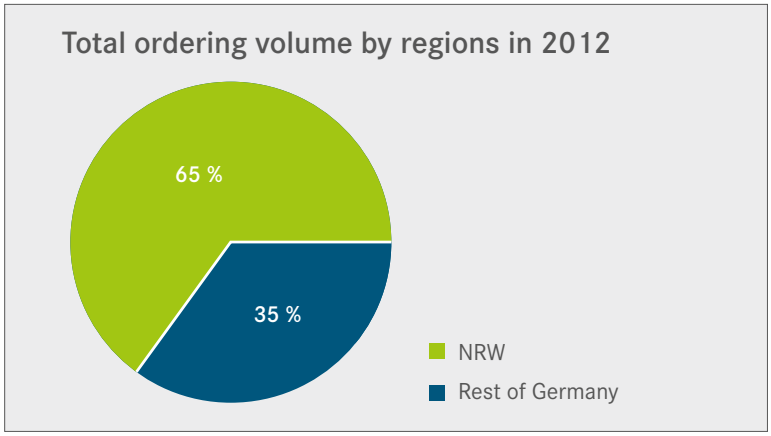
Investments 2012	Planned investments from basic funding (total period)	Actual spending 2012
Investments > € 2.5 million	Spending (thousands of €)	thousands of €
Research field Energy	**16,650**	**1,912**
Expansion of hydrogen laboratory	2,600	123
Membrane centre	10,420	1,525
Fuel Cell Laboratory	3,630	264
Research field Earth and Environment	**18,600**	**1,402**
ATMONSYS	3,300	530
Expansion of mobile platforms	3,300	548
TERENO (incl. MOBTOP)	12,000	234
HALO		90
Research field Health	**23,150**	**1,763**
New facility for small animals	4,500	0
PET Centre	12,275	1,763
Cyclotron replacement	6,375	0
Research field Key Technologies	**25,300**	**26,682**
Helmholtz Nanoelectronic Facility HNF I	25,300	12,177
Highly scalable supercomputer	[1]	14,505
Research field Structure of Matter	**9,610**	**972**
Neutron scattering instruments at FRM II	9,610	972
Total spent on investments > € 2.5 million	**93,310**	**32,731**
Share of investments in % > € 2.5 million	**34.10**	**23.96**

1) The Karlsruhe Institute of Technology is responsible for application and approval.

Personnel expenses

Important expenditure by Forschungszentrum Jülich in 2012 also includes the salaries of the employees. The employees of Forschungszentrum Jülich are paid according to the Collective Agreement for the Public Service. Personnel costs in 2012 totalled € 255.8 million, of which € 179 million was accounted for by employees with a permanent contract and almost € 6 million by salary grade C4 and W3 professorships. This means that around 51 % of the overall operational expenses are spent on employees with a permanent contract.

Forschungszentrum Jülich supports its employees by contributing to the civil-service supplementary pension scheme through the pension institution of the federal and state governments (VBL). Agreements between VBL and Forschungszentrum Jülich stipulate that insurance for a supplementary pension is taken out for all employees who would be eligible for insurance under the relevant collective agreement for the civil service ("Tarifvertrag über die betriebliche beziehungsweise zusätzliche Altersvorsorge des öffentlichen Dienstes"). The scheme is based on the principle of shared financing between employer and employee and since 1 January 2002 amounts to a total of 7.86 % of the gross salary. The entitlement to a company pension also includes a pension for surviving dependants and limited incapacity benefits.



Spending for materials

Forschungszentrum Jülich spends considerable sums on running the campus and the research activities of its employees. Purchases are made by the organizational unit Purchasing and Materials. In 2012, 65 % of the purchases were realized within North Rhine-Westphalia (NRW), the federal state where Forschungszentrum Jülich is located. Of total purchase orders, 13 % were placed with companies in the home district of Düren. By placing orders primarily in North Rhine-Westphalia, Forschungszentrum Jülich has an immediate economic impact on the region.

Spending in the public interest

During the period under review, spending on support for young scientists was of particular public interest. One of the priorities was support schemes for girls and young women. For example, "Girls' Day" took place at Forschungszentrum Jülich in April 2012. This was an opportunity for 28 girls to learn about scientific and technical professions. Special cooperations, such as with the local girls' secondary school (Mädchengymnasium Jülich) are intended to jump-start girls' and young women's interest in science, technology, engineering, and mathematics. About 4,500 children and young adults visited Forschungszentrum Jülich in 2012, of whom more than 1,000 were school students who came to Jülich on visits organized by Corporate Communications' Visitor Service.

Another highlight in the area of support for young scientists was the opening of the extension building for the JuLab Schools Laboratory in September 2013. In the construction phase lasting two years, seminar rooms and laboratories were built on three floors with a floor space totalling 690 m^2. They will be used to promote school students' enthusiasm for mathematics, physics, and technology. The construction costs for the JuLab extension were € 2.1 million. Apart from trying to make a widespread impact, JuLab is also actively supporting individual young talents, for example by hosting the annual regional heat of the "Jugend forscht" competition and organizing holiday programmes for particularly gifted children and young people. In addition to support for young talent, the further development of activities for combining a family with a

career were also in the focus of public interest. As part of the “berufundfamilie” re-audit, a number of measures were taken in the period under review to improve the work-life balance of employees. On the one hand, a concept was developed for testing ad hoc teleworking in a pilot project and a survey was conducted to determine childcare requirements at Forschungszentrum Jülich. On the other hand, two rooms for parents and children that can be used in childcare emergencies were opened in March 2012 and October 2013, respectively. In addition, new options for further training have been made available that enables employees to learn at a time and place of their choosing, and more information has been made available for those who look after a relative requiring care.

In parallel, teleworking was pursued further, as it is an important instrument helping employees to combine a family with a career. At the moment, about 200 home offices have been equipped for employees of Forschungszentrum Jülich.

The activities of Forschungszentrum Jülich’s Sports Association (BSG) are also of public interest. It provides its approximately 2,200 members with diverse sports and leisure activities under modern conditions. As the largest association in the Düren district, BSG covers almost all areas of popular sport in more than 50 sports groups, including, for example, swimming for children, fishing, and weight training, as well as aikido and zumba. BSG also regular participates in and organizes international sports meetings with other European research institutions. In 2013, BSG celebrated its 50th anniversary.

BSG is not only open to employees of Forschungszentrum Jülich. Anyone interested can become a member.

Economic scope

The exploitation of knowledge is a direct consequence of Forschungszentrum Jülich’s guiding principles and its Articles of Association and therefore plays an important role in its corporate strategy. Forschungszentrum Jülich’s mission is therefore to cooperate with science and industry and to disseminate knowledge.

The exploitation strategy aims to secure research findings and strategically important fields by means of protective rights in order to keep options open for their use in house and in joint research with third parties. This is the basis for exploiting research results in the form of licences and cooperations and acquiring additional third-party funding. This funding is used to support early-career scientists and spin-offs.

This exploitation strategy is based primarily on scientific excellence, which is illustrated by the large number of scientific publications produced by Jülich researchers every year. Research awards also testify to the outstanding quality of the scientists working at Forschungszentrum Jülich. The visibility of these achievements in the media and in industry is a cornerstone of the acquisition of third-party funds and has therefore a positive economic impact on Forschungszentrum Jülich.

In addition, Forschungszentrum Jülich also has an impact on the regional economy, both through its strategy of preferably purchasing in the region as well as the employment effect and therefore the salaries it pays. By developing solutions to challenges facing society, e.g. dementias, Forschungszentrum Jülich can also help to reduce burdens on the social security system.

Research is our product – technology transfer

Technology Transfer's activities in 2012 and 2013 continued to focus on the further expansion of economic relations with the aim of successfully marketing Jülich's know-how.

Forschungszentrum Jülich is also regularly involved in the Innovation Days conference and the Research Days that take place several times each year. Since 2012, Innovation Days have been providing an opportunity for non-university research in Germany to showcase the best application-oriented technologies and spin-off projects. They afford an opportunity to exchange ideas between innovative scientists, technology transfer experts, as well as decision-makers in industry and the financing sector. In 2012, Forschungszentrum Jülich was invited to present its 3D Brain Segmentation Platform for Hybrid MR-PET in the area of Life Sciences Technologies. The Helmholtz Association was responsible for launching the Innovation Days series. The event, which has been taking place regularly ever since, is organized in cooperation with the Max Planck Society, the Fraunhofer Society, and the Leibniz Association. At Research Days, in contrast, scientists present the results of application-oriented research and technologies to individual businesses. The most recent event, the Helmholtz–Bayer Research Day, took place in Berlin in December 2013 and was hosted by Bayer AG. A Helmholtz–Bosch Research Day is scheduled for May 2014 at Robert Bosch GmbH in Stuttgart.

Presenting exhibits from application-oriented research topics and results from the scientific institutes at trade fairs is a tried and tested strategy of technology marketing. This affords an opportunity to spark potential industry partners' interest in Forschungszentrum Jülich's expertise and, at the same time, to showcase Jülich's work as a whole. At these events, contacts can be established with licensing and cooperation partners, and also with potential customers for services offered by Jülich. Strategic considerations play an important role in selecting suitable trade fairs: decisions are coordinated with the institutes, Technology Transfer, and the Board of Directors. In 2012 and 2013, Forschungszentrum Jülich actively participated as an exhibitor at 14 and 13 events, respectively. Four of them took place abroad in both years.

Forschungszentrum Jülich's membership in the LifeTecAachen-Jülich e. V. association ensures that it maintains close contact with the regional life sciences industry. LifeTec was founded in 2000 with the aim of pooling and strengthening activities in this area in the Jülich–Aachen region. The association's main task is to enable access to complementary know-how by encouraging close cooperation between universities, institutes, and industrial partners of all sizes. The head of Technology Transfer at Forschungszentrum Jülich currently chairs the association.

Jülich also maintains close contact with the chambers of industry and commerce in the region. For example, it is an active member of GründerRegion Aachen. Other members include the universities in the region, the Aachen Chamber of Trades, the Aachen Chamber of Industry and Commerce, the districts of Düren, Heinsberg, and Euskirchen, as well as StädteRegion Aachen (an association of local authorities), and regional savings banks. Forschungszentrum Jülich is also a member of the Cologne transfer meeting, a network of technology transfer institutions of the regional universities, research institutions, savings banks, chambers of industry and commerce, and chambers of trade.

On the international level, Forschungszentrum Jülich cooperates closely with the Helmholtz Office in Beijing. Furthermore, possibilities of technology transfer to India were explored together with a representative of Forschungszentrum Jülich in Mumbai during the period under review. As of January 2014, these activities were transferred to Delhi. Opportunities for marketing Jülich's research findings are also being sounded out in the USA with the support of TreMonti, a consultancy agency for technology marketing.

Licensing plays an important role in the commercialization of research findings. Individual licensing agreements allow industry to obtain the rights of use to research findings of Forschungszentrum Jülich in the form of protective rights, copyrights, and know-how. Companies can thus gain a competitive edge in the market or the opportunity to open up new markets. Technology Transfer offers advice and support in this area for potential licence holders and interested companies. Through licensing agreements, industry and commerce make use of nearly 30 % of the patents held by Forschungszentrum Jülich. In 2012, Forschungszentrum Jülich filed 47 patents in Germany and 36 abroad. Forschungszentrum Jülich was granted 82 patents in 2012. The total number of protective rights held by Jülich at the end of 2012 was 16,892. The income from licences was roughly € 1.12 million.

The scientific institutes of Forschungszentrum Jülich as well as the numerous specialized infrastructure divisions and workshops equipped with unique technology offer interested companies a wide range of different high-tech and highly specialized scientific and technical services and contract work.

Patent applications and patents granted 2012

Patent applications Germany	47
of which priority applications	45
Patent applications abroad	36
of which priority applications	3
Total patents granted	82
of which technologies for which a patent was granted for the first time	25
Patents granted Germany	12
Patents granted abroad	70
Total number Protective rights 2012	**16,892**

Number of licences 2012

Total number	100
of which new	6
of which expiring	18
Total share abroad	31
Share USA (most important partner country)	12
Share SMEs	69
Income from licences 2012	**€ 1.12 million**

Third-party-funded BaSiGo project – simulating large crowds

The BaSiGo project aims to improve our understanding of the behaviour of large crowds of people at public events. For this purpose, Forschungszentrum Jülich is carrying out laboratory experiments as well as simulations of the movements of individuals at large-scale events. Its goal is to develop a computer-assisted planning tool for organizers, local authorities, and law enforcement services. The project is coordinated by the University of Wuppertal and is part of the Research for Civil Security programme. This priority programme is being funded with a total of some € 20.2 million by the Federal Ministry of Education and Research. Industry is also making available funding to the tune of € 4.3 million for the six collaborative projects in the programme.

In 2012 Forschungszentrum Jülich obtained third-party funds to the amount of € 172.2 million. The majority of these funds resulted from research and development activities for industry, the acquisition of public funding from Germany and abroad, plus project management on behalf of the Federal Republic of Germany and the Federal State of North Rhine-Westphalia. The research field of Key Technologies received the most third-party funds in 2012: around € 31 million. As the central third-party funds unit, Technology Transfer assists the institutes at Forschungszentrum Jülich in all administrative procedures relating to nationally and internationally funded projects as well as commissions from third parties.

The Bio.NRW Office, operated by Forschungszentrum Jülich on behalf of the Ministry of Innovation, Science and Research of the State of North Rhine-Westphalia, is also of great significance. The German biotechnology cluster BIO.NRW aims to promote cooperation and networking between different actors in the biotechnology sector – research, industry, investors, and politics on the state, national, and international levels.

Project Management Jülich is the project management organization with the highest turnover in Germany. It coordinates research and innovation funding programmes in the areas of bioeconomy and life sciences, energy, materials technologies, environment and sustainability, climate protection, marine and polar research, navigation and marine technology, technology transfer and start-up companies, as well as regional technology platforms and clusters. It works on behalf of several federal ministries, including the Federal Ministry of Education and Research, as well as numerous federal states and the EU Commission. In 2012, Project Management Jülich had a turnover of € 1.24 billion in research funding and approved 5,000 research projects.

Validation projects are another pillar of research commercialization. In cooperation with companies in the respective field, findings are examined to determine their potential for concrete applications and business models. Such projects are chiefly financed by validation funds, such as Forschungszentrum Jülich's technology transfer funds, the Helmholtz Validation Fund, or the Federal Ministry of Education and Research's VIP validation fund for the validation of the innovation potential of scientific research. Validation can lead to licensing agreements or initiate spin-off companies. Interested scientists at Jülich are supported by the Business Development team at Technology Transfer.

Technology transfer of a non-destructive analytical technique – Detecting valuable materials in electronic waste

One of the most promising spin-offs in 2012 and 2013 is based on a technology developed at the Institute of Energy and Climate Research in cooperation with RWTH Aachen University. It is a non-destructive method for analysing the content of drums with low-level radioactive waste by means of neutron radiation. The measuring technique developed for this purpose can also be used to determine the content of noble metals in electronic waste. Wet-chemical sample preparation, the method currently used in the recycling industry, requires a lot of staff, time, chemicals, and energy, not to mention the complicated sampling procedure. This is done away with by the Jülich method. Instead, it would allow waste to be analysed automatically on a conveyor belt for valuable materials. The recycling industry has already expressed interest.

For promising technologies developed at Jülich that are still in an early stage of exploitation, Technology Transfer organizes round table meetings. These meetings identify potential areas of application and markets in conjunction with representatives from science and industry. Internal and external experts from research and industry are invited to these events in order to identify the most important fields of application as well as relevant framework conditions for successful marketing. In 2012 and 2013, round tables were organized to discuss possible applications for porous titanium with participants from materials research, orthopaedics, surgery, and biomaterials research, and applications of scanning tunnelling hydrogen microscopy with experts in biophysics, materials research, and organic electronics. Other events are being planned in cooperation with the institutes.

As regards spin-offs, Forschungszentrum Jülich is a sponsor of the GründerRegion Aachen support organization for new businesses and works closely with regional actors. Together with Jülich Technology Centre, a concept for a business incubator was developed in 2012 with a view to reducing the barriers for budding entrepreneurs. The first step in setting up a spin-off company may be taking part in a business competition. This is why Technology Transfer supports business plan competitions by evaluating submitted business plans.

Presentation of research results as a basis for collaboration and the acquisition of third-party funding

The quality of work is not the only decisive factor for Forschungszentrum Jülich's success. An adequate communication of its achievements is no less essential. This is realized through scientific publications that expand the expertise of Forschungszentrum Jülich and open up new opportunities for cooperation, the communication of achievements and awards through the media, and lectures and presentations to acquire more third-party funding.

Publications

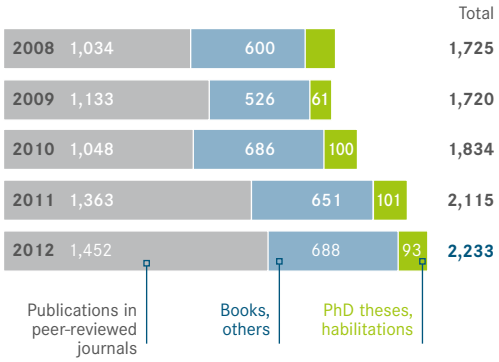
Publications in specialized media or in books and dissertations are among the most important indicators of scientific success. Whether in printed or electronic form: they are a key parameter for measuring the visibility and quality of work. The recognition of the scientists' expertise in their respective fields on a national and international level depends upon the quality of the publications.

From 2008 to 2012, the scientists at Forschungszentrum Jülich produced some 9,600 publications in the form of articles in scientific journals, as books, or as PhD and habilitation theses. 2012 was the year with the highest number of publications: 2,233. *Physical Review B* and *Physical Review Letters* are among the journals in which Jülich scientists published most frequently. Many of the journals in which they published their results are covered by the index of the Institute for Scientific Information and therefore have the highest scientific reputation.

Journals in which Jülich researchers published most frequently in 2012 (as of 31.12.2012).

Journal	Number of publications
Physical Review B	61
Physical Review Letters	35
Applied Physics Letters	30
Atmospheric Chemistry and Physics	28
Geophysical Research Abstracts	28
PLOS one	25
Nuclear Fusion	23
Journal of Physics: Condensed Matter	23
NeuroImage	21
Nature Publishing Group	15
Science	3

Jülich publications 2008–2012



Researchers at Forschungszentrum Jülich have the opportunity to obtain a bibliometrical study analysing their own publication behaviour and presence on the market. This is a service offered by the Central Library that is able to indicate weaknesses, identify possible cooperation partners, and describe scientific networks. Bibliometrics can be used for various purposes by senior staff, funding organizations, project management organizations, companies, and journalists.

Prizes and awards

Apart from the publication of scientific results, prizes and other accolades are also important indicators of the quality of Forschungszentrum Jülich's scientific achievements. Every year, numerous Jülich scientists are honoured for their work. For example, in 2012 Prof. Katrin Amunts and Dr. Dr. Svenja Caspers from the Institute of Neuroscience and Medicine were honoured by being appointed to the German Ethics Council and the "Junges Kolleg" of the North Rhine-Westphalian Academy of Sciences, Humanities and the Arts, respectively. Dr. Dmitry A. Fedosov from the Institute of Complex Systems received the Sofja Kovalevskaja Award, one of the most valuable German science prizes, for the development of a new simulation method for blood flow. Other outstanding prize winners of 2013 include Prof. Paolo Carloni, head of Computational Biophysics at Forschungszentrum Jülich, who was appointed honorary professor by Vietnam National University, and Prof. Syed M. Qaim from the Institute of Neuroscience and Medicine, who received a medal of honour from Rajshahi University in Bangladesh. One of the 2014 prize winners has also been named: Prof. Rainer Waser from the Peter Grünberg Institute is one of the winners of the 2014 Gottfried Wilhelm Leibniz Prize.

In 2007, Jülich physicist Peter Grünberg received the most renowned science prize in the world. Together with the French researcher Albert Fert from Paris-Sud University, he was awarded the Nobel Prize in Physics. The two solid-state researchers received the prize in recognition of their discovery of the giant magneto-resistance effect (GMR). The GMR effect led to the breakthrough to gigabyte hard drives and was the foundation of spintronics as a technology of the future. As a result of the application of the GMR effect in read heads from 1997, less than ten years after its discovery, the annual increase in storage density of hard disks doubled from 60 % to almost 100 %. Peter Grünberg's research thus illustrates the significance of research at Jülich for challenges facing society.

For a table on awards and other accolades in 2013 see Appendix, p. 124

Forschungszentrum Jülich itself also awards a prestigious prize. The Jülich Excellence Prize is awarded annually to young scientists based on outstanding PhD theses at Jülich and associated scientific achievements. The prize is endowed with € 5,000 for each winner. Every year, usually up to three and in exceptional cases to up to five young scientists can be awarded the prize provided that the proposed prize winners are among the top 5 % of their peers in their respective research field. The prize is presented at the annual JuDocs event.

Presence in the public arena

Corporate Communications is responsible for Forschungszentrum Jülich's visibility for the general public and in the media. It communicates Jülich research through different channels in a manner that is appropriate to different target groups, occasions, and topics. Presence in the public arena is a prerequisite for being perceived as an excellent development partner by businesses and plays an important role in the acquisition of third-party funds.

Corporate Communications sends press releases to a press mailing list, for example on outstanding publications, awards, and excellent scientific achievements. It is also the first point of contact for questions on Forschungszentrum Jülich and strives to achieve the best press coverage possible by closely cooperating with the media.

Corporate Communications also organizes and coordinates events at Forschungszentrum Jülich. These can be used to show Forschungszentrum Jülich in a positive light in the media and attract public attention. The most important events hosted by Forschungszentrum Jülich in the period under review were the Open Day and the annual "Girls' Day". Outstanding presentations included "Bringing Social Sciences to Energy" by Prof. Dr. Steven E. Koonin, former Under Secretary of Science in the US Department of Energy, in April 2012, and the lectures at the annual end-of-year ceremonies of Forschungszentrum Jülich, which took place at the Rhineland Regional Museum (LVR-LandesMuseum) in Bonn with about 300 guests from politics, science, and industry.

Corporate Communications maintains the website of Forschungszentrum Jülich, where it makes available all important information on the campus and research at Jülich.

Forschungszentrum Jülich is aware that its scientific research and the operation of the campus have an impact on the environment. As part of its Urban Development Master Plan 2050 and in accordance with its research priorities, Forschungszentrum Jülich is determined to use energy more efficiently in the future, thus reducing emissions. Its goal is to run the campus in a manner that produces as few emissions as possible and uses all resources carefully. In order to make this possible, Forschungszentrum Jülich will rely partly on the use of its own scientific results, which can be put to the test on campus. However, Forschungszentrum Jülich does not limit itself to the careful use of resources. The waste produced by operating the campus and performing research is treated in the same manner. Jülich also strives to become active in new fields on a project-by-project basis, for example by supporting employees who commute to work in an environmentally friendly way, and by purchasing and using products produced in a sustainable manner.

Environmental Responsibility

Forschungszentrum Jülich is aware that its scientific research and the operation of the campus have an impact on the environment. As part of its Urban Development Master Plan 2050 and in accordance with its research priorities, it is determined to use resources more efficiently in the future, thus reducing emissions that affect the climate. Its goal is to run the campus in a manner that is altogether more energy-efficient and which saves CO_2 as well as to use resources carefully. In order to make this possible, Forschungszentrum Jülich will rely to some extent on the use of its own scientific results, their implementation in practical applications, and testing them on campus.

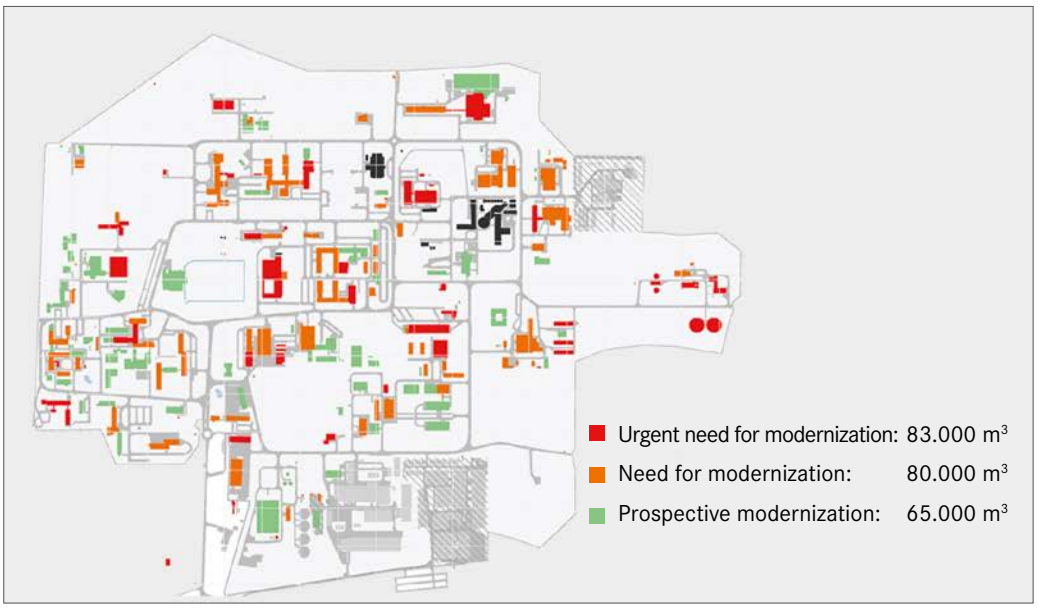
Forschungszentrum Jülich is not only planning to use resources efficiently, it is already implementing this strategy, for example in the disposal of waste from the operation of the campus and in research. Jülich also strives to become active in new fields on a project-by-project basis, for example by supporting employees who commute to work in an environmentally friendly way, and by purchasing and using products produced in a sustainable manner.

The campus of the future

The 2.2 m^2 campus of Forschungszentrum Jülich hosts scientific institutes, central facilities with large-scale facilities, and numerous different laboratories for physical, chemical, biological, and medical research. Including the administration and central infrastructure facilities, the campus accommodates 228 buildings. In addition, there are another 17 main buildings and 3 ancillary building on another property located at approximately 1.2 km from the main campus. With this infrastructure, Forschungszentrum Jülich resembles a small town.

Facts and figures (as of 31.12.2013)

Total area of Forschungszentrums Jülich	2.2 km^2
Number of buildings	228
Number of rooms	13,200
Gross building volume	2,071,135 m^3
Gross floor area	445,542 m^2
Net floor area	359,815 m^2
Structural area	83,000 m^2
Useful floor area	229,227 m^2



Existing buildings and the need for modernization 2013

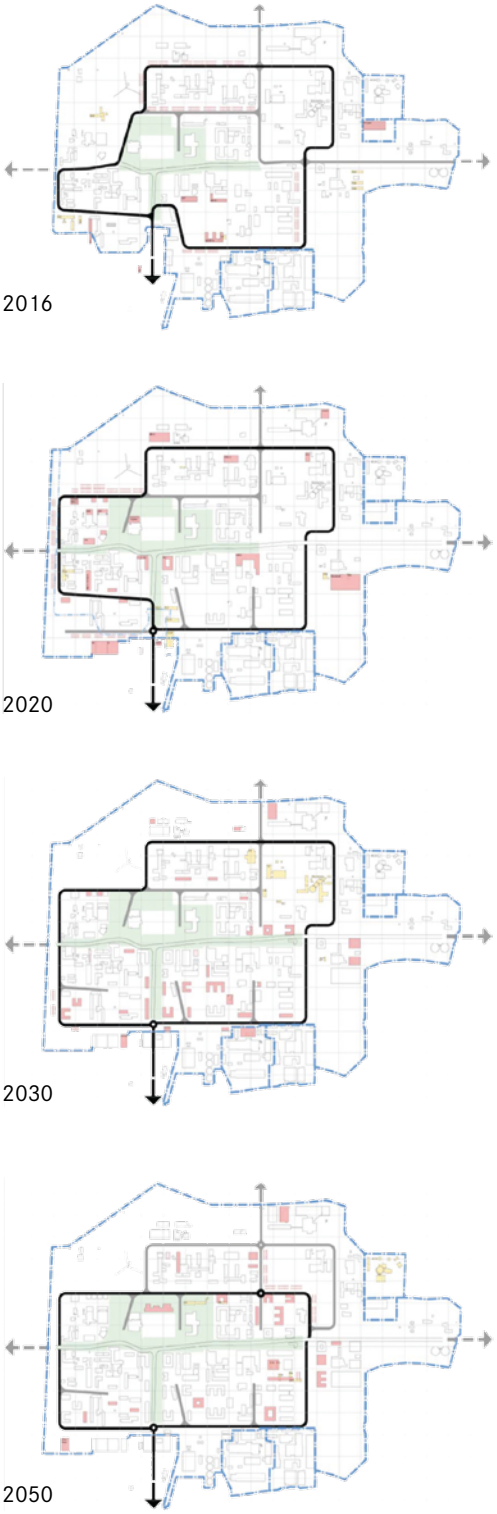
Urban Development Master Plan 2050

Forschungszentrum Jülich works towards providing comprehensive solutions to the grand challenges of our time. It also wants to show that cutting-edge research, efficient management, and sustainable use of resources are not mutually exclusive concepts. In the development of its campus, it is therefore backing solutions that have the potential to break new ground on and off campus. In 2011, Forschungszentrum Jülich started developing its Urban Development Master Plan 2050 to launch the transformation towards a sustainable and energy-efficient research centre.

As a first step, the architects and project planners at Planning and Building Services (B), supported by external experts for sustainable construction, documented the current condition of the buildings at Forschungszentrum Jülich. As a second step, the institutes were surveyed regarding their requirements for the campus and its buildings. Here, the focus was on human resource development, space requirements, changes in structural requirements, and current deficits.

These analyses and surveys predict that 39 % more space must be available for laboratories and offices by 2050 to meet demand. The state of the existing buildings is also of vital importance. This survey revealed a significant need for modernization in coming years. In addition, the Jülich employees are asking for better opportunities to meet their day-to-day needs, a company kindergarten, and better local public transport connections to Forschungszentrum Jülich.

A number of construction guidelines were developed based on the analysis of the status quo and the user surveys, taking into account the sustainability criteria defined by the German Sustainable Building Council (DGNB) and the Federal Assessment System for Sustainable Building (BNB).



Stages in the Urban Development Master Plan 2050

In addition to environmental and economic aspects, these criteria also comprise sociocultural and functional factors, the technical quality of buildings and infrastructure, as well as aspects related to the transformation process, such as the participation of employees and quality management. In addition to the challenges of a modernization programme including all aspects of sustainable, energy-efficient, and cost-effective construction, the concept of the urban development plan offers a great opportunity to future-proof Jülich's Sustainable Campus for the scientific projects and working methods of the coming decades and to become a model for a sustainable working environment. In so doing, the best possible technical, structural, and spatial prerequisites will be created for a special balance between highly motivated scientific work and quality of life.

The current plan envisages that there will be a higher density of buildings in the centre of the campus. There, the institutes will be grouped according to research priorities and be concentrated in a green zone with limited access for vehicles, while certain infrastructure facilities will be placed in peripheral locations in the forest. Central facilities will be located on a car-free boulevard in the parklike centre of the campus, while traffic will be restricted to a ring road leading to car parks with a clear layout. Bicycles will become the most important means of transport on campus. A higher density of central facilities in the centre of the new campus could compensate for Jülich's somewhat isolated location in a forest, and would enable employees to obtain everyday necessities without having to leave the campus. In particular, facilities outside of normal working times will be improved, as well as local public transport connections. The current drafts also provide for a reconversion of concrete-covered areas between buildings into green spaces in order to improve the actual work environment and optimize the micro-climate around the buildings.

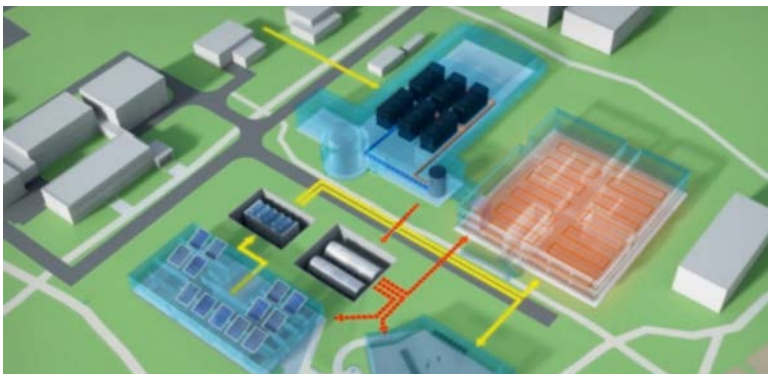
The Urban Development Master Plan will be implemented in several stages: by 2016, 2020, 2030, and finally 2050. It will also be adapted to the current situation at regular intervals of about three years. Any pending modernization measures and construction projects will be integrated into the overall concept, thus avoiding temporary buildings and the need for offices, laboratories and workshops to move buildings several times. In addition, it is necessary to construct modular buildings so that they remain flexible in their use, and to choose façade components that can be changed as required. In addition, recyclable construction materials should be used wherever possible. The aim is to keep the energy balance of buildings as neutral as possible throughout their entire life cycle.

However, the Urban Development Master Plan 2050 will not be set in stone. It is intended as a handbook for campus development that defines long-term guidelines. Its flexible modular system enables the step-by-step integration of individual construction measures into the targets of the master plan.

The modernization and development of the campus also offer the opportunity to implement new energy concepts. These are therefore given particular priority in Forschungszentrum Jülich's urban development plan. According to the German federal government's energy concept, about 80 % of the energy demand should be covered by renewables by 2050. For the Jülich research campus, this constitutes both a challenge and an opportunity, because a large proportion of the buildings are in need of modernization. New concepts for smart energy use and supply are therefore needed. These are being developed in parallel to the Urban Development Master Plan, in a project developing a smart energy supply for the Sustainable Campus during the same time intervals up to 2050.

Future energy supply of the campus

These are the reasons why each building is analysed not only in terms of possible energy savings, but also for its potential to become part of an inter-building energy distribution system. For example, it is planned to use heat given off by the supercomputers to supply heat to neighbouring buildings, and to store surplus solar energy in batteries or distribute it to other buildings. This kind of energy redistribution ensures the efficient use of energy.



Simulation of dynamic energy supply networks at Forschungszentrum Jülich

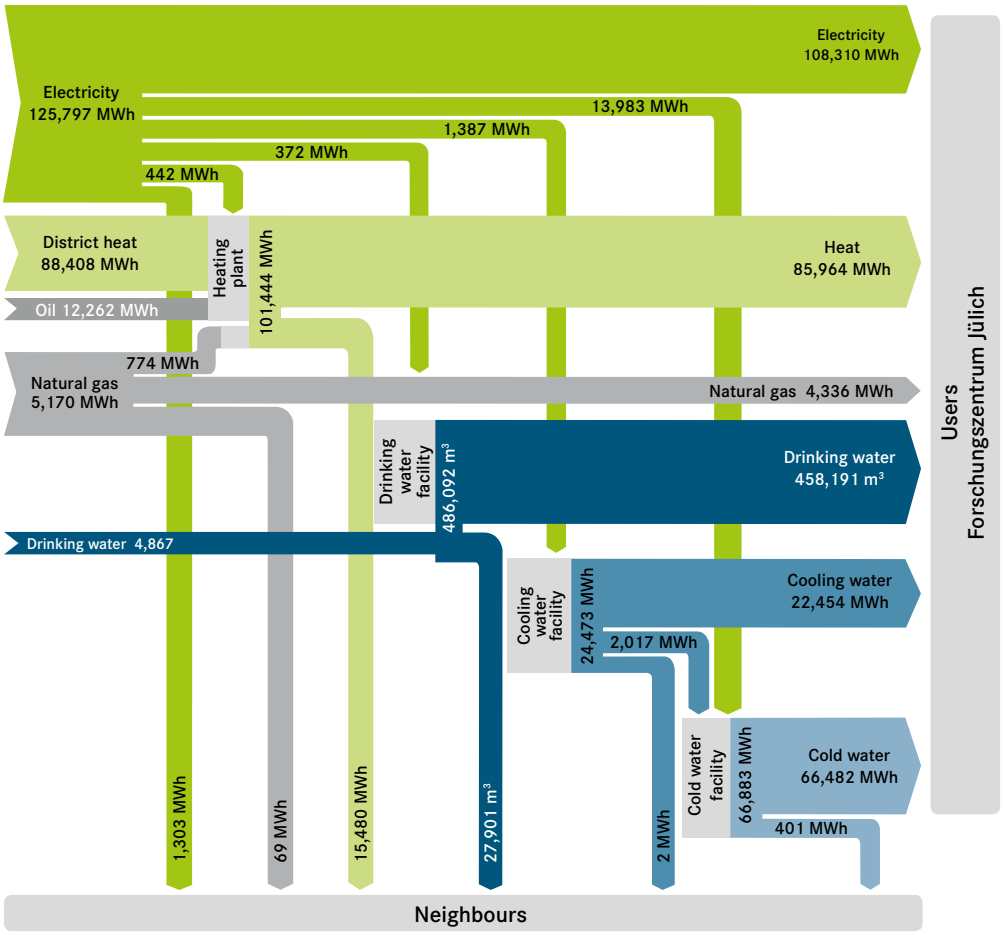
All building-specific energy concepts must fulfil different basic requirements in order to be considered for the future energy supply of the Sustainable Campus. The most important are the uninterruptable year-round supply of energy, high availability in case of a change of use, energy carrier price stability, efficient and resource-conserving use of energy, low CO_2 emissions, and altogether few adverse effects on the environment. Economic efficiency is another vital factor for the sustainability of a scientific institution such as Forschungszentrum Jülich. Energy carriers currently under consideration include deep geothermal energy and biomass, possibly in combination with biogas. The complete energy supply will be ensured with power stations on campus and by using the existing grid infrastructure.

Using and handling resources on campus

In terms of its consumption of resources, Forschungszentrum Jülich, with its building infrastructure and its numerous large-scale facilities, can be compared to a small town or an energy-intensive industrial plant. It has its own heating and power plant on campus that is ready to take over if the district heating network fails, its own infrastructure for water management, and a central cold water supply.

The technical and building infrastructure, which has grown organically since 1956, presents Forschungszentrum Jülich with enormous challenges and requires huge efforts to reach the targets set by the federal government in its energy concept of September 2010 and the relevant laws and energy savings directives. Forschungszentrum Jülich therefore aims to obtain the energy it requires from sustainable sources, to work and operate in an energy-efficient and resource-conserving manner, to cut emissions, and to achieve carbon neutrality. This requires increased awareness on the part of everyone on campus and a thorough analysis of user behaviour.

However, implementing all these measures does not mean that economic efficiency can be ignored. Depending on the classification aspired to, construction according to these sustainability criteria will cost about 10–15 % more than conventional building measures in accordance with the current Energy Savings Directive. This cost premium is the result of higher planning and documentation costs as well as additional investments for future energy-efficient operation and for higher levels of comfort, taking the aspect of wellbeing into account.



Flows of energy and media at Forschungszentrum Jülich in 2012

Energy and heat consumption

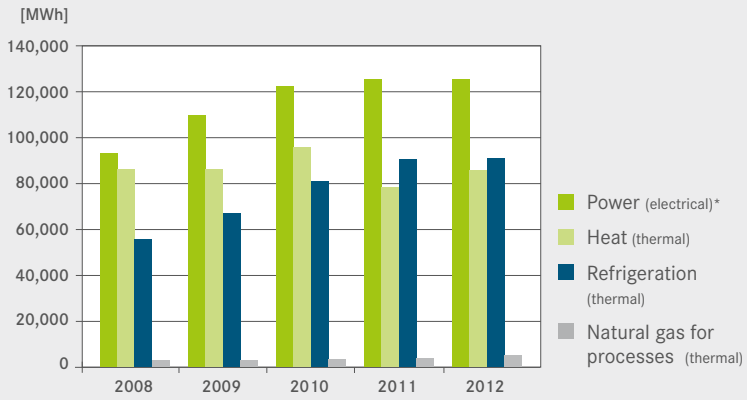
Forschungszentrum Jülich currently purchases power primarily from RWE and a smaller amount from local utility Stadtwerke Jülich. Forschungszentrum Jülich's medium-voltage campus network is supplied via several high-voltage supply points and distribution substations, some of them operated by Jülich. Two additional supply points provide power for the large-scale experiments COSY (ring accelerator) and the TEXTOR fusion experiment. The majority of the following data is from Forschungszentrum Jülich's own surveys and measurements in 2012. At the time this Sustainability Report went to press, the data for 2013 had not yet been finalized for all areas of resource consumption.

In 2012, Forschungszentrum Jülich's power consumption totalled 124.5 GWh. Of this, about 108 GWh, i.e. 87 %, was used directly as electric energy. Power consumed by the central infrastructure for the production and distribution of cold water, heat, and drinking water was approximately 16 GWh or 13 %. In 2013, the total electricity consumption increased to 126.5 GWh. The energy consumed in the form of electrical energy also increased to a total of 110.5 GWh. However, its proportion remained constant at 87 %.

Apart from the large experimental facilities COSY and TEXTOR, supercomputing is among the biggest power consumers at Forschungszentrum Jülich. Its share of total energy consumption was around 34 GWh or 27 % in 2012. Power consumption has been rising steadily over the last few years, both with and without taking supercomputing into account.

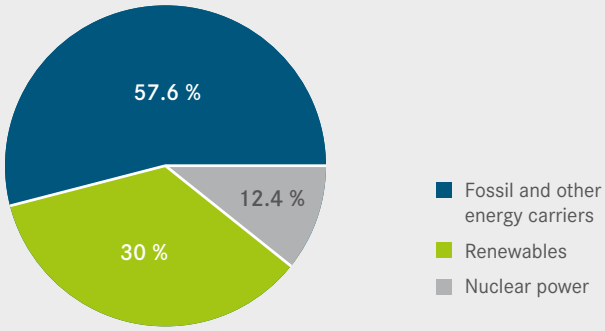
Since 2010, a larger share of the power purchased by Forschungszentrum Jülich has come from renewables than the German average. The distribution depends on what is produced by power suppliers and follows market economy and social policy trends. Overall, fossil energy carriers are dominant in the energy mix.

Energy consumption of Forschungszentrum Jülich



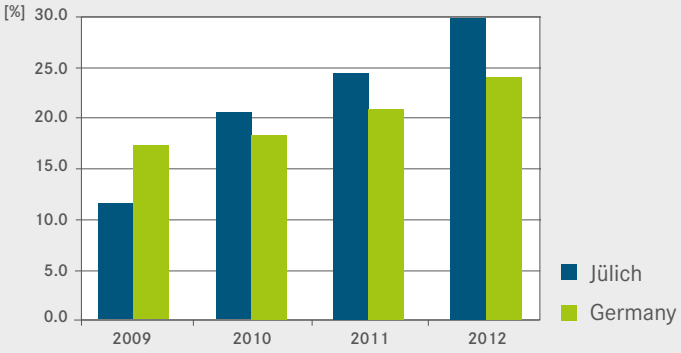
* includes power for water chilling and distribution as well as heat, drinking water, and cooling water distribution

Power mix of Forschungszentrum Jülich in 2012



Source: RWE

Proportion of renewables at Forschungszentrum Jülich



Source: Local power utility

Apart from a few buildings with gas water heaters, Forschungszentrum Jülich meets almost its entire space heating demand with district heat from the lignite power plant Weisweiler. From there, the heat is transported through a 16 km district heating pipeline to Jülich's own heating and power station with a nominal thermal capacity of 30 MW. Heat is distributed to the buildings on campus via an underground local heat network, which has been modernized to ensure energy efficiency. Should the district heating supply from Weisweiler break down, two oil-fired boilers with a total output of 25.5 MW_{th} will be started up at Forschungszentrum Jülich' own heating and power plant to cover peak loads and provide emergency supply. Forschungszentrum Jülich procures a small proportion of its natural gas supply from Stadtwerke Jülich. In 2012, Forschungszentrum Jülich consumed a total of 75 GWh of district heat, 10.4 GWh of heating oil, and 5.1 GWh of natural gas, of which about 1 GWh was used by gas water heaters for space heating. In 2013, the district heat consumption increased to 88.6 GWh. However, the use of heating oil was reduced to 1.4 GWh and the consumption of natural gas to 4.9 GWh.

Project examples of energy-efficiency measures from 2010 to 2012

Energy efficiency plays a key role in sustainable campus development since according to the German federal government's 2010 energy concept, about 80 % of energy requirements should be covered by renewables by 2050. Forschungszentrum Jülich must explore new avenues to shape up its infrastructure and buildings as well as large-scale facilities. For example, it is planning to implement results from its own research, for example in the field of energy, and to test their practical applicability on campus.

In cooperation with RWTH Aachen University, Jülich experts analyse the heat requirements of buildings on campus, which vary strongly depending on whether they accommodate laboratories or offices or both. In buildings with lecture theatres, for example, their use and capacity also play a role, because each person provides additional "heating" through their own body heat. Different types of existing buildings are also analysed in terms of their requirements over the course of a day. To this end, Forschungszentrum Jülich sends its data to the Chair of Energy Efficient Buildings and Indoor Climate of the E.ON Energy Research Center at RWTH Aachen University. With software that is being developed there as part of a research project for the simulation of water-based heat supply networks, the scientists from Aachen are planning a detailed, time-resolved model of Jülich's heat supply to use as a model for operational control in the future. Instead of a static average value of heat consumption, for example, the program will map the entire heat requirements for different uses and their fluctuations over the course of a day.

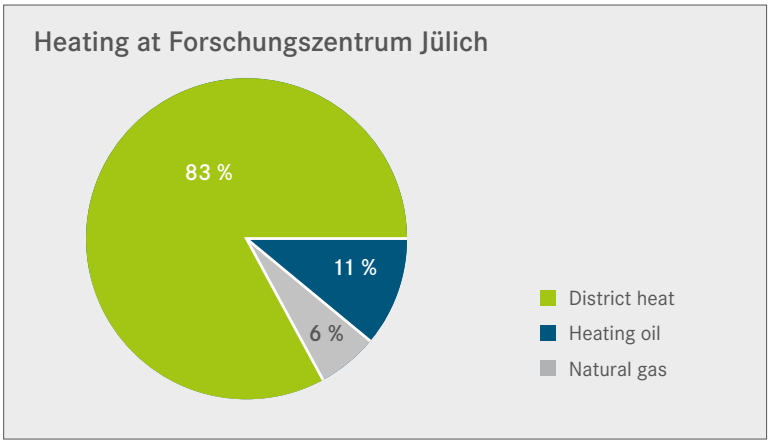
Implementation of energy controlling

The first step towards energy controlling and, in the longer term, energy management is local meters that automatically measure energy flows, for example those of electricity and water, and send the consumption data to a central database. Between 2011 and 2013, Electrical Engineering and Communications Engineering installed on campus and put into service 797 new meters that can be read remotely instead of continuing to measure power consumption centrally at a supply point on the edge of the campus. The installation and connection of these meters is an ongoing process. New meters are periodically installed in new buildings or if user requirements have changed.

The data are recorded by independent energy management software and archived in a database with a time and date stamp. These meter data are a prerequisite for recording dynamic load profiles and assessing buildings and distribution networks in terms of their energy efficiency. With the help of a numerical building and facility simulation, the operating states in the distribution network are optimized to reduce energy losses. In addition, the meter data are also used to account for consumption and costs broken down according to building and facility users, thus making it possible to identify potential for savings. When the integration of the meters into the energy management software is complete, the data on consumption per building will be made available by mid-2014 to increase awareness and optimize user behaviour. All of these measures, together with the future demand-oriented supply of energy in an energy management system still to be established, are intended to use resources more efficiently in the future.

Modernization of the district heating network

Between 2009 and 2013, the district heating network on the Jülich campus was modernized to increase energy efficiency, which involved considerable expenditure of more than € 20 million. The highly insulated underground piping system generated savings amounting to 4,584 MWh or 38 % in 2012 compared to 2010. Power consumption was also reduced by 150 MWh by the use of controlled pumps. Improving the insulation on the pipes in buildings reduced heat losses by another 208 MWh. In total, it is expected that 6,750 MWh can be saved annually. In parallel to the modernization of the district heating network, a project was started in 2011 for the simulation of dynamic energy supply networks. The aim is to better adapt the networks to dynamic loads in order to achieve additional significant energy savings.



LEDs for street lighting on campus

Over a period of four years, the conventional lighting for roads, footpaths, and open spaces is currently being replaced with LED lighting at an investment of almost € 1 million. This will reduce the power consumption required for lighting as well as maintenance and repair costs while at the same time increasing the light output. The changeover to LEDs began in 2011 and will be completed in 2014. In total, 810 lamps are being replaced during the project. The savings amounted to 47 MWh in 2012. When the changeover is complete, it is expected that a total of 131 MWh can be saved per year.

Introduction of virtual servers at Technical Infrastructure

Using virtualization technology, Technical Infrastructure replaced its 75 physical servers with 7 physical server platforms. By reducing the number of physical servers, in 2012 power consumption was cut by 274 MWh in the nominal load range. This corresponds to estimated savings of 91 %.

Building modernization measures in 2012

Central Institut for Engineering, Electronics and Analytics

It was decided to completely renovate the structure of the roof as part of pending roof repairs. For example, the old polystyrene insulation was replaced with expanded polystyrene foam. The thermal transmittance, which describes the heat loss, was reduced from 0.81 W/m^2 K to 0.176 W/m^2 K. The savings in terms of heat

losses amount to about 4 % relative to the heat consumption of the entire building. Heating energy savings amounted to 72 MWh in 2012. The heat consumption of the ventilation system was reduced by approximately 486 MWh, which corresponds to 28 % of the entire heat consumption, by the use of speed-controlled fans, the integration of a heat recovery system, and demand response controls. The power consumption was reduced by about 65 MWh, which corresponds to 7.7 %.

TEXTOR hall 2

As part of the necessary modernization of the 770 m^2 roof of the TEXTOR hall 2, several measures were undertaken. For example, the old cork insulation was replaced with expanded polystyrene foam. The new structure of the roof sealing and insulation reduced the heat losses of the entire building by 2 %. Heating energy savings amounted to 27 MWh in 2012.

Gästehaus Jülich

Forschungszentrum Jülich operates temporary accommodation in the town centre of Jülich. In 61 units of different sizes, all of them fully furnished and equipped, this Gästehaus is intended primarily for visiting scientists, who can stay here while working at Forschungszentrum Jülich. In 2012, a total of eight accommodation units were modernized in the building constructed in 1973. For example, the old, double-glazed aluminium-frame windows were replaced by new, triple-glazed windows with plastic frames. In addition, interior insulation was added and the outside door was replaced. Apart from these construction measures, a modern condensing boiler was installed instead of the old open-vent boilers. Heat losses relative to the entire building were thus reduced by about 11 % in 2012. Heating energy savings amounted to 66 MWh in 2012.

Energy-efficient new buildings in 2012

Plasma Physics

With a total floor space of 1,890 m^2, the new Plasma Physics building completed in 2012, at a cost of € 4.6 million, provides modern offices and new laboratory space for Jülich plasma physicists. Due to the very positive evaluation in terms of energy consumption, an application was submitted for subsequent certification according to the 2009 German Energy Savings Directive. With a primary energy consumption of 170 kWh/(m^2a), the new building is more than 42 % below the upper limit for energy-efficient buildings.

Office building for Technical Infrastructure

A new building costing € 3.5 million with a net floor space of 2,127 m^2 was constructed in 2012 for Technical Infrastructure and Planning and Building Services. Innovative office concepts were realized in this building. Due to its modern construction, the primary energy consumption of the building is 41 % below the requirements of the 2009 Energy Savings Directive. The primary energy requirement of the building is 98 kWh/(m^2a).

Central cold water system III

In order to continue to cover the expected increase in cold water, a third technical building for the central cold water system was constructed in 2012. The refrigerating capacity of the three chillers has been increased to 21 MW_{th}.

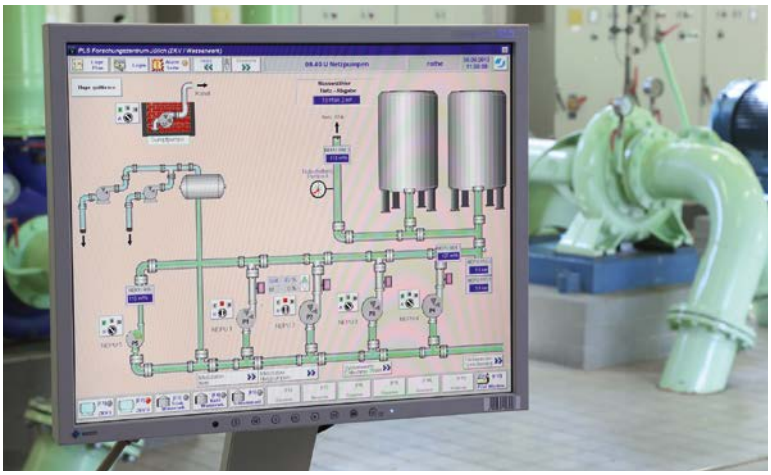
Certification of buildings

In parallel to its work on the Urban Development Master Plan, Forschungszentrum Jülich is seeking certification for sustainable planning in the scientific area. The Federal Ministry of Transport and Digital Infrastructure is currently developing and testing a dedicated assessment and certification system for research and laboratory buildings in Germany. It aims to introduce uniform standards that serve as a benchmark for sustainability and are financially feasible for institutions funded by the federal government. After all, sustainable options are often more expensive initially than alternatives that do not consider sustainability as a top priority in the construction phase, although the former save money throughout their entire life cycle.

Forschungszentrum Jülich is participating in the pilot phase of this project with two buildings that will be scrutinized with a view to sustainability criteria. For example, requirements on these buildings include assessing their entire life cycle and taking alternative uses and future expansions into consideration during the planning phase. This has been the case, for example, with the new technical facility for photovoltaics research and the new building for Plasma Physics at Forschungszentrum Jülich.

The building of the German Research School for Simulation Sciences (GRS) was the first in the Helmholtz Association to be certified by the German Sustainable Building Council (DGNB). It received a bronze certificate. Whenever new buildings are constructed – in particular for larger projects – Forschungszentrum Jülich will aim to achieve at least silver standard and integrate these requirements right from the beginning.

Use of water



Water is supplied from deep and shallow wells by Forschungszentrum Jülich's own waterworks. Distribution is ensured through water purification, storage, and Jülich's water supply network. In 2012, 458,191 m^3 of drinking water were used. Although the number of employees increased by 18 %, from 4,400 in 2008 to more than 5,200, in 2012, the drinking water consumption decreased by 33 % in the same period. This was achieved by a consistent switchover from drinking water chilling to the cheaper option of cold and cooling water chilling. This process continued to reduce consumption to 436,382 cm^3 in 2013.

Cooling is currently provided by three central water chillers with eight vapour-compression refrigeration systems and open recirculation cooling as well as a closed cold water network that is about 17 km long. The system reliably covers the cooling demand on campus. The central cold water system has a capacity of 21 MW_{th} and supplies consumers in 45 buildings. Energy consumption for cold water was 66.5 GWh in 2012 and 62 GWh in 2013. More cold water is taken from the River Rur, located at a distance of about 4 km, and pumped through a pipe to the waterworks, where it is purified and processed for use as cooling water. Distribution is also realized through another designated 10 km pipeline system on campus. About 1.5 million m^3 of water are taken from the River Rur every year for cooling purposes and then returned to the river.

At Forschungszentrum Jülich, the demand for cooling is determined by the scientific experiments, the processes, and air conditioning in buildings. The significant increase of 63 % in the demand for cooling since 2008 is due to the increased use of supercomputers and other scientific experiments that often require extreme cooling. In order to meet the rising demand, a third central water chiller with a capacity of 6 MW_{th} was constructed and put into operation in mid-2012.

The water supply team at Building and Property Management is responsible for three areas of supply and their products on campus. These are subject to stringent production and hygiene standards and the supply systems and networks for cooling water from the River Rur, drinking water, and central cold water are continuously monitored through laboratory measurements and authority inspections.

Waste Water at Building and Property Management is responsible for waste water. Waste water is discharged through three separate sewage systems: domestic wastewater through the sanitary sewage system, process water through the industrial wastewater system, and rainwater, groundwater, and cooling water through the

rainwater drainage system. Sanitary wastewater is purified in a mechanical and biological wastewater treatment plant based on a wastewater treatment method developed at Jülich (JARV). Process water is treated in a mechanical plant where chemical precipitation processes are also available. The separate system is necessary due to the handling of unsealed radioactive substances at Forschungszentrum Jülich. This also results in a special situation for waste water treatment requiring authorization under water law and the law on nuclear installations. The waste water is purified, processed, and discharged into the River Rur. In 2012, a total of 337,670 m^3 of processed wastewater was discharged into the River Rur. This volume corresponds to less than 5 % of the river's annual discharge.

Environmentally conscious use of resources

Digitization in the Central Library and for job applications

From 2005, the Central Library has been following the strategy of purchasing electronic journals instead of printed journals for the scientists at Forschungszentrum Jülich. The information portal of the Central Library allows employees of Forschungszentrum Jülich to access the media directly from their workplace.

The Central Library also aims to expand its collection of scientific literature in a resource-efficient manner. An increasing number of books are therefore only made available to the scientists as electronic versions. Because these e-books are intended to be used in the long term, the Central Library places great significance on the use of well-established open electronic formats. Forming purchasing consortia and acquiring packages of literature enables savings in comparison to purchasing individual titles.

The Central Library's switchover to electronic journals and books has reduced the use of a number of resources. For example, ordering an e-book does away with the need to transport the printed book from the printers to Jülich. The pro rata energy consumption of the necessary servers for making e-books available is much lower than for a reading room and stacks. Printed journals and books require an enormous amount of space in libraries. Expanding the collection with electronic media reduces the space requirements. Each and every sheet of paper saved also helps to reduce the consumption of wood products worldwide. The use of electronic media means that no books or journals are produced for borrowing in libraries. The publishers no longer need to produce large print runs and dispose of them if the title does not sell. However, experience has shown that paper consumption for copies and printouts usually increases with the use of e-books. This can only be counteracted if users change their habits in handling electronic media and using books.

Paper and energy consumption are not the only aspects to consider when it comes to the digitization of scientific publications. As a member of the Helmholtz Association, Forschungszentrum Jülich also champions "digital sustainability". It therefore believes that digital scientific resources should be in the public domain. The topic of open access is at the heart of these efforts.

Open access means that scientific literature is available free of change on the Internet. In keeping with the Helmholtz Association's mission to "contribute to solving grand challenges which face society, science and industry", the topic of open access is of great significance for the Helmholtz centres. Free access to scientific results promotes efficiency and innovation. Open access improves the supply of literature for science worldwide, facilitates the transfer of research results to industry, and provides society

with easy access to knowledge and information. This is why the Helmholtz Association's Assembly of Members decided in 2004 that all publications by scientists in the Helmholtz Association should by default be published with open access unless there is an express agreement to the contrary with the publisher or third parties.

There are two major options for open-access publications. With green open access, quality-controlled publications and other digital objects are self-archived in an institutional or subject repository. With gold open access, original scientific texts are published in open-access journals and, in principle, also other types of media, including monographs and anthologies. Well-established procedures for quality assurance in science, such as peer review, are an integral part of this strategy.

Forschungszentrum Jülich encourages its scientists to publish in open-access journals. For example, the Central Library pays publication fees for gold open-access publications. In addition, all publications by Forschungszentrum Jülich's own publishing house, such as PhD theses, are also published with open access. Scientists at Forschungszentrum Jülich are also actively involved in publishing open-access journals.

Share of open-access articles of Forschungszentrum Jülich in Web of Science

2000	2.4 %
2001	0.5 %
2002	1.1 %
2003	2.3 %
2004	3.6 %
2005	4.6 %
2006	5.4 %
2007	4.1 %
2008	6.7 %
2009	6.2 %
2010	10.8 %
2011	10.2 %
2012	13.5 %

Recruitment processes have also switched to a digital procedure with the introduction of the online recruitment system JuRS in 2012. JuRS saves about € 20,000 to € 30,000 in costs for materials and postage per year. The most important material in the recruitment process is paper, and its use by Forschungszentrum Jülich and also by the applicants has been reduced significantly throughout the recruitment process.

Recycling of chemicals in the new internal forum for reuse

An internal forum has been established for the release of chemical substances that are no longer needed. Chemicals are either disposed of by Waste Management or made available to other organizational units. Ever since the forum was set up, leftover chemicals have been used by trainees in chemistry. As a result, expenditure for chemicals in their training has been reduced in recent years by up to 40 %. The chemicals are registered on a "recycled chemicals list". The relevant chemicals are often substances that no longer fulfil the strict requirements of the individual institutes, but can be used without difficulty for training purposes.

Use of resources for research

The use of materials for research purposes and the associated consumption of resources, including rare substances such as platinum or rare earth metals, is difficult to assess. Although scientific work requires a large amount of resources, its findings also contribute to their efficient use. For example, Forschungszentrum Jülich developed a new catalyst for fuel cells that only requires a tenth of the typical amount of platinum previously needed due to the use of octahedral-shaped nanoparticles of a platinum-nickel alloy. In addition, Jülich researchers designed a system for identifying valuable substances in electronic waste, which makes it easier to recycle these materials.

Forschungszentrum Jülich is also making the use of resources in research more and more efficient. For example, liquid helium is used to cool numerous facilities and experiments. Failure of these cooling systems is a risk factor that can cause expensive and extensive damage to research facilities. As worldwide helium resources are limited, technical factors in its production or political crises could lead to helium shortages. This is why options for recycling and storing hydrogen have been expanded systematically by Building and Property Management. Despite all of these optimizations, it is estimated that about 10 % of the helium required on campus must be bought from outside Forschungszentrum Jülich.

Sustainable purchasing

Purchasing and Materials at Forschungszentrum Jülich is always at pains to fulfil the different requirements of the scientific institutes for the materials to be acquired. Environmental aspects also play an important role at Purchasing and Materials. For example, great care is taken to purchase energy-efficient devices for day-to-day purposes and to use environmentally compatible paper whenever possible.

However, Forschungszentrum Jülich does not yet have a dedicated sustainable purchasing strategy. It is currently very difficult to implement sustainability as the overriding principle for purchasing activities due to the very specific requirements of science as well as applicable legal guidelines, i.e. the limitations of valid public procurement law. However, the German federal government will have to pass new public procurement legislation by 2016 due to a new EU directive. Based on the new legislation, introducing a sustainability strategy at Purchasing and Materials will be reconsidered.

Green events

Corporate Communications coordinates central events for Forschungszentrum Jülich. In doing so, the Federal Ministry for the Environment's sustainability guidelines are already implemented during the planning phase. These stipulate that the entire event should produce as few emissions as possible. This is why venues are chosen that are operated sustainably. The team at Corporate Communications also makes sure that the venues can be reached easily by bus or rail and that the caterers use fair-traded organic food from the local area if possible. Both during the planning phase and the event itself, the use of paper is minimized. Attendees can only register online for events. Instead of disposable materials to decorate the speaker's platform, virtual projections are used, and for table decorations, pots of herbs that guests can take home with them afterwards. In order to conserve resources, these are the only gifts given to attendees. The concept is suitable both for central and scientific events.

Pots of herbs as table decorations at events

Emissions and waste

In reducing its CO_2 emissions, Forschungszentrum Jülich has set itself the goal of reaching the targets defined in the German federal government's energy concept. This concept aims to reduce heat energy consumption in buildings by 20 % between 2008 and 2020. In addition, the primary energy consumption in building operation should also be reduced by 80 % by 2050. Reaching these goals requires the modernization of buildings, construction of energy-efficient new buildings, and new energy concepts for the entire campus.

For example, new buildings should require as little energy as possible during both construction and operation. The aim is to generate the necessary energy in the building itself, provided that this is economically feasible. Surplus energy should be fed into the campus network, for example to supply older buildings or energy storage systems. The level of building autonomy strongly depends on the respective use. The vision for a future supply concept includes the potentials for energy generation of building envelopes, building technology, and the surroundings of a building. On-campus generation using renewable energy sources aims to minimize CO_2 emissions and Forschungszentrum Jülich's dependence on high-emission energy sources.

CO_2 emissions

The German federal government's 2010 energy concept aims to massively and sustainably reduce greenhouse gas emissions. Compared to the baseline year 1990, emissions are to be reduced by 40 % by 2020 and by 55 % by 2030. An overview of CO_2 emissions is provided in an internal report of Forschungszentrum Jülich. Its aim is to describe the development of emissions at Forschungszentrum Jülich in order to discuss reduction measures in a targeted manner. The CO_2 equivalent is determined using Forschungszentrum Jülich's power and heat energy consumption and the local energy suppliers' primary energy mix. The calculation is based on the energy supplier's specific emission values required by the German Energy Economy Act (EnWG).

In total, the energy consumption of Forschungszentrum Jülich, comprising power, heat, and natural gas as well as cooling water, cold water, and drinking water resulted in CO_2 emissions amounting to 102,384 tonnes in 2012. Of these, 69,599 tonnes were attributable to power consumption and 21,864 tonnes to heat consumption. In 2013, CO_2 emissions for heat consumption increased to 35,985 tonnes. This massive increase is only to a limited extent due to the increase in consumption of 5 GWh.

Until 2012, Forschungszentrum Jülich was unable to obtain specific information on the emission factor necessary for calculating the CO_2 emissions from its district heat supplier RWE. According to RWE, this calculation was not required by law. The DIN 18599-1 standard for assessing the energy efficiency of buildings was used to determine a plausible value for the district heat supply. The standard refers to the GEMIS system, which provides emission factors and other data. With its combined heat and power (CHP) plants, RWE fulfils the high-efficiency criterion, i.e. more than 50 % of the district heat is supplied from CHP plants. Based on these figures, an average value of the emission factors stated in the GEMIS sys-

CO_2 balance based on amounts of primary energy

Type of energy	CO_2 [t] in 2010	CO_2 [t] in 2011	CO_2 [t] in 2012
Power	69,722	71,946	69,599
Heat	24,145	19,846	21,864
Natural gas	582	722	874
Cooling water	611	728	818
Cold water	8,516	9,417	9,004
Drinking water	252	252	225
Sum	103,828	102,911	102,384

In accordance with the German Energy Economy Act, the basic values for 2013 will be published at the end of 2014.

tem was used to calculate the emission factor for Forschungszentrum Jülich, which resulted in a value of 250 grams of CO_2 per kilowatt-hour.

Due to legal changes in phase III of the European Union Emissions Trading Scheme (2013–2020), RWE had to calculate specific values for CO_2 emissions from district heat for the very first time. At 400 grams per kilowatt-hour, the emission factor is much higher than previously estimated. In order to ensure consistency with the figures already published in the emissions report and other publications, the emission factor originally calculated was left unchanged for this report for the years up to 2012. The new emission factor was used for the first time to determine the emissions for 2013.

The power mix and the power-related CO_2 emissions for the calendar year 2013 are not yet available. In accordance with current legislation, energy providers are not required to supply the relevant data before November of the following year, so that 2013 figures will only be available in November 2014.

The new building for the JuLab Schools Laboratory from the outside

The new building for the JuLab Schools Laboratory, which was officially opened in 2013, plays a particularly important role in Forschungszentrum Jülich's CO_2 strategy. It is equipped with state-of-the-art energy and fresh water meters, which record consumption data electronically, enabling fast data evaluation. These smart meters were installed for individual rooms – a currently unique pilot and demonstration project at Forschungszentrum Jülich. The installation of these smart meters in all laboratories of the JuLab extension building makes a lot of sense from an educational point of view. The aim is to calculate and assess the CO_2 footprint every day in working groups and also to have these data presented by participants in energy seminars and energy management scenarios. Calculating the carbon footprint can become the starting point for thinking and acting in a more sustainable manner and for an efficient energy management. In the longer term, a programme on CO_2 will be developed by JuLab in cooperation with selected institutes and made available to students, teachers, and trainees.

Other greenhouse gas emissions have not been measured at Forschungszentrum Jülich to date, However, it has been possible to infer the NO_x and SO_x emissions of the heating plant of Forschungszentrum Jülich in 2012 from the consumption of heating oil. The NO_x emissions were 997 kg and the SO_x emissions 3,507 kg in 2012.

Waste management and recycling

The operation of Forschungszentrum Jülich produces an increasing volume of different types of waste from research and infrastructure. These include mixtures of substances with very unusual properties that require a special method of disposal. The Waste Disposal Regulations of Forschungszentrum Jülich regulate the handling of all waste. It lays down the basic rules for the internal implementation of the German Closed Substance Cycle and Waste Management Act (KrWG). The company waste disposal regulations therefore list all the relevant rules and regulations and define rules for avoiding, recycling, and storing different types of waste. The annexes also regulate the specific procedures for different types of waste.

The disposal and recycling of waste is the task of Waste Management. It provides collection and transport containers suitable for different types of waste in the research laboratories and workshops. This requires the waste producers to notify Waste Management of the substances to be disposed of and to apply for the respective containers. Waste Management is also responsible for the fast transport and disposal of waste in accordance with the applicable regulations. Contracts for the disposal of any materials from Forschungszentrum Jülich are awarded on the basis of a public procurement procedure. Invitations to tender are only open to specialized waste management companies.

The waste management officer plays a major role in Forschungszentrum Jülich's waste management system, which is certified to ISO 9001. As an officer of Forschungszentrum Jülich, he or she reports directly to Safety and Radiation Protection and advises the operator and employees in matters relevant for avoiding and managing waste. In addition, he or she is responsible for informing employees on these matters and increasing their awareness. A waste portal on the intranet of Forschungszentrum Jülich provides all employees of Forschungszentrum Jülich with information on the topic of waste. It is also possible to subscribe to a waste-related newsletter. Employees of Forschungszentrum Jülich receive training in disposal routes and options as part of training courses. The content of these courses is also published on the intranet pages of Waste Management.

The waste management officer records and monitors material flows at different locations and for Forschungszentrum Jülich as a whole by means of appropriate documentation and a waste register. In addition, records of proper waste management are kept for all hazardous waste in accordance with the provisions of the Basel Convention, Annex I, II, III, and VIII. The waste management officer makes sure that the prescribed disposal routes and options are used by regular checks on the disposal facilities and inspection of the waste registers of all the companies involved. The following waste management and transport companies were inspected in the period under review:

- SalTec Umwelttechnik in Baal
- Schönmackers Umweltdienste in Erkelenz
- Schönmackers Umweltdienste in Aldenhoven
- Schönmackers Umweltdienste in Kempen
- EGK waste incineration plant in Krefeld
- Entsorgungsgesellschaft Niederrhein in Krefeld

The waste management officer is also responsible for preparing a waste balance to monitor the total amount of waste. According to these waste balances, 950 tonnes of non-hazardous and about 550 tonnes of hazardous waste were produced at Forschungszentrum Jülich in 2012. In 2013, 1,818 tonnes of non-hazardous and 490 tonnes of hazardous waste were generated. The increase in the amount of non-hazardous waste in 2013 was due to extensive modernization measures on campus.

The responsibilities of the waste management officer also include recording any incidents on campus, which must be logged with the date and the leaked amount of substances. There were six significant incidents with leaked lead acid, oil, and diesel in 2012. In all cases where oil or fuel were leaked, it was checked whether the sewage system was contaminated. As a precaution, leak sealing bags were used if required. No oil or fuel was detected in the drain at any time.

Incidents in 2012	Amount released
6 January 2012	**Acid: 50 litres**
A roll-off container was waiting to be filled with lead batteries at the collection point for waste materials. The container was damaged and leaked lead acid. The fuel was removed immediately using a chemical binder.	onto the soil
19 January 2012	**Oil: 5 litres**
An excavator parked by an external company leaked large amounts of oil. The leaked oil was treated immediately with an oil binder and the contaminated soil was removed.	onto the soil
8 February 2012	**Diesel: 50 litres**
A public service bus leaked fuel on the road leading to Forschungszentrum Jülich and on the campus. The fuel was removed immediately using an oil binder.	in the traffic area (road)
29 March 2012	**Hydraulic oil: 50 litres**
The hydraulic line burst on a crane and leaked hydraulic fluid, which was removed immediately using an oil binder.	in the traffic area (road)
13 November 2012	**Diesel: 15 litres**
A bucket containing 15 litres of diesel fell over after a tank at the heating plant has been refilled. The fuel ran off from the filling area into the sand trap. The diesel was immediately removed using a binder and the sand trap was cleaned by a qualified waste management company.	on the filling area tested acc. to the Federal Water Management Act (WHG)
20 December 2012	
On the truck parking area at the main gate and at building 16.4, fuel dripped from a truck through a leaking fuel line. The diesel was removed immediately using a binder.	on the filling area tested acc. to the Federal Water Management Act (WHG)

Use of chemicals

In order to use chemicals more efficiently, a hazardous substance database was introduced in 2005 and an internal forum for reuse in 2001. All chemicals stored at Forschungszentrum Jülich must be entered in the Dangerous Materials Registry Information System (DaMaRIS). DaMaRIS also has an internal chemicals marketplace that facilities the exchange of chemicals between institutes and the transfer of opened containers.

The internal chemicals marketplace was implemented based on a suggestion received by Ideas Management at Forschungszentrum Jülich. Based on the rules stipulated in the Waste Disposal Regulations, Waste Management collects large amounts of chemicals that are still fit for use. These include organic or inorganic substances contained in unopened packages and solvents of various types. However, even chemicals in unsealed, half-empty containers can still be used for various purposes. The chemicals are stored at the collection point for waste materials. A list of such chemicals is made available on the intranet of Forschungszentrum Jülich and in the waste newsletter by Waste Management. A total of 290 kg and 322 kg of recycling chemicals, respectively, were collected in 2012 and 2013. This saved Forschungszentrum Jülich about € 1,000 per year in disposal costs and up to € 14,500 in procurement costs. The trainees in chemistry benefited most from this type of recycling.

Mobile phone recycling drive for "Kleine Füchse" daycare centre

A mobile phone collection drive took place at Forschungszentrum Jülich from 22 April to 17 May 2013. During this period, used devices were collected in a container set up specifically for this purpose at the Seecasino canteen on campus.

The collection drive was for the benefit of the "Kleine Füchse" daycare centre, which is located on the site of the former federal railway repair shop (BAW) and the Vocational Training Centre of Forschungszentrum Jülich. For every mobile phone collected, "environment points" were awarded that the "Kleine Füchse" daycare centre was able to exchange for toys and book after the collection drive. The collection drive was organized in cooperation with recycling service provider Interseroh. Due to the success of the collection drive, mobile phone recycling for the "Kleine Füchse" daycare centre is now possible at any time. Mobile devices are collected at the institutes and infrastructure divisions of Forschungszentrum Jülich, coordinated by the waste management officer. A total of 290 mobile phones were collected in this way in 2013.

Mobility

Mobility plays an important role for resource efficiency on the campus, which accommodates about 5,500 employees. Forschungszentrum Jülich has its own fleet of low-emission vehicles and commissions external service providers with on-campus transport and also transportation for visitors between Forschungszentrum Jülich and regional airports. In addition, Forschungszentrum Jülich encourages its employees to use public transport, form car pools, or cycle to work. A study in 2011 on the benefits of car pools for the commute to Forschungszentrum Jülich and back shed light on the CO_2 savings potential in 2011. A communications campaign in 2013 therefore promoted car pools for commuting to work and

back home. For example, the Sustainable Campus Arena, an online forum that is now online on the intranet, offers a marketplace that helps employees to identify potential carpool partners. In addition, a number of measures aim to make bicycles the preferred means of transport on campus.

Business trips

Rules for business trips of Forschungszentrum Jülich employees are laid down in an internal regulation. To ensure that business trips are as cost-effective as possible, employees of Forschungszentrum Jülich are encouraged to use public transport options to reach their destination. This does not affect the employees' right to use their own car and have their expenses reimbursed in accordance with legal provisions. The Travel Costs Reimbursement office pays attention to which method of transportation is the cheapest.

Forschungszentrum Jülich's fleet of vehicles

Forschungszentrum Jülich's fleet of vehicles is divided into three different areas. Passenger Transport undertakes journeys on and off the campus. It uses modern low-emission vehicles. The transport of materials and the use of special vehicles, for example those of the Works Fire Brigade, usually take place on campus.

In total, Passenger Transport handles around 13,000 jobs every year, transporting more than 30,000 passengers. About 60 % of these jobs are covered by the team's own drivers, the remainder is provided by local external service providers. Passenger Transport has eight drivers and 24 vehicles, of which 16 can be driven by employees themselves. These vehicles cover about 650,000 km every year.

In 2012, Building and Property Management, which is part of Technical Infrastructure, acquired electrically driven scooters for its employees. These are a fast and potentially emission-free means of transport on campus. Various electric vehicles are currently being tested and relevant services are being developed by the Motor Vehicles Repair Shop. At the moment, no dedicated charging station infrastructure is in place so that all electric vehicles must be recharged at standard electrical sockets. A project outline for the development of a charging station infrastructure has been in the pipeline since 2012 and is currently being negotiated with external partners.

Better public transport connections

In order to improve the energy efficiency of employees and visitors on their way to Forschungszentrum Jülich and back, the centre supports better public transport connections to the campus. The intranet of Forschungszentrum Jülich has a car pool scheme that helps employees to use private cars more efficiently.

As part of these efforts, a regular bus service was established on 4 November 2013 from the Rurtalbahn's "Forschungszentrum" stop to the campus for all trains arriving and departing between 06:00 and 19:00. The new shuttle service of the SB11 bus route that connects to the Rurtalbahn train service was established to improve the service between the train stop and Forschungszentrum Jülich. This increases Forschungszentrum Jülich's public transport accessibility. In addition, Forschungszentrum Jülich is again considering the possibility of offering employer-subsidized "job tickets" in cooperation with the regional associations of transport companies.

Bike-friendly campus

Within the scope of the sustainable development of the campus and the Urban Development Master Plan 2050, Forschungszentrum Jülich aims to establish bicycles as the primary means of transport on campus.

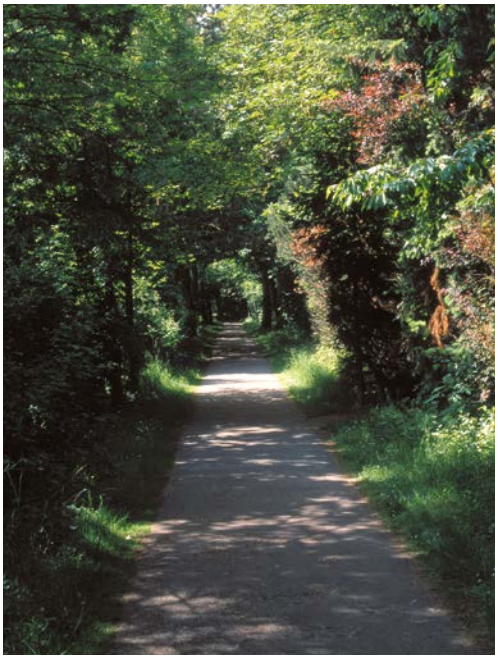
For the launch of the bike-friendly campus campaign, Corporate Communications organized a cycling week during which three measures were implemented to motivate employees to use their bikes to get to work. The safety of cyclists on campus was improved by cycle lanes on the Helmholtz Ring and access roads to the gates. The cycle lanes measure 1.25 m from the kerb and are reserved for cyclists. In addition, ten temporary bike stands were installed in front of institute buildings in order to determine the demand at the different buildings. Those stands that were frequently used stayed in place after the test phase, while the others were moved to other locations in order to be tested there. And last, but not least, the opening hours of the gate for cyclists were extended to twelve hours for a test period from June to late November 2012. As part of the test, the gate was open from 06:00 to 18:00. After the test phase, the new opening hours became a permanent feature from 2013.

As a result of these measures, there was a slight seasonal increase in the number of users of the gate for cyclists. While the highest figure in 2012 was 375 users per day in August, the maximum number increased to 517 per day in August 2013. This means that during the summer months, about 40 % of the about 1,200 Forschungszentrum Jülich employees who live in the town of Jülich cycle to work.

In addition, Forschungszentrum Jülich has about 700 official bikes managed and maintained by the bicycle workshop of the Works Fire Brigade. They are issued by the institutes and divisions. Bicycles are also available for groups of visitors who would like to discover the campus in an active way. This is a feature of a tour focusing on energy and climate research. It takes visitors to institutes involved in energy and climate research as well as plant and soil sciences.

Cutting-edge research in a green environment

Forschungszentrum Jülich is located close to the town of Jülich, right inside Hambach Forest. Including areas used by other institutions, the premises of Forschungszentrum Jülich are about 218 ha in size. In addition to the buildings, the campus is characterized by a large forested area and plenty of open spaces. The close-to-nature environment as well as the conservation and improvement of the environmental status of its fauna and flora are important aspects of the Urban Development Master Plan 2050. The green campus is also one of the reasons that work at Forschungszentrum Jülich is so attractive and will therefore be developed further.



The information on the species listed below is taken from plane survey sheet 5004 of the State Agency for Nature, the Environment and Consumer Protection for North Rhine-Westphalia. The species are categorized according to the Federal Agency for Nature Conservation's (BfN) classification. Surveys of the premises carried out by an office for landscape and environmental planning did not find any indications of the campus being used by bats and no increased planning-relevant importance for any species of birds.

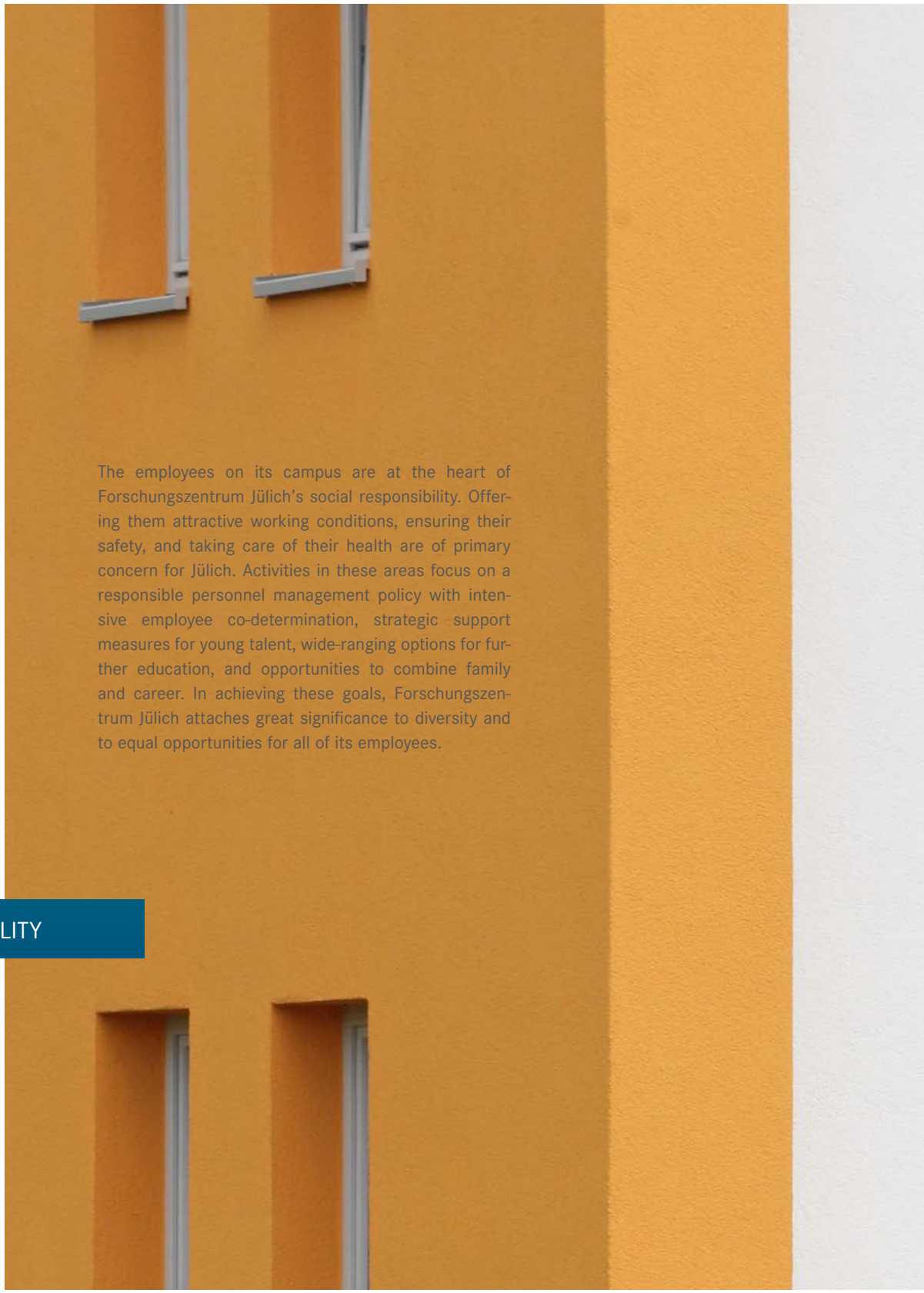
Endangered species

- **Bechstein's bat (Myotis bechsteinii)**
  BfN Red List 2 (critically endangered)
- **Grey long-eared bat (Plecotus austriacus)**
  BfN Red List 2 (critically endangered)
- **Corn bunting (Emberiza calandra)**
  BfN Red List 3 (endangered)
- **Red kite (Milvus milvus)**
  BfN Red List * (least concern)
- **Brandt's bat (Myotis brandtii)**
  BfN Red List V (near threatened)
- **Little ringed plover (Charadrius dubius)**
  BfN Red List * (least concern)
- **Western marsh harrier (Circus aeruginosus)**
  BfN Red List * (least concern)
- **Eurasian hobby (Falco subbuteo)**
  BfN Red List 3 (endangered)
- **Golden oriole (Oriolus oriolus)**
  BfN Red List V (near threatened)
- **Grey partridge (Perdix perdix)**
  BfN Red List 2 (critically endangered)
- **Common redstart (Phoenicurus phoenicurus)**
  BfN Red List * (least concern)
- **Turtle dove (Streptopelia turtur)**
  BfN Red List 3 (endangered)
- **Natterjack toad (Bufo calamita)**
  BfN Red List V (near threatened)
- **Green toad (Bufo viridis)**
  BfN Red List 3 (endangered)

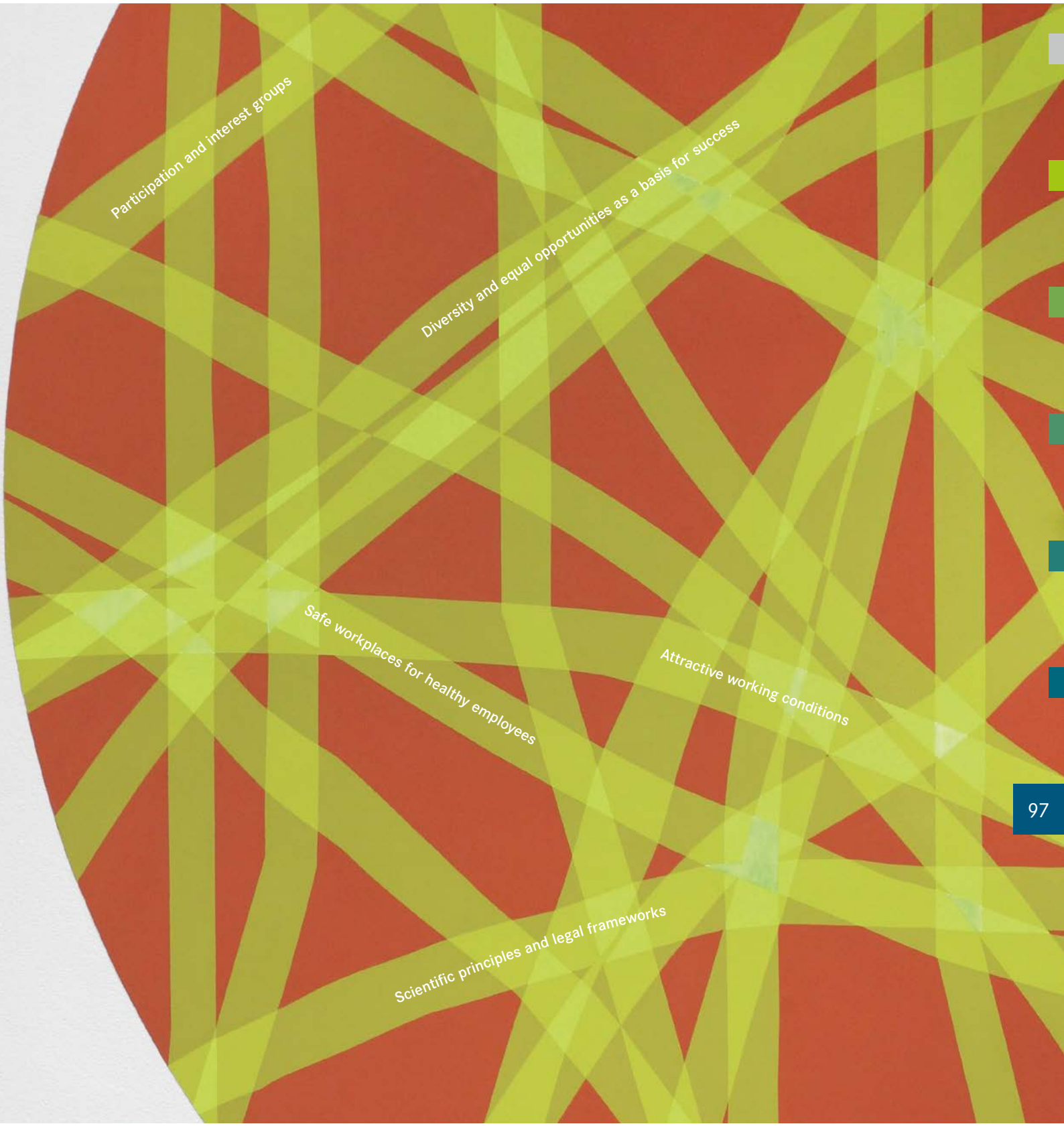
Forschungszentrum Jülich borders on several nature reserves. To the west of the campus lies the national nature reserve of Langenbroich and Stetternich Forest that is intended to ensure the survival of the endangered forest dominated by ash and bird cherry trees and its characteristic flora and fauna. To the northwest of the BAW site lies the 11 ha national nature reserve of Jülich's former railway repair shop. It serves to conserve and optimize rare pioneer and ruderal communities in a dry habitat rich in species. This applies, in particular, to the natterjack toad population. About 700 m to the northeast of the campus is the Natura-2000-FFH reserve of Lindenberg Forest. The objective for the development of the 103 ha area is to conserve and optimize a forest stand in a landscape that is otherwise poor in forests and to convert coniferous forest into indigenous deciduous forest. The area is a stepping stone habitat and therefore an important element in the network of forest habitats in the Jülich area. The confluence of the River Inde, located some 800 m to the southwest of Forschungszentrum Jülich, is also a Natura-2000-FFH reserve. The area covering about 92 ha enables the river to flow in its natural bed, protects the softwood-flood plain vegetation, and ensures its undisturbed further development. As the largest area of softwood-flood plain vegetation, this section of the River Rur is of great significance as a centre for the further distribution of species typical of this type of habitat. The velocity of this body of water, which is particularly important for amphibians and waterfowl, will be reduced to enable the formation of near-natural vegetation structures and the water area will be left to develop on its own.

Theoretically, the premises of Forschungszentrum Jülich provide a habitat for many different endangered species. Surveys of the premises carried out by an office for landscape and environmental planning did not, however, find any indications of the campus being used by bats and no increased importance for any planning-relevant species of birds.

As part of construction projects, Forschungszentrum Jülich compensates for any loss of vegetation by replacement planting. This is to prevent any significant reduction in the tree population on campus. On Open Day 2013, 40 apple trees were planted on campus next to building 03.9 together with visitors. Children in particular were invited to sponsor a tree and help to create the campus of the future. The trees were selected according to a number of ecological criteria. The species planted are resistant to diseases and therefore require little or no pesticides. In addition, optimal cross-pollination is also ensured.



The employees on its campus are at the heart of Forschungszentrum Jülich's social responsibility. Offering them attractive working conditions, ensuring their safety, and taking care of their health are of primary concern for Jülich. Activities in these areas focus on a responsible personnel management policy with intensive employee co-determination, strategic support measures for young talent, wide-ranging options for further education, and opportunities to combine family and career. In achieving these goals, Forschungszentrum Jülich attaches great significance to diversity and to equal opportunities for all of its employees.


Participation and interest groups
Diversity and equal opportunities as a basis for success
Safe workplaces for healthy employees
Attractive working conditions
Scientific principles and legal frameworks

Social Responsibility

The employees on its campus are at the heart of Forschungszentrum Jülich's social responsibility. Offering them attractive working conditions, ensuring their safety, and taking care of their health are of primary concern for Jülich. Activities in these areas focus on a responsible personnel management policy with intensive employee co-determination, strategic support measures for young talent, wide-ranging options for further education, and opportunities to combine family and career. In achieving these goals, Forschungszentrum Jülich attaches great significance to diversity and to equal opportunities for all of its employees.

Attractive working conditions

Forschungszentrum Jülich believes that its employees are the keystone to its success. It expresses this belief by making its employees an integral part of its institutional guiding principles:

"We regard the creativity and motivation of our staff as the greatest asset of our research centre."

For Forschungszentrum Jülich, a committed personnel policy is a decisive factor in consolidating its leading position in the competition for the brightest minds in science.

The central service provider responsible for all personnel matters is Personnel, comprising the six divisions of Personnel Management, Human Resource Development, Human Resource Planning and Controlling, Employee Payroll, the Vocational Training Centre, and the Medical Service. One of Personnel's most important tasks is recruiting qualified and motivated employees for the scientific institutes and facilities as well as for all other areas of Forschungszentrum Jülich, particularly given the shortage of skilled personnel that has been made more acute by demographic change. This also involves providing dedicated support for young talent, in the form of training in various occupations, work placements for school students, and the supervision of student dissertation work among other measures. Personnel is also responsible for coordinating and providing support to these groups. Furthermore, it is also continuously engaged in developing and implementing concepts for human resource development. This is a further step in combating the shortage of skilled personnel and equipping current employees with the skills needed for the future.

To attract new employees and retain them over the long term, it is important to provide attractive working conditions at Forschungszentrum Jülich. Thus, opportunities for combining family and career and an extensive range of further education options to prepare employees for future work are core components of Jülich's personnel policy.

Jülich's employees

As of 31 December 2013, a total of 5,534 employees were working at Forschungszentrum Jülich; 35.8 % of those were women, which was 1 % more than in the previous year. As of 31 December 2012, the total number of employees stood at 5,234. In 2012, the percentages of scientific personnel and technical personnel each amounted to 31.7 %. 13.2 % of the total workforce was employed in administration and 14.6 % in the project management organizations. 420 junior employees were also employed, with 118 students and 302 trainees.

Over 500 new employees started work at Forschungszentrum Jülich in 2012. In comparison, 762 people left employment. However, high fluctuation rates are common in the scientific community.

The average age of women employed at Forschungszentrum Jülich was 39. Among men it was slightly higher, at 42. More than half of the employees were under 40 years of age. Depending on the age of employees, different concerns take on more or less importance and must be given appropriate consideration by an employer. For employees under the age of 40, the most pressing concern is the opportunity to combine family and career. For those aged between 51 and 60, however, there is a stronger focus on promoting productivity, health, and wellbeing. As regards those over 60, a decisive competitive advantage is a favourable strategy for the transition to retirement, accompanied by flexible and individual working hours. Forschungszentrum Jülich addresses these challenges with a range of offers and programmes, which will be outlined later in this section. These are an important factor in Forschungszentrum Jülich's strategy for competing for skilled personnel as an attractive employer.

Number of employees (as of 2012)

	2012	2011	2010	2009
Total number of employees	**5,234**	**4,957**	**4,744**	**4,564**
of which full-time	3,823	3,614	3,491	3,352
of which part time	1,411	1,343	1,253	1,212
of which fixed-term	2,099	1,937	1,783	1,664
of which permanent	3,135	3,020	2,961	2,900
of which scientific personnel	845	805	697	677
of which technical personnel	904	896	897	899
of which other personnel	1,386	1,319	1,367	1,324
Scientific personnel	**1,658**	**1,549**	**1,460**	**1,323**
of which PhD students	469	409	390	347
Technical personnel	**1,662**	**1,642**	**1,643**	**1,611**
Administration	**691**	**647**	**624**	**608**
Project management organizations	**766**	**656**	**575**	**526**
Other employees	**457**	**463**	**442**	**496**
of which undergraduates/ postgraduates	118	133	112	134
of which trainees	302	291	298	329
of which students on placement	1	1	2	4
students on unpaid placement*	501			
of which scholarship holders	36	38	30	29
Breakdown by location	**5,234**	**4,957**	**4,744**	**4,564**
Jülich	4,896	4,719	4,537	4,374
Berlin	267	210	179	162
Rostock	29	28	28	28
Garching	42			

Personnel marketing

The number of projects and collaborations at Forschungszentrum Jülich has risen sharply over the past few years. This has gone hand in hand with a continuous growth in the number of employees. For example, there were 4,354 employees working at Jülich at the end of 2003. Nine years later, Forschungszentrum Jülich had almost 900 more employees. The rising number of employees in addition to the high fluctuation rates common in the scientific community mean that Jülich fills over 500 vacancies every year.

As a result, Forschungszentrum Jülich is faced with the challenge of meeting demands for high-quality personnel every year. Having to compete with numerous well-respected research institutions and companies is just one of the difficulties involved in recruiting new skilled employees, however. Demographic change and the associated decline in the number of qualified employees is a further factor complicating the situation on the labour market. This is especially true of STEM fields (i.e. science, technology, engineering, and mathematics), where there are often more vacant positions than there are graduates and trainees. In comparison to the many employers based in attractive urban areas, Forschungszentrum Jülich's relatively remote location puts it at a disadvantage. This is particularly relevant in the case of younger applicants, who give some consideration to their potential future home when selecting an employer.

These recruitment difficulties may occasionally result in positions remaining unfilled. This leads to funding based on appropriate staff, or on a specific time frame, being lost. Furthermore, the cost of placing job advertisements in various media can be very high. In light of these diverse circumstances, Forschungszentrum Jülich has included personnel shortages as an explicit factor in its risk report.

To counteract this risk, Forschungszentrum Jülich pursues a committed personnel policy. Internal and external marketing strategies for attracting employees and trainees are a vital element of this policy. As part of its continued efforts, Personnel seizes every opportunity of presenting Forschungszentrum Jülich as an attractive employer both internally and externally. Long-term personnel marketing strategies, in particular, are an important element of social sustainability and are vital to Jülich's future success.

At the request of the Board of Directors, Jülich's personnel marketing strategy was expanded in spring 2013 to include the following measures:

- Consistent further development of marketing strategies for attracting employees and trainees with regard to relevant target groups, suitable target regions, appropriate target audience messages, and successful marketing instruments
- Increased internal and external networking with relevant contacts to exploit areas of synergy and to raise Forschungszentrum Jülich's profile at appropriate locations as an attractive employer and training institution
- Visibility at target-group-specific national and international recruitment and training fairs
- Integration of the topic of diversity and equal opportunities into all activities, to emphasize Jülich's commitment to providing opportunities for combining family and career as well as to recruiting excellent women scientists
- Use and optimization of communication channels relevant to different target groups, such as the careers web page, social media, and image advertising, as well as appropriate trade fair infrastructures and merchandise

Furthermore, employees themselves also act as ambassadors for Forschungszentrum Jülich in their external activities. The presence of a large number of Jülich scientists at numerous conferences, and the commitment shown in their teaching activities, are valuable opportunities not available to other companies.

To enhance its attractiveness for dual-career couples, Forschungszentrum Jülich provides a Dual Career Service. It is aimed at applicants for executive positions in science as well as in the technical and administrative infrastructure and their partners. The Dual Career Service is on hand to provide these couples with guidance and advice on various matters. For example, it assists applicants' partners in their job search by reviewing their application documents – a service which is particularly helpful to skilled workers from abroad who are applying for positions in Germany. Furthermore, it provides information on job opportunities at Forschungszentrum Jülich as well as on the regional job market. Forschungszentrum Jülich's Dual Career Service is a founding member of the Dual Career Network Rhineland and cooperates closely with the Dual Career Service of RWTH Aachen University.

A continuous evaluation of all activities at Personnel and the establishment of appropriate reporting structures ensure that existing formats are continually developed and optimized and that new activities are incorporated.

Employment models

In principle, the working hours for the German Civil Service apply to employees of Forschungszentrum Jülich. These are laid down in the Collective Agreement for the Civil Service (TVöD) and correspond to 39 hours per week as of 1 October 2005. Payment is also in accordance with the TVöD, but the agreement does not provide for special payments.

However, Forschungszentrum Jülich is aware of its employees' different needs with respect to working hours, which are primarily due to private circumstances. For example, parents require a different degree of flexibility in their working hours than newly qualified single employees. For this reason, Jülich offers various employment models geared towards its employees' different stages of life. These models help to ensure the successful reconciliation of family and career.

Thus, flexitime regulations with no defined core hours are in effect for all employees. This makes it possible to react flexibly to individual incidents such as a doctor's appointment or having to look after children at short notice. By offering optional teleworking from home, Forschungszentrum Jülich caters for the circumstances of parents and of employees who provide care for family members, for example. At the moment, about 200 employees make use of teleworking at Forschungszentrum Jülich. In addition, ad hoc teleworking will also be offered from March 2014, initially scheduled for a limited period of one year. As part of this one-year pilot project, employees can carry out their work from home on ten days per year.

For employees who decide not to work full time for reasons related to the upbringing of children or the care of family members, Forschungszentrum Jülich also offers the option of working part time. As of 31 December 2012, the percentage of part-time employees was approximately 27 %. In well-founded cases, such as caring for a family member, it is also possible to take special unpaid leave.

In addition to looking after children, which generally occurs at the beginning of an employee's working life, and caring for family members, which is more frequently required after the age of 50, the transition to retirement is a third stage of an employee's life to which an employer should respond by offering appropriate options. Forschungszentrum Jülich therefore offers specific solutions for this transitional period, one example being early retirement. At present, Personnel is also developing an internal regulation to continue employing former staff members after they have retired. This will allow Forschungszentrum Jülich to ensure that know-how is passed on. The regulation will also provide retired staff with the opportunity to successively reduce their working hours and thus avoid making a radical change.

Joint appointments

To retain its place among the leading research institutions in the scientific arena, Forschungszentrum Jülich aims to establish strategic partnerships with universities in Germany and abroad. One of the key elements in this strategy is the joint appointment of heads of institutes at Jülich in conjunction with universities. For the scientists appointed, this is an employment model that combines work on campus with teaching activities at a university. A major focus in these activities is Jülich's collaboration with RWTH Aachen University, with whom the largest number of joint professors have been appointed. As of 31 December 2013, 105 professors had been appointed jointly with 11 universities, including those in Cologne, Bochum, and Münster.

Total appointments (as of 31.12.2012)

Universität	Jülich model	Reverse model	Total
FH Aachen	8		8
HHU Düsseldorf	11	3	14
RWTH Aachen	37	7	44
Uni Bochum	4		4
Uni Bonn	7	3	10
Uni Duisburg-Essen	1		1
Uni Köln	7	1	8
Uni Münster	1		1
Uni Regensburg	1		1
Uni Stuttgart	1		1
Uni Wuppertal	3		3
Total	81	14	95

This table includes only those professors appointed to grades W1, W2 or W3 according to the Jülich model and according to the reverse Jülich model, including GRS.

Jülich model: Directors of institutes at Forschungszentrum Jülich are appointed professor in a joint procedure with one of the partner universities and are simultaneously seconded by the university to Forschungszentrum Jülich in order to fulfil their duties as head of institute at Jülich.

Reverse Jülich model: Professors whose primary employment is at their university also work as directors of an institute at Jülich.

Support for young talent

Ever since its foundation, Forschungszentrum Jülich has promoted the aim of providing support for young talent through a number of decentralized measures and instruments. These not only target young people in academic courses of study, but also those following non-academic career paths. In the juelich_horizons programme launched in 2013, activities in this area will be enhanced further. The programme is divided into four areas: juelich_impulse for children and teenagers, juelich_tracks for vocational training and dual study programmes, juelich_chances for university students and graduates, and juelich_heads for early-career employees in top-level research.

Forschungszentrum Jülich offers vocational training in 24 different occupations. Since September 2013, RWTH Aachen University and the Jülich Aachen Research Alliance (JARA) have also offered joint vocational training for electronics technicians for devices and systems. In addition, biological and chemical laboratory technicians can complete a part-time bachelor's degree at Hogeschool Zuyd in Heerlen, the Netherlands. Around 300 trainees are currently pursuing vocational training at Forschungszentrum Jülich. In 2012, four Jülich trainees were among the top trainees in the whole of Germany and were recognized for their achievements by the Federal Chamber of Industry and Commerce.

Parallel to vocational training, six courses of study are offered in the form of a dual study programme in collaboration with Aachen University of Applied Sciences and FOM University of Applied Sciences. In 2012, 115 students successfully applied for a place on one of the courses. Moreover, each year around 140 students are given the opportunity to gain an insight into work at Forschungszentrum Jülich and to get their first taste of professional life by completing a work placement. One of these students was selected as Germany's intern of the year as part of "Tag der Praktikanten", a nationwide private business initiative for interns, on the basis of his outstanding work and confident personality.

Vocational training occupations at a glance

Scientific occupations
Biological laboratory technician
Chemical laboratory technician
Physics laboratory technician
Commercial occupations
Office administrator
Office communications specialist
Technical occupations
Plant mechanic for sanitary, heating and air conditioning systems
Electronics technician for industrial engineering
Electronics technician for devices and systems
Information technology specialist specializing in system integration
Sewage engineering technician
Water supply engineering technician
Glassware maker
Industrial electrician specializing in industrial engineering
Industrial mechanic for precision instruments
Motor vehicle mechatronics technician
Mechatronics technician for refrigeration technology
Technical product designer specializing in machinery and plant construction
Materials tester
Other occupations
Specialist in media and information services specializing in librarianship
Protection and safety specialist
Professional caterer
Media designer, digital and print media
Print media technologist

Overview of dual study programmes

Bachelor of Engineering Physics and physics laboratory assistant (Chamber of Industry and Commerce – IHK)
Bachelor of Science and chemistry laboratory assistant (IHK)
Bachelor of Arts in Business Administration and office communications specialist (IHK)
Bachelor of Engineering in Electrical Engineering and electronics technician for industrial engineering (IHK)
Bachelor of Mechanical Engineering and industrial mechanic (IHK)
Bachelor of Science in Scientific Programming and mathematical and technical software developer (IHK)

As of 31 December 2013, 695 PhD students were employed at Jülich – of whom around 35 % were women. Forschungszentrum Jülich also collaborates with eleven graduate colleges and schools which offer subject-specific training as well as training in soft skills. These include the German Research School for Simulation Sciences (GRS), which gives around 100 postgraduate and PhD students the chance to learn the basic principles of simulation sciences and perform cutting-edge research. Students at GRS focus on computer-aided natural and engineering sciences, and courses are developed by scientific personnel and professors from different disciplines at GRS, Forschungszentrum Jülich, and RWTH Aachen University. The International Helmholtz Research School BioSoft offers excellent opportunities for PhD theses in soft matter and biophysics. The courses prepare scholarship holders for interdisciplinary work at the intersection of biology, chemistry, and physics. Seminars on soft skills are also offered on topics ranging from preparing for a PhD thesis to training courses for job applications and leadership skills. HITEC is a Helmholtz Graduate School of Forschungszentrum Jülich and the five partner universities Aachen, Bochum, Cologne, Düsseldorf, and Wuppertal focusing on energy and climate research. Almost all PhD students in the fields of energy and environmental research at Jülich take part. HITEC provides participants with the expertise and the methodological and communication skills necessary for scientific work at the highest international level. Furthermore, it provides well-founded interdisciplinary know-how on the scientific, technical, and social dimensions of the topic of energy and climate, such as the complex relations between the energy supply and its impact on climate change.

Forschungszentrum Jülich offers specific funding programmes for international students. For instance, ten to fifteen young Chinese scientists come to Jülich each year as part of the Chinese Scholarship Council (CSC) programme. Schools held during the university holidays – such as the IFF Spring School, which has been running for over 40 years and attracted a total of 536 researchers in 2012 and 2013 – intensify cooperation with partner research institutions and establish personal contacts between participants. Experience has shown that many of the participants return to Jülich at a later stage in their careers.

Early-career scientists in their postdoc phase benefit from the close cooperation between Jülich's institutes and the universities. For example, Forschungszentrum Jülich assists postdocs in establishing independent young investigators groups. In 2013, 21 young investigators groups were working at Jülich, of which 14 were Helmholtz Young Investigators Groups. Of the 21 groups, 8 were headed by women and 12 by international early-career scientists. Eleven of the group heads were junior professors. In 2013, five young investigators groups were evaluated by internationally respected experts. In each case, the experts recommended that a tenured position be offered to the group head. In the call for applications for the Helmholtz Young Investigators Groups in 2013, Forschungszentrum Jülich was particularly successful in comparison to other Helmholtz centres. Of the 19 grants awarded, five went to early-career researchers from Jülich. These groups will start work in 2014.

The Helmholtz postdoc programme, in which Forschungszentrum Jülich also participates, allows promising scientists to expand their own areas of research after successfully completing their PhDs. With seven candidates selected for funding in 2012 and three in 2013, Forschungszentrum Jülich was the most successful Helmholtz centre in the first round of the funding programme.

Further training

Alongside support measures for young talent, further training for employees is the second pillar of Forschungszentrum Jülich's pursuit of excellence. Human Resource Development is responsible for internal training measures at Jülich. It organizes over 300 courses each year with the aim of continuously enhancing employees' qualifications. Each year, employees make use of a total of 4,000 further education and training places.

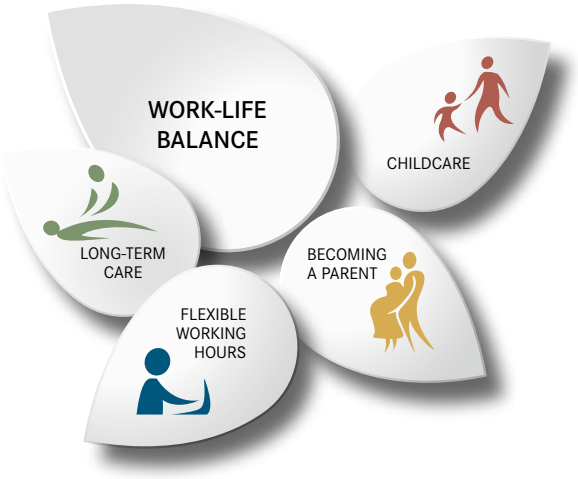
The content of the annual training programme is based on feedback from the individual organizational units. The qualification process is selective and efficient as the programme is tailored to actual demand. The courses on offer cover a broad spectrum. In addition to traditional computer and language courses, as well as seminars on all kinds of specialized topics, Human Resource Development offers a wide range of measures for the acquisition of soft skills. Moreover, programmes are offered for defined target groups – such as PhD programmes or development programmes for senior staff – as are specific training courses for entire organizational units, such as team building activities or coaching for senior staff.

The training programme and a list of upcoming courses are available on the intranet of Forschungszentrum Jülich. A dedicated newsletter with information on current training courses is also issued regularly.

The use of e-learning formats for further training is intended to ensure an increased focus on reconciling family and career in skills development. Following a successful introductory period, blended learning formats were also continued, i.e. using a combination of face-to-face sessions and e-learning to teach course content, such as the Microsoft Office software in IT. This enables participants to use the Internet on their own computers at home to complete courses they have already begun.

Total funds spent on skills development for employees in 2012 amounted to over € 1.1 million. However, Forschungszentrum Jülich is not always in a position to fund individual further training requests. A basic prerequisite for approving a request is a professional need for training with respect to an employee's current or future work at Jülich. Should Forschungszentrum Jülich be unable to cover the cost of further training, a suitable alternative may be funding provided by public programmes. Human Resource Development has compiled a list of the most important support programmes for all employees as well as those for senior staff and decentralized administrative staff in the organizational units. It also offers advice to all employees interested in these programmes.

Opportunity to combine family and career



The opportunity to combine family and career is one of the most important factors influencing scientists' and specialists' decision on whether to accept a position within a company or a research institution. Forschungszentrum Jülich is conscious of this fact and therefore endeavours to provide a family-friendly working environment on campus. Couples who do not have children are explicitly included in the concept of family.

In order to strategically address the process of improving opportunities to combine family and career, Forschungszentrum Jülich decided to conduct the "berufundfamilie" audit in 2010. This certificate is recommended by all leading associations in German industry and is sponsored by the federal government. As a strategic management instrument, the audit by non-profit organization berufundfamilie gGmbH supports companies, universities, and local authorities in implementing a family-friendly staff policy.

The first certificate was valid until 2013 and set out a number of goals and measures that were implemented by the end of the certification period. For example, as part of this process a comprehensive health management policy was put into effect. In addition to a range of options for stress management, preventive measures are currently offered for building up a tolerance to stressful situations and for reflecting on work-life balance. Another important goal was to make working hours more flexible, which is provided for in various employment models at Forschungszentrum Jülich (p. 101). This measure was of particular significance for parents and for those who provide care for family members in their efforts to combine family and career.

Planned development of company kindergarten

To provide further support for parents, Forschungszentrum Jülich offers and arranges childcare facilities for its employees – such as rooms for parents and children, a toddlers group, the "Kleine Füchse" daycare centre, and activities organized during school holidays. The first room for parents and children was opened in March 2012. It provides a safe, child-friendly working environment for parents with children aged between six months and twelve years who need to bring their children to work with them due to unexpected short-term childcare difficulties. Jülich thus enables parents to look after their children at work in an emergency, while continuing with their work. As this offer met with high demand and a very positive response, a second room for parents and children was opened in October 2013. The possibility of opening further such rooms at locations on and off campus is being considered. Employees at Forschungszentrum Jülich are also entitled to a reimbursement of childcare fees incurred for additional childcare requirements at their place of residence while participating in an official work-related training course. In spite of these support measures, a survey on childcare requirements in 2012 revealed that without exception, parents want these facilities to be expanded further – a concern that Forschungszentrum Jülich is continuing to address.

Beyond childcare facilities and flexible working hours, employees at Jülich are of course also entitled to take parental leave, leave to care for a family member, and special unpaid leave. However, returning to everyday work after taking such leave often proves very challenging. Forschungszentrum Jülich therefore supports its employees by providing a special programme for those returning to work. The programme consists of four elements and is started even before the period of parental or special leave has begun. The aim of the programme is to reduce the length of time away from work as much as possible, for example by discussing options for childcare or other care. A further goal is to facilitate an easier, smoother return to work. In this regard, Forschungszentrum Jülich helps employees to stay in touch with developments on campus, and encourages them to participate in events. The third main goal of the programme focuses on the acquisition of qualifications while on leave. This enables employees to maintain or even expand their professional skills.

After the expiry of the first "berufundfamilie" certificate, the re-audit process in 2013 marked a second important step in the development of improved opportunities for combining family and career at Jülich. The new certificate is valid until 2016 and, over the next three years, will ensure the continuation of the process that has been set in motion. In this way, the overall concept of a family-friendly campus – with the slogan "Work-Life Balance" – will be sustainably integrated into Jülich's corporate policy in the long term.

More than 80 employees from all levels of seniority and all organizational units were involved in the re-audit process. A total of 22 goals, with 70 measures, were set for the period up to 2016. Three major challenges to be addressed over the coming three years are the establishment of a daycare centre on campus, transparency in communication, and the involvement of all senior members of staff. Efficient processes and conditions will also enable employees with family commitments to reconcile their everyday work with private concerns. The target agreements defined as part of the "berufundfamilie" re-audit were ratified by the Board of Directors of Forschungszentrum Jülich.

Indeed, senior members of staff have an important part to play in the implementation of the concept. They must be made aware of issues in this regard and be available and equipped to work together with their employees to agree on suitable solutions for each individual situation. To facilitate this, all training courses offered for senior staff cover topics such as family-friendly management and the integration of measures for combining family and career in day-to-day management tasks. In addition, a seminar is also provided on health awareness in management.

Diversity and equal opportunities as a basis for success

International employees, equal opportunities for men and women, and the integration of people with disabilities are essential in order to retain Forschungszentrum Jülich's leading position in the competition between international research institutions.

Forschungszentrum Jülich therefore attaches great significance to collaboration with researchers abroad and simultaneously encourages foreign scientists to come to Jülich for research stays. For example, a third of all Jülich PhD students are from countries other than Germany.

Equal opportunities for men and women in their careers – to realize this goal at Jülich, the Board of Directors established the Equal Opportunities Bureau in 1998. The Equal Opportunities Bureau offers intensive advisory services, in particular to women – who are still under-represented in executive positions at Forschungszentrum Jülich as at other organizations – in order to prepare them for a career in research and support them

along the way. This includes specific career advisory services and information on funding opportunities as well as special training and mentoring programmes. One such programme is TANDEMplus, a cooperation with RWTH Aachen University and Karlsruhe Institute of Technology, in which five employees from Forschungszentrum Jülich are currently participating. Another is the Helmholtz mentoring programme “Taking the lead”, which currently has two participants from Jülich.

In addition, the Equal Opportunities Bureau provides services that help reconcile work and family life (p. 106), such as assistance in finding childcare facilities and advice on telework and time- and location-independent training courses (p. 105). In order to further improve support measures in this area, the “berufundfamilie” audit was conducted at Forschungszentrum Jülich in 2010. Jülich was successfully re-audited in 2013 (p. 106).

In 2013, a quota for women was introduced for vacant and newly created positions at Forschungszentrum Jülich, which is modelled on the reporting system of the Joint Science Conference (GWK). As a result, self-imposed quotas must be defined for different levels of management and salary grades. In defining these quotas, Forschungszentrum Jülich has set itself the goal of recruiting a woman for every third vacant or newly created scientific position by 31 December 2017.

To support the institutes in fulfilling these quotas, a number of measures have been established. For example, initial funding from central funds is available to cover a percentage of the personnel costs for a given position for one year, and development programmes specifically addressing women are also offered.

After Jülich’s new Articles of Association came into force on 14 November 2012, the guidelines for appointing professors were reviewed in 2013. The new version contains various measures designed to give increased consideration to women applicants in appointment procedures, such as deciding on a set number of applications from women candidates at the start of the process. Another new addition is the systematic evaluation of candidates’ managerial experience and abilities. The recruitment initiative led by the Helmholtz Association assists suitable women candidates in their applications with a view to increasing the share of women appointed as W3 salary grade professors. This assistance has already contributed to the success of four women scientists.

Forschungszentrum Jülich also attaches great significance to equal opportunities in appointments to committees and assessment panels that are responsible for personnel issues. Thus, at least one member of each Search Committee is a female scientific and technical employee from the institute in question. In November 2012, Forschungszentrum Jülich hosted a conference organized by the working group Women at Research Centres (akfifz) on the topic of equal opportunities as a competitive edge on the international scene. The

event, which attracted high-ranking national and international speakers, focused partly on the competitive advantages to be gained by companies that increasingly employ and support women in executive positions. Another major topic was identifying the measures and regulatory mechanisms required to attract highly qualified women employees in a fiercely competitive labour market.

To raise external awareness of the principle of equal opportunities, Forschungszentrum Jülich is careful to use appropriate language in its internal and external publications, in its press and public relations, and on its websites. The Corporate Communications division makes every effort to address both sexes in its written communications. Gender-neutral language is also used in new standards and legal bases.

However, equal opportunities at Forschungszentrum Jülich involves more than equality between women and men. The integration of people with disabilities is also a decisive factor in activities at Human Resource Development. To this end, Jülich adopted an integration agreement in 2004. It aims to remove or alleviate barriers preventing employees with severe disabilities from carrying out their work, eliminate difficulties in employing people with disabilities, and encourage these employees' continuing professional development. In 2013, Forschungszentrum Jülich was designated as "disability friendly" by the working group for inclusion (AKI) of the town of Jülich for its work on integration. Forschungszentrum Jülich received the award in recognition of its openness and friendliness in its dealings with people with disabilities and its willingness to provide disabled access to its buildings.

Participation and interest groups – important instruments of sustainable change

Processes of change can only be actively shaped with the support of employees. Forschungszentrum Jülich therefore involves its employees in this change. As the transformation to a sustainable campus is a long-term undertaking, this involvement at various levels will be a continuous part of the project throughout its entire duration.

Sustainable campus development with the Sustainable Campus Arena

Jülich cannot become a sustainable research centre without the participation and commitment of its employees. For this reason, the Sustainable Campus staff unit launched the "Sustainable Campus Arena", a central instrument in the form of an online discussion forum. The Sustainable Campus Arena can be accessed via the intranet of Forschungszentrum Jülich and, as a moderated online forum, offers all employees the opportunity to learn about topics related to the sustainable campus as well as to discuss and play an active part in shaping the process of sustainable change. Topics discussed in the Arena include mobility on campus, energy efficiency in laboratories and offices, and ways of making the campus more sustainable. Through the networking of the know-how and the different perspectives collected on campus, Forschungszentrum Jülich hopes to gain new impetus for the sustainable development of the campus. The task of the moderators is therefore to initiate topics for discussion, monitor the discussions, and above all to compile constructive suggestions and submit them to the Sustainable Campus staff unit and the Board of Directors.

Co-determination opportunities

A Works Council represents the interests of employees at Forschungszentrum Jülich. There are also various interest groups whose members sit on numerous committees or speak on behalf of particular groups in the workforce.

The Works Council comprises the elected representatives of the employees of Forschungszentrum Jülich. In addition to the Works Council at Jülich, employee participation bodies are also active at Jülich's sites in Berlin, Warnemünde, and Munich. The General Works Council is responsible for all of Jülich's sites and is based at Jülich. The council members represent the interests and rights of Forschungszentrum Jülich's employees in all dealings with the management of Forschungszentrum Jülich and of its branch offices. Their tasks include advising colleagues on matters of day-to-day work and their employment. Matters concerning all of Forschungszentrum Jülich's sites are dealt with by the General Works Council. In addition to the Works Councils, six further interest groups support specific employee groups at Forschungszentrum Jülich and represent those employees' rights on important committees.

Two scientific and technical employees sit on the Supervisory Board. They are elected as representatives by all employees in a secret ballot. Employees can contact either of them about any issues concerning the Supervisory Board. Representatives are also elected to the Scientific and Technical Council (WTR) by Jülich's scientific and technical employees. They represent these employees from the subinstitutes on the council and inform their colleagues of developments within WTR. The elected representatives in WTR meet delegates from other institutes on a regular basis in the Representatives' Assembly and represent the scientific interests of Forschungszentrum Jülich's scientific and technical employees.

The Framework Regulations for Institutes of Forschungszentrum Jülich describe the structures of co-determination in scientific matters within the scientific institutes and subinstitutes. Every employee is a member of an institute assembly or a subinstitute assembly that meets at least once a year. In addition, the institutes or their subinstitutes elect advisory committees that discuss all matters concerning the work programme and the allocation of resources within the framework of scientific and technical planning. Each institute and each subinstitute may define their own detailed rules for institute assemblies and advisory committees.

Employees with disabilities as well as young employees and trainees each have their own interest group at Forschungszentrum Jülich. The Disabled Persons' Representatives (SBVs) are the elected representatives of disabled colleagues at Forschungszentrum Jülich and have offices in Jülich and Berlin. They provide support for applications to have disabilities officially recognized or the degree of disability re-assessed, and help less severely disabled people to achieve the same rights as severely disabled people. Furthermore, the SBVs assist disabled colleagues in having their workplace equipped to meet their needs, and represent disabled employees in all matters related to their work and employment. The SBVs are involved in the recruitment process and ensure that qualified disabled people are invited to job interviews. The Young Employees' and Trainees' Representatives (JAVs) advocate the interests of young people (under the age of 18) and trainees (under the age of 25) at Forschungszentrum Jülich. The JAVs advise groups on legal matters related to their work and training, and assist them when work-related or personal problems arise.

Employee surveys

Employee surveys are an effective means of obtaining quantitative data from employees. During the period under review (2012–2013), Forschungszentrum Jülich made use of this instrument a total of six times and conducted surveys of different employee groups on various issues.

In order to create a basis for the selective improvement of childcare facilities, a survey on childcare requirements on the Jülich campus was conducted towards the end of 2012 (see "berufundfamilie" audit, p. 106). The survey targeted parents with children up to the age of 14. The results of the survey revealed a clear need for an improvement of childcare facilities at Jülich, including childcare during the school holidays. Those surveyed communicated a demand for an expansion of childcare facilities on campus or close to Forschungszentrum Jülich. They also stated that they want high-quality childcare and a staff-to-child ratio that is higher than the legal minimum. In return, they said that they were prepared to make an appropriate financial contribution.

An employee survey was also conducted to involve Forschungszentrum Jülich's employees in the process of campus development as part of the Urban Development Master Plan 2050 (see Chapter 5). Between June and December 2012, user interviews were conducted on the basis of a standardized questionnaire sent out in advance. The survey focused on human resource development, space requirements, changes in structural requirements, and current deficiencies. It also contained questions on overall campus development. The results indicated a demand for better facilities for meeting employees' day-to-day needs, a company kindergarten, and better local public transport connections to Forschungszentrum Jülich. The user survey was carried out by Technical Infrastructure and architectural firm Hegger-Hegger-Schleiff.

In 2012, Studium Universale, an initiative by Jülich PhD students, conducted a survey of PhD students on commuting patterns between Aachen and Jülich by bus in order to assess the demand for express bus services. On this basis, the bus service was extended. Furthermore, Studium Universale regularly encourages PhD students to participate in surveys associated with Helmholtz Juniors. Following surveys in 2008 and 2010, this Helmholtz PhD students' initiative conducted its third survey of PhD students throughout the Helmholtz Association in June–July 2012. PhD students were asked about the conditions in which they carry out their doctoral research as well as about any problems or demands. The survey formed the basis for the further improvement of conditions for PhD students within the Helmholtz Association.

The Works Council of Forschungszentrum Jülich conducted a survey on job satisfaction and the atmosphere at the workplace in 2013. Parameters such as communication, job satisfaction, working atmosphere, and teamwork – for example with superiors – were assessed. Almost 95 % of respondents stated that they enjoyed working at Forschungszentrum Jülich, with the interesting work and good working atmosphere being particularly appreciated. The working environment, flexible working hours, and job security were further reasons to continue working for Forschungszentrum Jülich in future.

In 2013, Forschungszentrum Jülich also supported the online survey on academic human resource development conducted by the HIS Institute of Higher Education Research and supported by the Federal Ministry of Education and Research (BMBF). The survey was prompted by the increased attention focused in recent years on the training of young scientists in Germany as a result of the Excellence Initiative. All scientific staff, PhD students, and postdocs were encouraged to participate in the online survey.

Safe workplace for healthy employees

Owing to the multitude of large-scale scientific facilities and to the hazardous substances sometimes handled as part of research activities, safety at work and health protection are important aspects of operations at Forschungszentrum Jülich. The General Safety Regulations thus contain provisions that must be observed in order to ensure the safety of everybody on campus at Forschungszentrum Jülich. These regulations are based on statutory provisions, requirements by the authorities, and the relevant technical standards. Every employee is obliged to contribute to maintaining safety and order at Forschungszentrum Jülich and to carefully observe the safety regulations. The Safety and Radiation Protection division is responsible for safety at Forschungszentrum Jülich.

The Medical Service is responsible for health management policy. Its tasks include performing all work-related medical check-ups, for example for new employees, and providing advice on health care.

Equipment safety

Research involves breaking new ground. In order to explore unknown processes, it is sometimes necessary to construct and operate novel devices or facilities. To ensure employee safety in particular, the relevant laws, provisions, accident prevention regulations, technical regulations, and internal regulations of Forschungszentrum Jülich must be complied with when planning, manufacturing, purchasing, and operating novel experimental equipment. For this purpose, a regulation on the planning and operation of experimental equipment is in place at Forschungszentrum Jülich. The current version entered into force in December 2010.

To ensure that experimental equipment is operated in compliance with legislation, all legal requirements must be taken into consideration, operational activities defined, and industrial safety requirements implemented during the planning phase. Particular care must be taken for experimental equipment with a unique design and process control and for which no operational experience is available.

The immission control officers must be notified of all applicable facilities or processes as well as hazardous substances so that an initial assessment of requirements can be carried out. This applies in particular to new facilities, processes, or operating ranges as soon as the planning stage has commenced. The Industrial Safety division also provides assistance on all issues surrounding the construction and safe operation of experimental equipment. The Licensing division is responsible for applying for the necessary legal licences.

Furthermore, operating instructions must be compiled for the operation of experimental equipment, and on this basis safety instructions must be prepared. These must contain the essential points enabling employees to work safely with the entire facility. Before a new experimental facility can be put into operation, a review must be carried out to ensure that all essential aspects enabling safe operation have been taken into account.

If the regulation on the planning and operation of experimental equipment is not complied with, the Board of Directors, in accordance with its obligations with respect to employee safety, has the right to prevent the experimental equipment from being put into operation or to cease the operation of a facility already in use.

Safety at work

Workplace safety at Forschungszentrum Jülich is assessed on the basis of a written hazard assessment. This assessment is explicitly provided for by various laws and ordinances to which Forschungszentrum Jülich is subject.

This legislation not only requires a hazard assessment but also specifies documentation requirements. Thus, a hazard assessment that has not been documented in writing is regarded as not having been undertaken and constitutes a grossly negligent violation of the accident prevention regulation for professional associations BGV A1. In the event of an accident for which insurance is provided by the professional association, this generally leads to the professional association initiating recourse proceedings against the person responsible.

Every senior member of staff, which includes heads of organizational units as well as master craftsmen, laboratory supervisors, and team leaders, is responsible for the completion of the hazard assessment in their area of responsibility. Specialists for safety at work and doctors at the Medical Service are available to advise them in this regard. A new hazard assessment must be conducted before a new employee commences work, in the event of major changes at the workplace, and following an accident.

German laws and regulations for industrial safety

Occupational safety and health act (ArbSchG) § 5
Works constitution act (BetrVG) § 90
Ordinance on industrial safety and health (BetrSichV) § 3
Hazardous substances ordinance (GefStoffV) § 6
Biological agents ordinance (BioStoffV) § 5 / § 6 / § 7 / § 8
Accident prevention regulation for professional associations BGV A1 § 3
Noise and vibrations occupational safety and health ordinance (LärmVibrationsArbSchV) § 3
Occupational safety and health ordinance on artificial optical radiation (OStrV) § 33

Hazard assessments are conducted in accordance with a predefined process. The workplace or the activity is first defined and, where necessary, its scope is narrowed. On the basis of a checklist, all potential hazards facing employees at the workplace are established. Each individual hazard defined is addressed in the summary of results. Measures are determined for eliminating and reducing these hazards, and the persons responsible for these measures are designated. The date by which each person must carry out each measure is then decided. An examination is then carried out to ensure that the implementation of the measures has been completed effectively. The summary of findings must be signed and followed up by the senior member of staff responsible.

In order to execute this process to a high standard, it is useful to give an internal presentation on the implementation of each step. Furthermore, training courses on hazard assessments are organized several times a year as part of Forschungszentrum Jülich's further training programme. Specialists for safety at work are also available for advice at all times. A list of contacts for specific topics is provided on the intranet.

Health protection

The Medical Service of Forschungszentrum Jülich is responsible for the area of health protection. As part of its duties, the team of 14 employees implements various measures in occupational medicine, sports medicine, environmental medicine, first aid, and social counselling. In addition, the Medical Service is the point of contact for people with disabilities and is part of Forschungszentrum Jülich's working group on health.

Work-related medical check-ups are performed in various situations for a number of reasons. These include new appointments, handling hazardous substances such as asbestos dust, heavy metals, or etching agents, activities in controlled areas or with biohazards, as well as special physical requirements at work.

The Medical Service is also involved in workplace evaluations as part of regular inspections in cooperation with the Works Council and safety experts. Evaluations are initiated by employees and superiors on a case-by-case basis. Moreover, the Medical Service can provide medical advice on a number of situations affecting work at Forschungszentrum Jülich. This includes ergonomic advice for working with computer screens, which is available in the event of work-related health problems. However, the Medical Service also provides advice on the reintegration of employees at work after illness or disablement, as well as on retraining, business trips to tropical countries or other long-distance destinations, and maternity leave.

General health protection measures include annual flu vaccinations as well as opportunities to test and seek advice at the Medical Service on risk factors such as blood lipid concentration, blood sugar levels, or blood pressure. The Medical Service's duties also involve organizing and providing advice on health care courses and presentations, and it also offers consultations and examinations in connection with work-related sport.

The Medical Service also provides a social counselling service. All employees can approach the Medical Service team to discuss issues such as personal or work-related crises, stress management, or advice for smokers. Should an employee make use of the social counselling service, the team is obliged to maintain confidentiality under German law.

In the event of an emergency, the Medical Service is responsible for providing medical care on the campus of Forschungszentrum Jülich. A fully equipped emergency vehicle for paramedics and an ambulance with a comprehensive range of equipment are provided for this purpose. This makes it possible to perform special treatment in the event of poisoning, chemical burns, other burns, or radionuclide contamination. Activities in the context of emergency medical care also include the provision of training for first aiders and further training for specialist staff.

Safety-related incidents in 2012

Despite an extensive range of preventive measures, work-related accidents do occur at Forschungszentrum Jülich as at other workplaces. Should an employee of Forschungszentrum Jülich sustain an accident at work, the senior member of staff responsible must be notified and a report on the accident written.

In 2012, 50 notifiable accidents were reported, of which 28 were work-related accidents and 16 were travel accidents. There was also one company sports accident and five work-related sports accidents. As a consequence of these accidents, a total of 1,418 working days were lost. This corresponds to an average of 26 working days lost per accident. The cost associated with the accidents in 2013 amounted to approximately € 445,000.

Safety training

Forschungszentrum Jülich works continuously to improve and maintain a high level of safety for its employees. Safety training is therefore offered throughout the year. This takes the form of presentations, courses, and consultations by both internal and external experts. Due to the wide range of research fields at Jülich, training covers a large number of topics and targets different groups within the research centre. Topics range from training courses for crane operators and forklift drivers to instruction sessions on operating laser devices and training courses on hazard assessments. Trainees and new employees are instructed on safety at work when they take up employment and during their training.

Training is organized by the Industrial Safety division. The health and safety committee also holds quarterly meetings in which reports are presented on the measures implemented.

Scientific principles and legal frameworks

In its role as a publicly funded scientific institution, Forschungszentrum Jülich believes it has a responsibility towards society. It therefore works towards providing comprehensive solutions to the grand challenges in the fields of health, energy and environment, and information technology – all while complying with legislation on research, labour practices, and regulations for the Civil Service.

Upholding good scientific practice

The Regulations for Upholding Good Scientific Practice at Forschungszentrum Jülich GmbH have been in force at Jülich since 1 January 2002. Employees are obliged to follow the principles of conscientiousness, integrity, open discourse, and clearly regulated procedures for dealing with misconduct. All senior staff must assume responsibility for ensuring that these quality standards are endorsed in the institutes. Forschungszentrum Jülich also believes that senior staff should provide a good example for young scientists at the beginning of their careers and emphasize the importance of good scientific practice.

An essential part of the regulations is formed by the three ombudsmen, who are appointed once every four years by the Board of Directors of Forschungszentrum Jülich. These ombudsmen are appointed for a term of four years during which time employees may approach them in relation to issues of scientific misconduct. The group of ombudsmen is composed of one current head of institute, one former head of institute, and one scientific or technical employee who also holds a professorship. At least one of these three people must be a woman.

The quality standards upheld at Jülich are founded on the framework provisions of the Helmholtz Association. These in turn are based on the German Research Foundation's Proposals for Safeguarding Good Scientific Practice.

Compliance with legislation and internal regulations

Work at Forschungszentrum Jülich is subject to numerous legal provisions that must be complied with in all areas. The Law division is a key player in this regard, monitoring the implementation and consideration of all relevant legislation. Due to the many and varied demands of a research centre operating in a worldwide scientific and economic context, the division's range of activities includes company, labour, contract, and commercial administration law. Other priorities comprise issues influenced by public law in the area of laws on public grants and project management.

Forschungszentrum Jülich is governed by the Corporate Sector Supervision and Transparency Act (KonTraG). This act aims to identify all risks to the viability of a company as early as possible. As stipulated in the act, a risk management system is also in place at Forschungszentrum Jülich. Jülich's risk representative presents the results of the risk inventory and assessment in an annual risk report. For further information on Forschungszentrum Jülich's risk management system, see Chapter 2 of this report ("Strategy"; p. 27).

The Patents division represents Forschungszentrum Jülich in all matters related to commercial protective rights. The division is responsible for the registration and enforcement of protective rights relating to inventions in which employees of Forschungszentrum Jülich are involved. In particular, it secures the innovative lead that results from the research and development work of Forschungszentrum Jülich's individual institutes.

Anti-corruption measures

To prevent corruption, Forschungszentrum Jülich provides its senior staff with detailed information on this issue. The corresponding internal regulations are laid down in the Code of Conduct for Corruption Prevention at Forschungszentrum Jülich GmbH. This identifies areas vulnerable to corruption and makes the employees working in those areas aware of the issue. The code contains rules of conduct for preventing and investigating corruption as well as regulations on the acceptance of rewards and gifts by federal employees. It also defines the obligation to register and apply for approval of secondary employment.

Regular training courses on corruption prevention are held for employees. An extensive training campaign for all senior staff was implemented in 2010 with an almost 100 % participation rate. In 2011, 12 people took part in training – one from infrastructure, one from research, and ten from Project Management Jülich. A further 15 people undertook training in 2012 – one from infrastructure and 14 from research. In 2013, a survey determined that there was no demand for further training measures.

No cases were recorded of bribes being accepted at Forschungszentrum Jülich in the period under review.

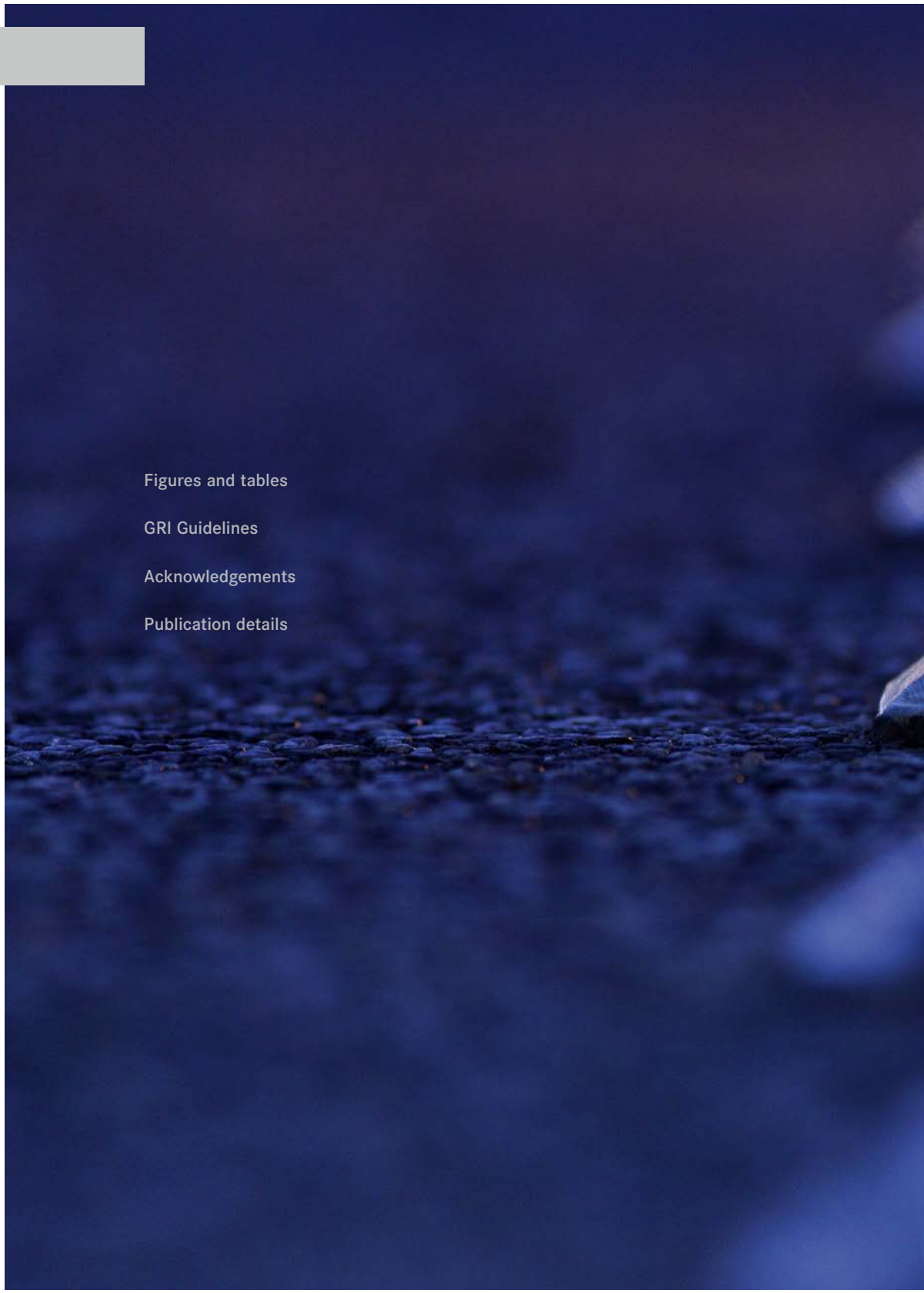
Guidelines on integration

The integration of people with disabilities in the working environment at Forschungszentrum Jülich is regulated by an integration agreement.

The agreement aims to remove or alleviate any barriers faced by those with disabilities. This explicitly involves supporting the careers of employees with disabilities, to be achieved by appointing disabled people and providing training, by funding measures for integration and rehabilitation, and by providing an accessible working environment. For instance, Forschungszentrum Jülich encourages applications from people with disabilities in all of its job advertisements. In this context, but also in a wider sense, Forschungszentrum Jülich is opposed to all forms of discrimination.

Auditing

In an effort to improve business processes as well as to ensure an efficient, economic, and proper use of funds and to safeguard assets, the Auditing staff unit, reporting directly to the Board of Directors, was established at Forschungszentrum Jülich. It investigates, assesses, and monitors aspects such as the efficacy of the internal control system and, in particular, of the processes involved in the accounting system. In addition, the internal Auditing team provides a number of auditing and consultancy services to third parties on behalf of both the Board of Directors and the Federal Ministry of Education and Research (BMBF), and also works closely with external audit bodies such as the German Federal Audit Office and the Audit Office of the Federal State of North Rhine-Westphalia as well as with public auditors. All auditing activities are based on the principles of the German Institute of Internal Auditors (DIIR) as well as those of the Institute of Public Auditors in Germany (IDW) and the recommendations compiled on this basis for the establishment of auditing departments in the Helmholtz Association of German Research Centres.



Figures and tables

Cooperations

The future lies in networked research. In 2012, Forschungszentrum Jülich worked on 263 nationally funded projects and 155 EU projects together with numerous partners from science and industry. A total of 50 national and international alliances were coordinated by Jülich.

Profit and loss statement 2012 (thousands of €)

	2012		2011	
Income from subsidies		513,534		594,449
Other subsidies		427,829		512,657
from federal government	377,142		453,560	
from state government	50,687		59,097	
Third-party project funding		85,705		81,792
from federal government	44,949		47,525	
from state government	8,640		6,735	
from DFG	6,592		5,212	
from others	11,356		11,508	
from EU	14,168		10,812	
Revenues and other income		116,179		147,341
Revenues from research, development, and use of research facilities		9,623		14,081
Revenues from licensing and know-how agreements		1,118		1,267
Revenues from project management organizations		57,843		32,050
Revenues from infrastructure services and the sale of materials		8,409		8,425
Revenues from the disposal of fixed assets		487		560
Increase or reduction in the inventory of work in progress and services (of which from EU: 968; prev. year: 9,706)		2,314		19,578
Other own work capitalized		602		712
Other operating income		31,645		60,487
Other interest and similar income		4,138		10,181
Allocations to special items for subsidies		-98,082		-61,498
Transferred subsidies		-45,057		-48,142
Income from subsidies, revenue, and other income available to cover expenses		**486,574**		**632,150**
Personnel costs		272,285		252,010
Operating costs		49,190		50,048
Material costs		23,728		26,378
Costs for energy and water		20,099		19,065
Costs for external research and development		5,363		4,605
Other costs		155,104		311,896
Other interest and similar costs		9,995		18,196
Non-recurring expenses		0.0		0.0
Depreciation on fixed assets		0.0		0.0
Depreciation on fixed assets		54,463		51,163
Income from liquidation of special items for subsidies		-54,463		-51,163
Total expenditure		486,574		632,150
Result of normal business activity/Annual result		0.0		0.0

Bodies and committees

Partners' Meeting

Partners: Federal Republic of Germany, represented by the Federal Ministry of Education and Research; Federal State of North Rhine-Westphalia, represented by the Ministry of Innovation, Science and Research

Supervisory Board

MinDir Dr. Karl Eugen Huthmacher (Chairman)
Federal Ministry of Education and Research

State Secretary Helmut Dockter (Vice-Chairman)
Ministry of Innovation, Science and Research of the State of North Rhine-Westphalia

Dr.-Ing. Manfred Bayerlein
Entrepreneur

Prof. Dr. Ulrike Beisiegel
University of Göttingen

Prof. Dr. Wolfgang Berens
University of Münster

MinDirig Berthold Goeke
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

State Secretary Peter Knitsch
Ministry of Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia

Dr. Arnd Jürgen Kuhn
Forschungszentrum Jülich, Institute of Bio- and Geosciences

MinDirig Prof. Dr. Diethard Mager
Federal Ministry of Economics and Technology

Prof. Dr. Uwe Pietrzyk
Forschungszentrum Jülich, Institute of Neuroscience and Medicine

Dr. Heike Riel
IBM Research Zürich, Switzerland

MinDirig Dr. Beatrix Vierkorn-Rudolph
Federal Ministry of Education and Research

http://www.fz-juelich.de/portal/EN/AboutUs/organizational_structure/_node.html

Management Board (Board of Directors)

Prof. Dr. Achim Bachem
(Chairman)

Karsten Beneke
(Vice-Chairman)

Prof. Dr. Sebastian M. Schmidt
(Member of the Board of Directors)

Prof. Dr. Harald Bolt
(Member of the Board of Directors)

Scientific and Technical Council*

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Nuclear Physics Institute

Prof. Dr. Rudolf Merkel (Vice-Chairman)
Institute of Complex Systems

Prof. Dr. Markus Büscher (Vice-Chairman)
Peter Grünberg Institute

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IBM Research Zürich, Switzerland

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Donald Danforth Plant Science Center, USA

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K.U. Leuven, Belgium

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ANR, France

Prof. Dr. Thomas Roser
Brookhaven National Laboratory, USA

Prof. Dr. Elke Scheer
University of Konstanz, Germany

Prof. Dr. Horst Simon
Lawrence Berkeley National Laboratory, USA

Prof. Dr. Metin Tolan
TU Dortmund University, Germany

Dr. Peter Nagler
Evonik AG, Germany

* in accordance with Articles of Association

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(Chairman of the Board of Directors)

Information and Communications Management
A. Bernhardt

Corporate Development
Dr. N. Drewes

Corporate Communications
Dr. A. Rother

Staff units

Office of the Board of Directors and International Affairs
Dr. T. Voß

Sustainable Campus
Dr. P. Burauel

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Prof. Dr. Sebastian M. Schmidt
(Member of the Board of Directors)

Institute of Complex Systems
Prof. J. K. G. Dhont, Prof. C. Fahlke, Prof. J. Fitter (acting), Prof. G. Gompper, Prof. R. Merkel, Prof. A. Offenhäusser, Prof. D. Richter, Prof. D. Willbold

Nuclear Physics Institute
Prof. A. Lehrach (acting), Prof. U.-G. Meißner, Prof. J. Ritman, Prof. H. Ströher

Institute for Advanced Simulation
Prof. S. Blügel, Prof. P. Carloni, Prof. M. Diesmann, Prof. D. DiVincenzo, Prof. G. Gompper, Prof. Th. Lippert, Prof. U.-G. Meißner

Institute of Neuroscience and Medicine
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Jülich Centre for Neutron Science
Prof. D. Richter, Prof. Th. Brückel

Peter Grünberg Institute
Prof. S. Blügel, Prof. Th. Brückel, Prof. D. DiVincenzo, Prof. R. E. Dunin-Borkowski, Prof. D. A. Grützmacher, Prof. A. Offenhäusser, Prof. C. M. Schneider, Prof. S. Tautz, Prof. R. Waser

IT Services
F. Bläsen

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Prof. Dr. Harald Bolt
(Member of the Board of Directors)

Institute of Bio- and Geosciences
Prof. W. Amelung, Prof. M. Bott, Prof. K.-E. Jaeger, Prof. J. Pietruszka, Prof. U. Schurr, Prof. B. Usadel, Prof. H. Vereecken, Prof. W. Wiechert

Institute of Energy and Climate Research
Prof. H.-J. Allelein, Prof. D. Bosbach, Prof. R.-A. Eichel, Prof. O. Guillon, Prof. J.-Fr. Hake, Prof. A. Kiendler-Scharr, Prof. Ch. Linsmeier, Prof. U. Rau, Prof. M. Riese, Prof. U. Samm, Prof. L. Singheiser, Prof. D. Stolten, Prof. B. Thomauske, Prof. A. Wahner, Prof. P. Wasserscheid

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Karsten Beneke
(Vice-Chairman of the Board of Directors)

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R. Kellermann

Purchasing and Materials
R.-D. Heitz

Law and Patents
Ch. Naumann

Organization and Planning
A. Emondts

Technology Transfer
Dr. R. Raue

Central Library
Dr. B. Mittermaier

Technical Infrastructure
Dr. G. Damm

Nuclear Services
Dr. G. Damm / R. Printz

Safety and Radiation Protection
B. Heuel-Fabianek

Building and Property Management
M. Franken

Planning and Building Services
J. Kuchenbecker

Project management organizations

Project Management Jülich
Dr. Ch. Stienen

Project Management Organization Energy, Technology, Sustainability
Dr. B. Steingrobe

Staff unit

Auditing
A. Kamps

Awards and appointments in 2013

Awardee/Institute	Award
Prof. Tilmann Beck Institute of Energy and Climate Research	Medal of honour from the Faculty of Metals Engineering and Industrial Computer Science at AGH University of Science and Technology in Kraków, Poland
Cornelius Berger Institute of Energy and Climate Research	Young Author Award for a paper presented at the 13th Symposium Energy Innovation in Graz, Austria
Dr. Stephan Binder Institute of Bio- and Geosciences	Innovation Award of the German BioRegions
Prof. Nicolas Brüggemann Institute of Bio- and Geosciences	Erwin Schrödinger Prize of the Stifterverband für die Deutsche Wissenschaft and the Helmholtz Association together with four other members of a German-Chinese research group
Dr. Danilo Bzdok, Institute of Neuroscience and Medicine	Hans Heimann Prize of the German Association for Psychiatry, Psychotherapy and Psychosomatics (DGPPN), Friedrich Wilhelm Prize of RWTH Aachen University, and Grünenthal Prize, Faculty of Medicine at RWTH Aachen University, for his PhD thesis
Dr. Dr. Svenja Caspers, Prof. Simon Eickhoff, Prof. Karl Zilles and Prof. Katrin Amunts Institute of Neuroscience and Medicine	Poster prize at the "Imaging the brain at different scales: how to integrate multi-scale structural information?" workshop of the International Neuroinformatics Coordinating Facility
Prof. Simon Eickhoff Institute of Neuroscience and Medicine	Niels-A. Lassen Prize of the German Society for Clinical Neurophysiology and Functional Imaging (DGKN) and Hans Heimann Prize of DGPPN for his PhD thesis
Wolfgang Frings Jülich Supercomputing Centre	Best Paper Award at the International Conference on Supercomputing (ICS) 2013, Eugene, Oregon, USA, 10–14 June 2013
Dr. Carolin Huhn Central Institute of Engineering, Electronics and Analytics	Prize of the Society of German Chemists' (GDCh) Special Interest Group for Analytical Chemistry
Andreas Havenith Institute of Energy and Climate Research	Karl Wirtz Prize of the German Nuclear Society (KTG)
Dr. Holger Janßen, Prof. Werner Lehnert, Prof. Detlef Stolten and Dr. Jen Supra Institute of Energy and Climate Research	Best Paper Award 2012 of the American Society of Mechanical Engineers (ASME)
Prof. Chunlin Jia Peter Grünberg Institute	Hatsujiro Hashimoto Medal of the International Federation of Societies for Microscopy
Carsten Karbach Jülich Supercomputing Centre	Young talent award from the PARS group of Gesellschaft für Informatik
Dr. Andrei Kulikovsky Institute of Energy and Climate Research	Alexander Kuznetsov Prize for Theoretical Electrochemistry of the International Society of Electrochemistry
Prof. Ulf G. Meißner Institute for Advanced Simulation and Nuclear Physics Institute	Beller Lectureship Award of the American Physical Society
Dr. Giuseppe Mercurio Peter Grünberg Institute	Excellence Prize of Forschungszentrum Jülich

Awardee/Institute	Award
Dr. Vadim Migunov Peter Grünberg Institute	Young scientists' award from the Heinz Bethge Foundation for Applied Electron Microscopy for his PhD thesis
Dr. Felix Plöger Institute of Energy and Climate Research	Excellence Prize of Forschungszentrum Jülich
Prof. Syed M. Qaim Institute of Neuroscience and Medicine	Medal of honour from Rajshahi University in Bangladesch
Dr. Georg Schendzielorz Institute of Bio- and Geosciences	Innovation Award of the German BioRegions
Anna Westhoff Jülich Supercomputing Centre	Medal of honour from Aachen University of Applied Sciences for her master's dissertation
Dr. Chao Zhang formerly German Research School for Simulation Sciences	Excellence Prize of Forschungszentrum Jülich and 2012 Chinese Government Award for Outstanding Self-Financed Students from the Chinese Scholarship Council
Awardee	**Award**
Prof. Aleksandra Czyrska-Filemonowicz, Prof. Andrew A. Maudsley, Prof. Dani Or and Prof. Yuehui Yu	received the Helmholtz International Fellow Award
Prof. Markus Gross	from ETH Zürich received the Karl Heinz Beckurts Prize of the Helmholtz Association
Dr. Ute Linz Institute of Complex Systems	was appointed to the Scientific Program Committee of the 2013 North American Particle Accelerator Conference (NA-PAC)
Reimar Bauer Institute of Energy and Climate Research	was elected a nominated member of the Python Software Foundation (PSF)
Prof. Andreas Wahner Institute of Energy and Climate Research	was appointed a member of the Advisory Committee of the Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan, until August 2016t

GRI Guidelines

GRI Index

Version G3.1 of the Global Reporting Initiative (GRI) Guidelines was used as a basis for reporting. It is stated whether items are fully reported (++), partially reported (+/-), not reported (n/r), or not applicable to Forschungszentrum Jülich (n/a).
There are currently no sector supplements available for research. According to our own assessment, this Sustainability Report complies with GRI's Application Level B.

More information is available at www.globalreporting.org.

GRI indicator		Comment	Page	Status
Strategy and analysis				
1.1	Statement from the most senior decision-maker		8/9	+/+
1.2	Description of key impacts, risks, and opportunities		8; 22–24; 48	+/-
Organizational profile				
2.1	Name of the organization		14	+/+
2.2	Primary brands, products, and/or services		38–47	+/+
2.3	Operational structure		15–18	+/+
2.4	Location of organization's headquarters		133	+/+
2.5	Countries in operation		18; 49–55	+/+
2.6	Nature of ownership and legal form		14; 19	+/+
2.7	Markets served		19; 59–61; 65–69	+/+
2.8	Scale of the organization	Patents as a "product"	19; 58; 67; 69/70	+/+
2.9	Significant changes regarding size, structure, or ownership	No significant changes		+/+
2.10	Awards received	Mostly individuals	70/71; 83; 109; 124/125	+/+
Report parameters				
3.1	Reporting period		11	+/+
3.2	Date of most recent previous report		11	+/+
3.3	Reporting cycle		11	+/+
3.4	Contact point for questions		133	+/+
3.5	Process for defining report content		11; 25/26	+/+
3.6	Boundary of the report		11	+/+
3.7	Limitations on the scope	None		+/+
3.8	Basis for reporting on joint ventures, subsidiaries, etc.	None		+/+
3.9	Data measurement techniques	External audit	11; 56; 80	+/+
3.10	Effect of any re-statements of information provided in earlier reports	None		+/+
3.11	Significant changes in the scope, boundary, or measurement methods	None		+/+
3.12	GRI Content Index		126–130	+/+
3.13	External assurance	Not assessed externally		+/+

GRI indicator		Comment	Page	Status
Governance, commitments, and engagement				
4.1	Governance structure		15–17; 122/123	+/-
4.2	Indication of whether chairperson is also executive officer		15	+/+
4.3	Number and gender of members of the highest governance body that are independent and/or non-executive members		15	+/+
4.4	Mechanisms for shareholders and employees to provide recommendations or direction to the Board of Directors	No shareholders	32–34; 48; 110	+/+
4.5	Linkage between compensation for members of the Board of Directors and the organization's performance		24; 101	+/-
4.6	Processes in place for the Board of Directors to ensure conflicts of interest are avoided		115/116	+/+
4.7	Expertise of the members of the Board of Directors in terms of sustainability issues		15/16; 22; 122	+/+
4.8	Statements of mission or values, codes of conduct, and principles		14; 22–24; 65; 86; 98; 117	+/+
4.9	Procedures of the Board of Directors for overseeing the organization's performance in terms of sustainability		15; 23; 27	+/+
4.10	Processes for evaluating the Board of Directors' performance with respect to sustainability		15	+/+
4.11	Precautionary approach or principle		26–28; 112/113	+/+
4.12	Externally developed charters, principles, or other initiatives to which the organization subscribes or endorses		24/25; 86; 106/107; 115	+/+
4.13	Memberships		32–35; 66	+/+
4.14	Stakeholder groups		31–35	+/+
4.15	Identification and selection of stakeholder groups		31–35	+/+
4.16	Approaches to stakeholder engagement	No additional efforts for this report	32–35	+/+
4.17	Key topics and concerns raised through stakeholder engagement		31–35	+/+
Economic performance indicators				
Management approach			14; 38; 48/49; 58–61; 66–71	+/+
EC 1	Direct economic value generated and distributed		58–61; 121	+/+
EC 2	Financial implications and other risks and opportunities for the organization's activities due to climate change		39–41; 51/52; 60/61	+/-
EC 3	Organization's benefit plan obligations	Employer: 6.45 % Employee: 1.41 %	58; 64; 101/102	+/+
EC 4	Significant financial assistance received from government		19; 58–60	+/-
EC 5	Range of ratios of standard entry level wages compared to local minimum wage		101	+/-

GRI indicator		Comment	Page	Status
EC 6	Policy, practices, and proportion of spending on locally based suppliers		64; 86	+/-
EC 7	Local hiring		29–31; 100	+/+
EC 8	Infrastructure investments and services provided for public benefit		64/65	+/-
EC 9	Indirect economic impacts		32–34; 66–68	+/+
Environmental performance indicators				
Management approach			9; 22/23; 26–29; 75–78; 80/81; 83; 87–95	+/+
EN 1	Materials used		84–86	+/-
EN 2	Recycled input materials		86; 89–91	+/-
EN 3	Direct energy consumption by primary energy source (2012/2013)	Natural gas: 20,240 GJ / 19,388 GJ Heating oil: 41,089 GJ / 5,417 GJ	78–81	+/+
EN 4	Indirect energy consumption by primary source (2012/2013)	Electricity: 1,342,656 GJ / 1,364,159 GJ District heat: 182,875 GJ / 223,302 GJ	78–81	+/+
EN 5	Energy saved	24,300 GJ in 2012 (modernization of district heating network)	81–83	+/+
EN 6	Initiatives for energy efficiency and renewables		39; 45; 77; 80–83; 109	+/+
EN 7	Initiatives to reduce indirect energy consumption		80–86; 91–93	+/-
EN 8	Total water withdrawal	Groundwater: 769,239 m^3 Rainwater: 1,476,000 m^3 Local supplier: 1,883 m^3	78; 83/84	+/+
EN 9	Effects of water withdrawal	No substantial withdrawal of > 5 %	78; 84	+/+
EN 10	Water recycled and reused	No recycling		+/+
EN 11	Land owned, leased, managed in or adjacent to, protected areas			+/+
EN 12	Impacts on biodiversity	No measures planned in protected areas	94/95	+/+
EN 13	Habitats protected or restored	Close cooperation with forest and landscape authorities; no measures	94/95	+/+
EN 14	Strategies for managing impacts on biodiversity		94/95	+/-
EN 15	Endangered species		94	+/+
EN 16	Greenhouse gas emissions		87/88	+/+
EN 17	Other relevant greenhouse gas emissions		86; 91–93	+/-
EN 18	Initiatives to reduce greenhouse gas emissions		86; 91–93	+/-
EN 19	Emissions of ozone-depleting substances			n/r
EN 20	NO_x, SO_x, and other air emissions		88	+/-
EN 21	Water discharge	Wastewater: 84,917 m^3 BOD_5: 6.7 mg/l Industrial wastewater: 252,753 m^3 COD: 26.4 mg/l	84	+/+
EN 22	Waste by type and disposal method		89–91	+/-
EN 23	Significant spills		90	+/+
EN 24	Waste deemed hazardous under the terms of the Basel Convention	558,181 t		+/-

GRI indicator		Comment	Page	Status
EN 25	Impact of water discharge on biodiversity		84	+/-
EN 26	Initiatives to mitigate environmental impacts		29; 68; 83; 84–86; 89–91	+/-
EN 27	Packaging materials	No products sold		n/a
EN 28	Sanctions for noncompliance with environmental laws and regulations	No fines or other sanctions		+/+
EN 29	Impacts of transport	Number of business trips: 23,079 (in 2012)	91–93	+/-
EN 30	Environmental protection expenditures and investments			n/r
Social performance indicators: Labour practices and decent work				
Management approach			29–32; 64; 100–111; 114	+/+
LA 1	Workforce by employment type		98/99	+/-
LA 2	Employee turnover	Employees lost: 762 of which women: 240 of which men: 522 < 30 years: 357 30–50 years: 237 > 50 years: 150	98	+/-
LA 3	Benefits provided to full-time employees	No special benefits provided only for full-time employees		+/+
LA 4	Percentage of employees covered by collective bargaining agreements	All employees are covered by TVöD regulations		+/+
LA 5	Notice period(s) regarding significant operational changes			n/r
LA 6	Percentage of total workforce represented in formal joint management–worker health and safety committees		113	+/+
LA 7	Occupational diseases, lost days and absenteeism, and total number of work-related fatalities		115	+/-
LA 8	Education and training in place regarding serious diseases		112–115	+/+
LA 9	Health and safety topics covered in formal agreements with trade unions		112/113; 116	+/+
LA 10	Further training for employees	2012: 303 internal training courses	115	+/-
LA 11	Programmes for lifelong learning			n/r
LA 12	Performance and career development reviews of employees			n/r
LA 13	Composition of governance bodies			n/r
LA 14	Ratio of basic salary and remuneration of women to men			n/r
LA 15	Parental leave			n/r
Social performance indicators: Human rights				
Management approach			34/35; 107; 110; 112/113; 115–117	+/+
HR 1	Investment agreements			n/r
HR 2	Human rights screening of suppliers and contractors			n/r
HR 3	Training on human rights			n/r

GRI indicator		Comment	Page	Status
HR 4	Incidents of discrimination	No incidents in period under review		+/+
HR 5	Freedom of association and collective bargaining			n/r
HR 6	Child labour			n/r
HR 7	Forced or compulsory labour			n/r
HR 8	Security personnel trained in the organization's policies or procedures		115–117	+/–
HR 9	Violations involving rights of indigenous peoples			n/a
HR 10	Analysis of operations in the form of human rights reviews and/or impact assessments	Committee for equality	130	+/–
HR 11	Grievances related to human rights			n/r
Social performance indicators: Society				
Management approach			34/35; 49–51; 71; 115–117	+/+
SO 1	Impact on local community			n/r
SO 2	Risks related to corruption		116	+/–
SO 3	Anti-corruption training		116	+/+
SO 4	Actions taken in response to incidents of corruption			n/r
SO 5	Lobbying			n/r
SO 6	Contributions to political parties, politicians, and related institutions			n/r
SO 7	Legal actions for anti-competitive behaviour, anti-trust, and monopoly practices			n/r
SO 8	Sanctions for non-compliance with regulations			n/r
SO 9	Negative impacts on local communities			n/r
SO 10	Prevention and mitigation measures implemented			n/r
Social performance indicators: Product responsibility				
Management approach			24/25; 27; 34/35; 71; 112/113; 116/117; 130	+/+
PR 1	Health and safety impacts		66–71; 89–91; 112/113	+/+
PR 2	Non-compliance with health and safety standards and regulations		90; 115	+/–
PR 3	Product information			n/r
PR 4	Non-compliance with product and service information standards			n/r
PR 5	Customer satisfaction		24/25; 111/112	+/+
PR 6	Fundraising and marketing communications standards		34/35; 71; 116/117	+/+
PR 7	Non-compliance with marketing communications standards			n/r
PR 8	Complaints regarding customer privacy	Compliance with Federal Data Protection Act (BDSG); data protection officer		+/–
PR 9	Sanctions for non-compliance with regulations concerning the provision and use of products and services			n/r

Assessment of GRI Application Level

Global Reporting Initiative™

Statement
GRI Application Level Check

GRI hereby states that **Forschungszentrum Jülich GmbH** has presented its report "Sustainability Report 2012/2013 - Networking, Researching, Thinking Ahead" to GRI's Report Services which have concluded that the report fulfills the requirement of Application Level B.

GRI Application Levels communicate the extent to which the content of the G3.1 Guidelines has been used in the submitted sustainability reporting. The Check confirms that the required set and number of disclosures for that Application Level have been addressed in the reporting and that the GRI Content Index demonstrates a valid representation of the required disclosures, as described in the GRI G3.1 Guidelines. For methodology, see www.globalreporting.org/SiteCollectionDocuments/ALC-Methodology.pdf

Application Levels do not provide an opinion on the sustainability performance of the reporter nor the quality of the information in the report.

Amsterdam, 3 June 2014

B
GRI REPORT
GRI CHECKED

Ásthildur Hjaltadóttir
Director Services
Global Reporting Initiative

The Global Reporting Initiative (GRI) is a network-based organization that has pioneered the development of the world's most widely used sustainability reporting framework and is committed to its continuous improvement and application worldwide. The GRI Guidelines set out the principles and indicators that organizations can use to measure and report their economic, environmental, and social performance. www.globalreporting.org

***Disclaimer:** Where the relevant sustainability reporting includes external links, including to audio visual material, this statement only concerns material submitted to GRI at the time of the Check on 15 April 2014. GRI explicitly excludes the statement being applied to any later changes to such material.*

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This Sustainability Report is not the work of the Sustainable Campus staff unit alone. Only with the support and efforts of numerous organizational units has it been possible to compile the important figures, facts, and documents that serve as the basis of this first Sustainability Report of Forschungszentrum Jülich. The Sustainable Campus staff unit would like to thank all those who have contributed to this report.

Numerous scientists have readily provided us with information on their research projects – too many to be named here individually.

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In August 2010, Forschungszentrum Jülich became certified as part of the „audit berufundfamilie“ initiative. Jülich has thus committed itself to continuously defining and implementing measures for improving the reconciliation of work and family life.

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