Dr. Andreas Pinkwart, Professor, Minister of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia, visited E.ON ERC in late July to learn about current developments and research content on the path forward to a successful energy transition. High-ranking representatives of E.ON SE and the research center – including Dr. Karsten Wildberger, member of the Board of Management of E.ON SE, and Dr. Rik W. De Doncker, Professor, Director of E.ON ERC – presented current findings and developments, such as possibilities for expanding sector coupling and for further digitizing the supply of energy. The discussion also touched on the opportunities that arise from the use of innovative methods, such as Hardware in the Loop. Pinkwart, who was in 2006 instrumental in supporting the establishment of the energy research center in Aachen in his prior role as NRW Minister of Innovation, Science, Research and Technology, was visibly impressed by the rapid development that E.ON ERC has undergone in the mere 12 years since it was founded.

During the tour of the E.ON ERC testing hall, Minister Pinkwart was highly impressed by the diversity of the research projects in progress and the many interdisciplinary approaches that are being pursued (from left to right: Prof. D. Müller, Prof. A. Pinkwart, Dr. K. Wildberger, Prof. R. W. De Doncker, Dr. I. Luge, Dr. J. Handke, Dr. E. Kugeler).
Three institutes of E.ON ERC – ACS, EBC, and PGS – are working with the Center for Wind Power Drives (CWD) and the Institute of Energy Efficiency and Sustainable Building (e3d) to develop the “Urban Energy Lab 4.0,” a new infrastructure for energy research. The project, which is coordinated by Prof. Dirk Müller (EBC), is established under the auspices of RWTH Aachen University. It takes an interdisciplinary approach encompassing the Faculties of Civil Engineering, Electrical Engineering, and Mechanical Engineering, with the goal of creating experimental possibilities that can be used to work on current research questions relating to the German energy transition on a much broader basis than was previously possible, all at a single site. The project is being supported through funding from the State of North Rhine-Westphalia and the European Regional Development Fund (ERDF) and has a budget of 4.9 million euros.

The objective for the researchers involved is to create a unique, highly interconnected infrastructure on the RWTH Aachen University Campus that can be used to both develop and analyze innovative urban energy supply concepts. Key elements of these kinds of supply concepts include decentralized generation, sector coupling, and new possibilities in digitization. Systems like these can only meet the wide range of requirements that apply if the planning, construction, and operation of building technology, technical building equipment, networks and automation take place in close coordination.

The new research infrastructure that is being created at RWTH Aachen University as part of this project will give rise to a flexible, versatile testing field where controllable experiments on holistic energy supply concepts can be performed. Topics of inquiry range from supplying one room to an overall view of an entire urban neighborhood in terms of energy. The project is forming a basis for identifying and developing new technologies and sustainable solution concepts for delivering a safe, reliable, and also eco-friendly supply of energy to urban environments.

The necessary scaling of real-world conditions to lab conditions takes place via a Hardware-in-the-Loop platform. In the process, some parts of the energy supply system under consideration are replaced by complex simulations in order to be able to operating and testing newly developed elements under realistic overall conditions. This Hardware-in-the-Loop approach is unique in Germany in terms of its planned scale, the ability to expand it flexibly, and its interdisciplinary structure.

The EBC and e3d institutes are responsible for building the climate test bench, which will be used for simultaneous simulation of the thermal, acoustic, and lighting-related effects in indoor environments as well as for building the multiple-chamber façade test bench. In addition, EBC will be responsible for setting up a coolant lab to test heat pumps and cooling systems. The ACS institute is responsible for depicting energy flows in urban neighborhoods with real-time capability and for networking, automation, and simulation.

Together, the institutes involved and CWD will work to develop an interconnected large-scale test bench with real-time-capable connections between physically separate elements. Various research partners can be integrated into the overall concept with their own testing environments. The research infrastructure can be expanded on a flexible basis, which also means it can be adapted to meet different requirements.

Another hall is currently being constructed on the RWTH Aachen University campus, behind the E.ON ERC testing hall. Key elements of the new energy research infrastructure will be housed there. This facility, dubbed the "Testing Hall for Energy-Efficient Construction," will be officially opened on November 14, 2018 (see events, p. 6).
In the National 5G Energy Hub (N5GEH) project, researchers from multiple faculties and two higher education institutions are working with industry partners to harness the 5G mobile communications standard for applications in energy technology over the next few years, especially in the fields of electrical networks and building energy technology. At TU Dresden, the Chairs of Building Energy Systems and Heat Supply and of Electrical Power Supply and the Institute of Communication Technology are involved. RWTH Aachen University is represented by the EBC and ACS institutes of E.ON ERC and by the Institute for Theoretical Information Technology (TI). Further partners include Ericsson, Deutsche Telekom, E.ON, and Techem. This large-scale project has a financial volume of just under 3.8 million euros and is receiving key support from the German Federal Ministry for Economic Affairs and Energy (BMWi).

In the N5GEH project, researchers are working to develop an open, scalable hardware and software architecture that enables communication based on mobile telecommunication standards between energy applications and overarching system components. Many of the transmission and communication channels that are still wired today could be replaced in this way to connect the increasing number of decentralized energy supply infrastructures, storage facilities, and consumption points – which are dominated by renewables – into a single functional overall system. In the future, the technologies bundled together in the 5G standard will make it much easier than before to coordinate local electrical inputs and loads intelligently at a decentralized level. This approach supports the use of volatile energy from renewable sources and the dynamic integration of generation and storage systems while maintaining the reliability of the energy supply system.

The new system architecture offers a broad range of applications, including automatic, long-term monitoring of numerous individual components of the overall system. This will facilitate fault detection and automatic triggering of protective mechanisms in particular.

The cooperation agreement for the National 5G Energy Hub was signed in Dresden on July 19. Everyone involved is looking forward to their new interdisciplinary task. Shown here: project co-coordinators Dr. J. Seifert (TU Dresden, center left) and Dr. Dirk Müller, Professor (RWTH Aachen University, center right), Dr. H. Müller-Steinhagen, Professor, Rector of TU Dresden (left), and J.-P. Meyer-Kahlen, head of the ICT Development Center Eurolab at Ericsson in Aachen.

The startup aedifion, a spinoff of the EBC institute, received a coveted award in the “Digital Innovations” business startup competition organized by the German Federal Ministry for Economic Affairs and Energy (BMWi) at the Hannover Messe trade fair in 2018. The young company develops solutions for cloud-based processing of operating data from building automation systems.

The EBC institute was actively represented by several employees at this year’s Roomvent & Ventilation conference, which was organized by the Federation of European Heating, Ventilation and Air Conditioning Associations (REHVA) and held in Espoo, Finland, in June. Paul Mathis, Felix Nienaber, Kai Rewitz, Tim Röder, Paul Seiwert, and Jens Teichmann gave warmly received talks about their current research work. Even better, researchers from the institute took home Best Paper Awards in not just one or two, but three categories.

Tim Röder, Paul Mathis, and Professor Müller received an award for their paper on multizone airflow simulations in Modelica. Paul Mathis, Max Rohn, Tim Röder, and Professor Müller were recognized for their paper on heat transfer on Kármán vortex streets in vertically heated ducts. Paul Mathis accepted the award (see image). Felix Nienaber, Mark Wesseling, Davide Calì, and Professor Müller received an award for their paper on air quality-based presence algorithms.

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The liberalization of the energy supply and the steady increase in decentralized generation of energy from renewable sources have brought significant structural changes on the energy markets. The reliability of the energy supply has long since stopped being something only providers have to worry about. Consumers can also help to ensure the stability of the grid by arranging their demand for energy around certain schedules. In the past, these options were almost entirely the purview of industry, business, and the public sector, while private consumers have lacked the necessary equipment (smart meters). Prices per kilowatt-hour for private consumers are still typically set by collective agreements, so there is hardly any financial incentive to shift energy consumption to periods of lower general use on the grid (except for those who have a split high/low rate structure). Unlike fixed prices, dynamic electricity prices offer incentives to shift energy consumption to times when prices are lower because demand is also lower. Peaks in demand can be “shaved,” reducing the overall load. This makes dynamic pricing an inexpensive way to help stabilize the networks.

Findings on how dynamic pricing affects the electricity consumption behavior of private consumers have been spotty thus far. With financial support from the Strategy Fund of the Excellence Initiative of RWTH Aachen University, researchers from the FCN institute have developed and performed a lab experiment to identify possible consumption change strategies with dynamic electricity prices as a background. During this computer-assisted lab experiment, test subjects received payments depending on how successful their consumption decisions were.

**E.ON ERC Ticker**

Every fall, RWTH Aachen University hosts the “5 vor 12” science night. As a matter of course, a number of researchers from E.ON ERC will once again be on hand to contribute to a successful and varied program at this year’s event, to be held at the C.A.R.L. lecture hall center starting at 7 p.m. on November 9. The event’s overarching goal is to connect members of all generations with science in a fun and understandable way through exciting talks and experiments, worthwhile videos, and cabaret and musical interludes.

The International Energy Cooperation Program (IECP) of E.ON ERC offers students, scientists, and researchers many opportunities to work at world-renowned research institutions, share ideas, and learn from the experience of partners. In the IECP exchange program, participants can organize research project stays and implement internships. For an overview of past cooperative initiatives and the specific areas of research emphasis of international partner universities, please see the current IECP brochure, which is available to download [here](#).
In general, the results show that electricity consumers develop successful demand and/or procurement strategies in an electricity market with dynamic pricing. The researchers also observed, however, that some test subjects regularly deviate from the optimum strategy in terms of price (see chart). Some buy their energy too early, while others wait too long to make a decision – with negative financial consequences in both cases. This indicates that while introducing dynamic electricity prices would not be an issue for average consumers, a significant minority would still have a hard time with the change. The researchers believe automatic demand management would be friendlier to consumers, since this method also takes account of customers who are not able to adjust their consumption behavior strategically to accommodate dynamic pricing.

FCN Working Paper No. 5/2018 contains detailed information on this experiment. It is available to download here.

The chapter „Consumer Behavior and the Use of Energy“ of the Handbook of Sustainable Energy (Part II, Chapter 10) offers a good overview of behavior research in the energy sector.
**PGS | DC technology**

**Particularities of DC fuses**

Dr. Jens Weber (see picture) and Johannes-Georg Gödeke, two executives from fuse manufacturer SIBA, visited E.ON ERC in June to provide information on particular aspects that need to be taken into account when developing fuses for DC systems. Following an introduction on the general structure and function of fuses, the discussion quickly turned to the specific challenges that arise during development and use of DC fuses. The focus was on the principle of arc quenching and the basics of configuring the devices for use in DC systems. The two experts presented DC application examples and provided an overview of what kinds of devices and systems are already protected with DC fuses today. A look ahead at upcoming challenges resulting from the expected development of DC systems led to a spirited discussion.

On July 20, 78 participants from nine countries and three continents came together for the farewell colloquium for Professor Christoph Clauser at E.ON ERC at RWTH Aachen University. Clauser, who has been heading the Institute of Applied Geophysics and Geothermal Energy and looks forward to an active retirement, has 12 years of successful research and teaching activities under his belt here alone, after 18.5 years in all as a professor at RWTH Aachen University. Following impressive talks on current developments in the research fields where Clauser himself is active, former and current colleagues spent the afternoon presenting personal recollections – with and without connections to their work – from Clauser’s career, which included research activities in Berlin, Braunschweig, Hannover, and Aachen.

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**Events**

November 14, 2018
10:00 a.m.
Aachen, Mathieustr.

Opening of the Testing Hall for Energy-Efficient Construction
For further information, please e-mail
halleneroeffnung_e3d_abc@e3d.rwth-aachen.de