IFFOCUS
2/2014

POWER IN RESERVE

LARGE-SCALE BATTERY STORAGE TEST
Buildings off the grid and supplied

MANAGING POWER SMARTLY
Compensating for the volatility of renewables

SENSITIVE, SENSIBLE GRIDS
Supplying consumers reliably and stably

Photo: Fraunhofer IFF

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The researchers at the Fraunhofer Institute for Factory Operation and Automation IFF develop applied solutions for smart work systems, resource efficient production and logistics, and convergent supply infrastructures, thus enabling companies to respond to the market quickly and to boost their manufacturing performance and reliability.

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» Mastering the energy transition is perfectly possible: On the one hand, with new models and technologies. On the other hand, with smart methods for more efficient manufacturing and clever use of existing resources. «

Prof. Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg.

Editorial

Without a doubt, the energy transition is one of our most significant initiatives: Renewables will replace nuclear energy and supply us safely and cleanly. This places substantial social responsibility on us. Companies will have to overcome some challenges as they follow this path, though. Everyday, they are confronted by the question of how to master the energy transition.

From Consumer to Producer

Until now, the electricity market functioned according to a simple model: Power plants supplied electricity to the grid; businesses and households consumed it. This is now a thing of the past: Consumers are becoming producers with increasing frequency. Solar panels on roofs, small cogeneration units in basements, wind turbines in fields – even private individuals are supplying electricity to the grid. Many companies produce a goodly portion of their electricity themselves in order to cut costs. In the process, as much energy as possible ought to come from renewable sources.

Controlling Energy Smartly

Unfortunately, they are not available all of the time. The electrical grid, however, always has to be stable and always has to be available. Factories, service providers and households need power around the clock.

Not only the electrical grid and the supply infrastructure have to be upgraded technologically. Energy consumption in buildings, factories and even industrial parks has to be controlled smartly. After all, companies can rarely disconnect their "energy guzzlers" from the grid just because the sun is not shining at the moment.

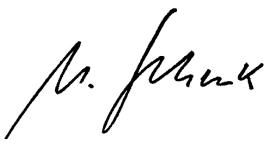
Power in Reserve

Researchers from the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg want to counterbalance the volatility of renewables. They have developed solutions for smart energy management. The moment energy from renewables is available, internal storage systems, such as a battery storage system or a fleet of electrical vehicles, is charged and consumption is adjusted. If, on the other hand, renewables "ebb", the stored electricity is used.

Mastering the Energy Transition

This makes mastering the energy transition perfectly possible: On the one hand, with new models and technologies. On the other hand, with smart methods for more efficient manufacturing and clever use of existing resources. Our current issue presents a number of examples that are currently proving their worth in the field.

See for yourself,



Your,
Michael Schenk

Power in Reserve: Large Battery Storage System Passes First Major Test

The energy transition is increasing the risk of fluctuations in regional electrical grids. Large batteries will provide stability in the future. They can return stored power to the grid or temporarily supply power to final customers. A mobile battery storage system with 1 megawatt of power, one of the largest in Germany, is located at the Fraunhofer IFF in Magdeburg. The researchers demonstrated its use in a major test during which they even fully disconnecting their research facility from the grid.

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Managing Energy Smartly

How can smart infrastructures compensate for the fluctuating availability of renewable energy sources? How can energy consumption be cut an additional twenty percent without reducing output? Dynamic energy management is the solution.

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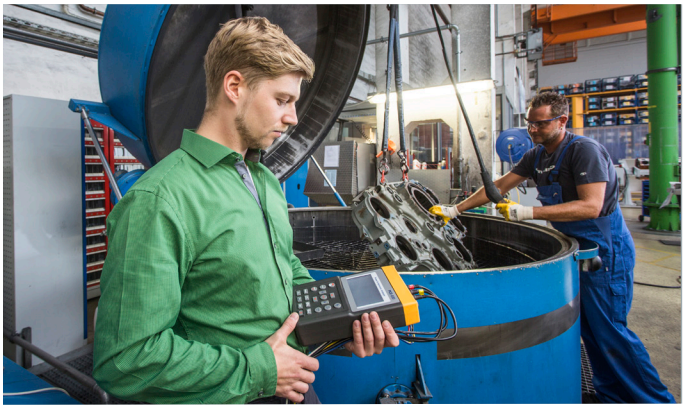

Identifying Energy Guzzlers in Manufacturing

Companies that want to stay competitive have to organize their manufacturing efficiently, especially wherever resource and energy consumption is concerned. Researchers at the Fraunhofer IFF are analyzing the locations of the levers worth adjusting.

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IFFocus 2/2014 Power in Reserve

Interview

One Hundred Percent from Renewables: Stefan Müller, COO of Enerparc AG explains how battery storage systems can be used to overcome ebbs.

PAGE 14

Sharp Minds

Who earned a doctorate? Who is new? Find out more about the people at the Fraunhofer IFF.

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Prof. Michael Schenk (l.) and Hojin Ryu (r.), SK innovation, signing the cooperation agreement. In the background: Prof. Alexander Verl (l.), Fraunhofer-Gesellschaft Executive Board, and Saxony-Anhalt Minister of Higher Education, Research and Economic Affairs Hartmut Möllring (re).

Fraunhofer IFF and SK innovation Sign Cooperation Agreement at the 17th IFF Science Days in Magdeburg

The efficient use of energy and resources and the potential added value from digital factories are priority issues in industry. As might be expected, they were also the focus of attention at the 17th IFF Science Days held in Magdeburg from June 24 to 26, 2014. The Fraunhofer IFF hosts the three-day event, which traditionally combines the Digital Engineering Conference and the Magdeburg Logistics Days, which are scheduled at the same time. This year, too, national and international experts from industry and research discussed in nearly one hundred individual events the latest technologies, best practices and industry's current demands on research.

A highlight during the IFF Science Days was the was the signing of a long-term research agreement between the Fraunhofer IFF and the South Korean company SK innovation. The two partners intend to exchange their findings on research on large battery storage systems intensively in the future. The Fraunhofer IFF in Magdeburg works together with Otto von Guericke University Magdeburg on research on smart grids and supply infrastructures and develops solutions for reliable energy management systems. It also collaborates closely with regional companies in the ER-WIN® innovation cluster and develops solutions for significantly more energy efficient manufacturing. SK innovation is one of the world largest manufacturers of battery systems.

The signing of the cooperation agreement von was accompanied by the opening of the largest mobile battery systems in Germany at the research institute in Magdeburg's Port of Science. The large energy storage system has a capacity of 0.5 megawatt hours and an output of 1 megawatt. In the future, the Fraunhofer IFF will use this battery for research and make it available to companies, too, to test the suitability of approaches to energy efficient manufacturing. (mar) ■

More Energy Efficiency in Commercial Laundries: Deutscher Textilreinigungs-Verband and Fraunhofer IFF Are Collaborating

Commercial laundering is a sector with great potential for energy savings. That is why the Deutsche Textilreinigungs-Verband (DTV) is turning to the Fraunhofer IFF in Magdeburg for support. The two partners signed a cooperation agreement in Magdeburg on June 26 2014. In addition to energy efficiency, the partners are also interested in optimizing laundry operations and making staff's work easier. Among other things, automated solutions, such as the use of robots, and the latest RFID technologies are supposed to be developed for use in commercial laundries.

"We consider collaboration with the Fraunhofer IFF to be an opportunity to tackle future technical challenges for companies with the support of experienced researchers," says Joachim Krause, member of the DTV executive board and chairman of its technology and environmental protection committee. "Very important aspects are the level of automation and the logistics and related potentials for improvement in processes that consume energy. Technical modifications in process flows will enable us to scrutinize and boost resource and energy efficiency. To this end, we intend to research and refine our processes and technologies collaboratively."

Among other things, the Fraunhofer IFF specializes in planning more energy and resource efficient manufacturing methods. Director Prof Michael Schenk stresses his institute's role as a research and development partner for the industry: "Our common goal is to find new methods to handle the growing technological, economic and ecological challenges for small and medium-sized enterprises. We benefit from being able to transfer solutions that boost resource and energy efficiency, which we have already successfully developed for other industries. The integration of technical innovations will keep the laundry industry competitive, too." (mar) ■

Joachim Krause (l.), Deutscher Textilreinigungs-Verband DTV, and Prof. Michael Schenk (r), Fraunhofer IFF, at the signing of the cooperation agreement at the 17th IFF Science Days in Magdeburg.

Storage Systems for the Energy Transition: Fraunhofer IFF Successfully Tests a Large Battery in Magdeburg

The energy transition increases the risk of fluctuations in regional electrical grids. Large batteries will help stabilize them in the future. They can resupply stored power to the grid or temporarily supply end customers. One of the largest mobile storage systems in Germany with an output of one megawatt is located at the Fraunhofer IFF in Magdeburg. On October 2, 2014, researchers demonstrated its use in the presence of Saxony-Anhalt Minister President Reiner Haseloff. To do so, they even disconnected their research facility completely from the grid.

Factories need power. Their assembly lines have to run, sometimes around the clock. Ideally, the energy for this comes from renewables. Conventional power plants have to fill in, however, whenever certain weather conditions prevent wind turbines and solar cells from delivering sufficient power. Efficient energy storage systems are a solution: They store excess power from renewables and resupply it to the grid when voltage fluctuates. What is more, they could be doubly valuable to companies because they enable the use of inexpensive store power to cover high consumption periods during which additional expensive power would otherwise have to be drawn from the conventional transmission grid.

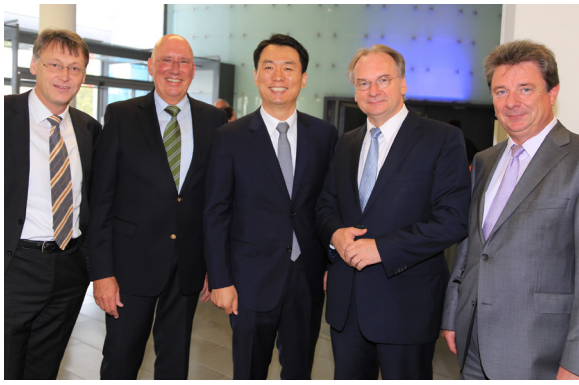
The Fraunhofer IFF in Magdeburg demonstrated how this functions in reality In a successful large-scale test, the researchers disconnected their facility fully from the public grid and only used a large battery to supply it with power. Research work proceeded normally in the building, which houses approximately one hundred fifty employees as well as offices and various laboratories.

According to Minister President Reiner Haseloff, "The research being done at the Fraunhofer IFF in Magdeburg shows that we are well on the way to developing and using efficient energy storage systems." Haseloff pointed out that the Fraunhofer IFF's battery storage system with an output of one megawatt comes from the South Korean company SK innovation. "On my trip to South Korea in recent weeks, we reached an agreement with company representatives to collaborate on projects with even far higher storage capacities in Halle and Magdeburg." The state of Saxony-Anhalt is supporting the Fraunhofer IFF's research project with one million euros.

Over ninety invited guests and staffers from the Fraunhofer IFF intently watching the test of the large battery ...

From l. to r.: Prof. Michael Schenk (Fraunhofer IFF), Saxony-Anhalt Minister President Haseloff and Chanyul Lee (SK innovation) starting the test of the large battery in Magdeburg.

Since the institute's facility is already equipped with a smart energy management system, the Fraunhofer IFF also has an idea test environment for its large storage system. Dr. Przemyslaw Komarnicki, who is working with his team on storage management and grid integration at the Fraunhofer IFF, explains, "We intend to study a broad range of research issues. We are interested in the cost effective and technically trouble-free use of electrical energy storage systems." The mobile large battery is intended for use in companies and their supply networks, for instance at the energy park operator Enerparc AG. (akw/mar) ■



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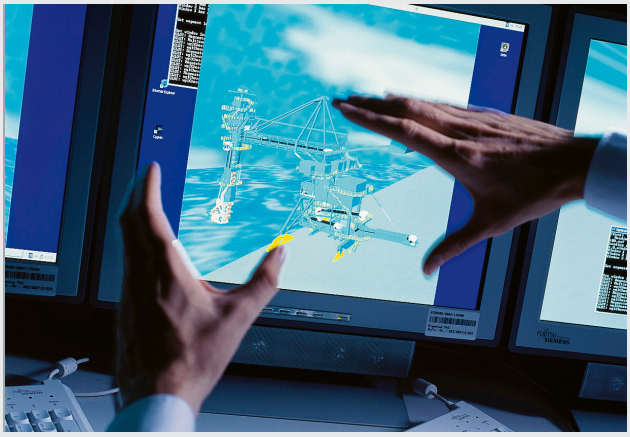
Researchers Establish a German-Thai Center of Excellence in Digital Engineering in Bangkok



The German-Thai center of excellence in Bangkok will transfer state-of-the-art digital engineering-methods to academia and industry in Thailand.

The Fraunhofer IFF and Otto von Guericke University in Magdeburg and the NSTDA, the largest research organization in Thailand, are starting to set up a joint center of excellence in Bangkok. It will transfer state-of-the-art digital engineering-methods to academia and industry in Thailand.

A cooperation agreement signed in Magdeburg in October 2013, has taken on concrete form for researchers: They conferred with over one hundred attendees of a series of workshops in the Thai capital in May on the organization of the planned digital engineering center in the Science Park of the National Science and Technology Development Agency NSTDA. It will be opening soon.On the one hand, it is intended to enable students to earn degrees in this field at their universities. On the other hand it is intended to establish digital technologies in Thailand's industry, too. Partnerships with industry and the country' most important universities, including those in Bangkok, Chiang Mai and Khon Kaen, will assure the success of both goals.

King Mongkut's University of Technology in Thonburi and North Bangkok, Chiang Mai University, Thammasat University, Kasetsart University, Khon Kaen University, Mae Fah Luang University and Prince of Songkla University will be involved in the center of excellence. Each of the Thai universities, with impressive enrollment figures and even as many as 60000 students, will represent one specific facet of research, e.g. engineering, medical engineering, urban and infrastructure development, the environment or logistics. (akw) ■

International University Consortium: Otto von Guericke University Magdeburg and the Fraunhofer IFF Join the Global Education and Research Network

Otto von Guericke University and the Fraunhofer IFF in Magdeburg have been admitted to the circle of the international Global U8 Consortium GU8. The members of this prestigious association of universities specialized in logistics research are working to establish a global network of excellence among research and industry partners in Europe, Asia, Australia and South America.

Professor Jens Strackeljan, president of Otto von Guericke University, feels the admission to the GU8 Consortium will further trengthen Magdeburg as a center of research. "We are delighted to be allowed to join this network of excellent universities. Our admission to the GU8 Consortium will increase the diversity of research here and contribute to developing our international visibility and excellence, thus making Magdeburg more attractive to students from all over the world."

The GU8's common focus is international logistics. Prof. Michael Schenk, Director of the Fraunhofer IFF and holder of the Chair of Logistics Systems at Otto von Guericke University Magdeburg, sees great potential in the consortium to continue advancing research in these fields. "The GU8 partners' collaboration will help us develop and consolidate our edge in logistics research internationally. This could make the network one of the most important sources of inspiration for new technologies for reliable and efficient logistics," according to Schenk. In this context, the Fraunhofer IFF will assume the role of the application partner for regional business and industry. The institute will coordinate academic research findings with industry, modify them and transfer them to practical applications.

Seven full partner universities, Fortaleza in Brazil, Haifa in Israel, Hull in Great Britain, Le Havre in France, Inha in South Korea, Malaysia Perlis in Malaysia and Xiamen in China, and one associated partner university, RMIT in Australia, are members of the GU8 Consortium. (mar) ■

https://gu8.inha.ac.kr

Attendees of the final CEESA event in discussion with State Secretary Tamara Zieschang at the Fraunhofer IFF.

Six Successful Years: Cluster Erneuerbare Energien Sachsen-Anhalt CEESA

After six years of successful cluster work, the final CEESA workshop was held at the Fraunhofer IFF in Magdeburg on December 9. , Extremely important especially to industry, interactive supply infrastructures were the main topic and focus of attention.

State Secretary Tamara Zieschang from the Saxony-Anhalt Ministry of Higher Education, Research and Economic Affairs stressed the importance of renewable energies for Saxony-Anhalt as an economic factor, which has created well over 26,000. Michael Dörffel, head of a department in the Saxony-Anhalt Ministry of Agriculture and the Environment, drew attention to current projects on renewable energies and emphasized taking advantage of cost cutting potentials as a crucial factor for implementing effective sustainable energy supply structures.

In their talks, representatives from industrial and utility companies presented the current challenges of sustainable energy sources and their integration as well as solutions to meet these challenges. In particular, the use of different storage technologies, load shift capabilities and their integration in distribution grids while using suitable communications and information technologies constituted a promising approach.

When CEESA was launched, the local companies and research organizations in it wanted to network and jointly pursue activities for a sustainable energy supply. The final workshop also marked the end of funding from the Saxony-Anhalt Ministry of Higher Education, Research and Economic Affairs. Die Member companies intend to stay active in the cluster and continue their work. (akw) ■

Establishing Electric Vehicles in the Near Future

Electric vehicles and charging stations are not always compatible. Manufacturers' different systems are often to blame. As a result, vehicles cannot be identified and charged. Until now, electric vehicles, charging infrastructures and the underlying distribution grid behind were largely developed independently. Interoperability is crucial, though. An electric car's network components have to be compatible with outside systems.

This is why a mandatory standard was developed for communication between electric vehicles and electrical grids, which all manufacturers are supposed to use to build their systems. Compatibility with this standard ISO/IEC 15118 will simplify complex interoperability in the future. The Fraunhofer IFF worked together with industry and research partners to advance this standardization.

In the eNterop project funded by the Federal Ministry of Economic Affairs and Industry, a conformance testing system was developed, which manufactures can use to test their systems' conformance with the vehicle to grid communications standard ISO/IEC 15118. The project is thus taking a first and important step toward electric vehicle and charging infrastructure interoperability.

One million electric vehicles are supposed to be rolling on Germany's roads by 2020. The Federal Ministry of Economic Affairs and Energy funded the eNterop project so that electric vehicles and charging stations will be compatible, too.

In October of 2014, the eNterop consortium hosted a cross-project "testival" at the Technische Universität Dortmund. The event was intended to bring experts and developers together and to use the eNterop testing system to perform the first ISO/IEC 15118 conformance tests. The next public presentation of the project was on December 3, 2014. All of the partners gathered for the conclusion of the project. They explained the outcome of their research to the interested public. Along with the presentation, exhibits about the project deliverables were on display, which could be discussed down to the technical details. (akw) ■

For more information and to register online, visit:

www.enterop.net

2014 International Supply Chain Conference:
Digitization for More Transparency and Security in Supply Chains

The use of advanced technologies to monitor shipments and control process is a factor that is steadily growing more important in the logistics industry, too. They help safeguard and verify shipments and significantly affect the efficiency of every operation. This trend will continue in he future and increasingly entail growing digitization.

"Why the logistics industry logically has to take this step is obvious," says Professor Michael Schenk, Leiter des Fraunhofer IFF in Magdeburg. "Digitization brings significantly more transparency and, thus, controllability into process. As regards Industry 4.0, digitization is an absolute must for service companies and manufacturers adjusting to conditions of advanced manufacturing. This requires infrastructures, though, which have to be built now."

The Fraunhofer IFF presented current research and development projects that exemplify such cross-process digitization at the International Supply Chain Conference in Berlin from October 22 to 24, 2014. Projects included a "Digital Fingerprint of Shipments" for more security in the air cargo supply chain, which is being developed in the joint project ESeclog funded by the Federal Ministry of Education and Research, and a logistics control center supported by telematics for transparent and exactly coordinated manufacturing and logistics operations at the wind turbine manufacturer ENERCON. (mar) ■

www.bvl.de/dlk

Emergency Call Boxes:
Upgrading Lifesavers Smartly

The roughly 16,000 emergency call boxes on German highways are erected in 2,000 meter intervals on both sides of exit and entrance ramps.

In 2013, they proved to be helpers in a hour of need over 70,000 times: That is how often motorists used emergency call boxes on German highways to report an accident or breakdown. More than just motorists in trouble will profit from call boxes in the future. The project "Upgrading Emergency Call Boxes for Highway Communication" ANIKA started recently. Its objective is to enable emergency call boxes to communicate with passing vehicles. An emergency call box that detects a traffic jam, for instance, will be able to transmit this information to the Traffic Message Channel and police through a control center. At the same time the control center will be able to issue warnings to following vehicles and oncoming traffic through emergency call boxes.

The initiative grew out of the collaboration between ITS Niedersachsen and the Saxony-Anhalt Galileo Test Bed. A consortium of companies is involved in order to determine how emergency call boxes can be upgraded for vehicle-to-infrastructure communication. "Linking the existing infrastructure of emergency call boxes with communications technology is the appeal of the ANIKA project and, when tests are successful, will contribute to smart, digital traffic management of the future," according to Thomas Webel, Saxony-Anhalt Minister of Regional Development and Transportation. Along with the Saxony-Anhalt Galileo Test Bed, ifak system GmbH and Tonfunk Systementwicklung GmbH are also members of the consortium. Another partner is the Fraunhofer IFF. German carmakers such as Volkswagen are involved in the project as associated partners. (akw) ■

STIMULATE Research Campus: Assistive Robotics for Medical Procedures

In June of 2014, STIMULATE Solution Centre for Image Guided Local Therapies for the Development of Innovative Medical Equipment based at Otto von Guericke University Magdeburg was officially selected to be one of ten national research campuses. The interdisciplinary group of research organizations and businesses intends to develop new minimally invasive, high quality and trendsetting methods of diagnostics and therapy for oncological, neurological and cardiological illnesses. Work will focus on innovative, image-guided minimally invasive methods and technologies. In the long term, STIMULATE is supposed to evolve into a German center for image-guided medicine. At first, the Federal Ministry of Education and Research will fund the initiative with an annual budget of up to € 2 billion for a period of five years.

The research campus consortium consists of Otto von Guericke University Magdeburg, Siemens Healthcare and the STIMULATE Association with members from industry and business and non academic research. The Fraunhofer IFF is one.

In a robotic subproject, the Fraunhofer IFF is developing a robotic assistance system that precisely positions electrodes for radio frequency ablation of spinal cord tumors. The application is being developed and prepared for testing in a multi-stage process and in close cooperation with Otto von Guericke University Magdeburg's Medical School. (mar) ■

www.forschungscampus-stimulate.de

Stefan Kaspar and Alexander Schubel, Landshut University of Applied Sciences, at the opening of the logistics conference in Magdeburg.

Good spirits at the opening of the logistics workshop in Magdeburg.

Impressions

of the 17th IFF Science Days from June 24 to 26, 2014

Prof. Ulrich Schmucker, Fraunhofer IFF, in an animated conversation with Prof. Rolf Hiersemann, School of Electrical Engineering and Information Systems at Mittweida University of Applied Sciences, and Dr. Rüdiger Mecke, Fraunhofer IFF, about a mobile assistance system that localizes and rectifies errors in a production plant.

Prof. Gerhard Müller, Fraunhofer IFF, with Dr. Klaus Klang, State Secretary in the Saxony-Anhalt Ministry of Regional Development and Transportation.

Dr. Gerd Esser, CEO of inpro Innovationsgesellschaft, and Prof. Reiner Anderl, Professor of Data Processing in Engineering, Department of Mechanical Engineering TU Darmstadt, at the opening of the Digital Engineering Conference.

Andreas Höpfner and Andreas Bartz (r.) from Fraunhofer IFF, explain novel software for planning of electrical grids using VR to Olaf Stecken, VDMA Grossanlagenbau, and Dr. Jörg Stöcklein, Heinz Nixdorf Institute, University of Paderborn.

The relaxed get together after the Digital Engineering Conference: Margret Köhli, CEO of WARETEX GmbH, Dr. Frank Ryll, Annegret Brandau and Sebastian Möser, all from Fraunhofer IFF, and Lothar Kühne, WARETEX GmbH.

Some of the guests at the opening of the large battery storage system: Prof. Burghard Scheel, Chairman of the Fraunhofer IFF Advisory Board, Dr. Jürgen Ude, MAHREG Cluster Manager, Dr. Christoph Günther, CEO of InfraLeuna, and Dr. Stefan-Robert Deibel, Vice Senior President of BASF in Ludwigshafen.

Prof. Michael Schenk, Director of the Fraunhofer IFF, and Hojin Ryu, General Manager of SK innovation, signing the cooperation agreement.

Dr. Przemyslaw Komarnicki from the Fraunhofer IFF explaining the large energy storage system to Prof. Verl, member of the Fraunhofer-Gesellschaft Executive Board, and Hartmut Möllring, Saxony-Anhalt Minister of Higher Education, Research and Economic Affairs, .

Lars Bauder und Marius Jachmann (center) are the best graduates in the logistics program at Otto von Guericke University Magdeburg in 2014. They were recognized at the evening event by Prof. Michael Schenk (l.), Dr. Tobias Reggelin and Fabian Behrendt from the office of the Group for Production.

Prof. Jörg von Garrel, Riedlingen Distance University, Matthias Knobloch, Auto Club Europa, Malte Stamer, DEKRA Akademie GmbH, Sönke Duckwitz, RWTH Aachen, and Carsten Hauser, DR Bildungszentrum Mittelhessen, enjoying the traditional event.

Prof. Klaus Richter, Fraunhofer IFF, Jörg Lammerich, VLS Engineering GmbH, and Dirk Jonsson, CEO of TRESTON Deutschland GmbH, talking shop.

The evening event again proved to be an ideal platform for networking this year, too: Patrick Dittmer with Hendrik Thamer, both from the Institut für Produktion und Logistik GmbH at the University of Bremen, and Dr. Markus Kückelhaus, DHL Customer Solutions & Innovation.

A sociable get together at the evening event in Festung Mark: Dr. Keith Ulrich, CEO of Athenga GmbH, Brigitte Smyth, Richard Smyth, Dr. Markus Koch, Otto von Guericke University, and Sebastian Trojahn, Fraunhofer IFF.

One Hundred Percent from Renewables:
Overcoming Ebbs with Battery Storage Systems

Interview with Stefan Müller
Enerparc AG COO and Shareholder

Although sun and wind deliver a lot of energy, the amount of power from solar systems and wind turbines fluctuates considerably. Large batteries will counterbalance these irregularities in the future: They store and supply power to the grid as needed. One of the largest mobile battery storage systems in Germany is located at the Fraunhofer IFF in Magdeburg. For the first time, the storage system is going to be put to use at a company, Enerparc AG, the operator of the largest energy park in Germany.

Anna Mahler

The one megawatt battery at the Fraunhofer IFF is mobile and versatile – clients can use the large energy storage system for research purposes. What is your assessment of the opportunities presented by this storage technology for companies?

Medium-sized companies in particular often approach us with the request to supply their operations with power one hundred percent from renewables. So far, this has been possible on a grand scale only to eighty percent, however. According to a study, reaching the last twenty percent is extremely costly. Energy storage systems could solve this problem. Parks could use them to use their power at times when solar power systems do not produce any power, for instance, at night.

In Neuhardenberg, Enerparc AG operates the largest energy park in Germany. The mobile storage system is supposed to put to use at a company for the first time. What do you expect from the storage system for Enerparc AG?

At present, I see two uses in our solar power plant. On the one hand, the solar parks also have to be surveilled at night. The alarm system is armed and data have to be transferred. In short, the solar park consumes power at night, too, which we draw from the public grid. Thus, we deliver our valuable solar power in new solar parks for nine cents per kilowatt hour during the day and have to pay thirty cents for it at night. The second point is obvious at present at one of our large energy parks: If it is producing too much power, it is cut back. Although we receive compensation for this from the Bundesnetzagentur, it would be more expedient to be able to produce, store and use power as needed. Regardless of the solar system, I see an additional function in the storage system. Enerparc sells power on the energy exchange: We store energy when it is cheap and feed it back into the grid when demand peaks. This way we stabilize the grid.

What hopes do you place in the field test in Neuhardenberg?

We would like to see whether it functions and how good the Fraunhofer IFF is. The problem is not trivial: Spitzen abzufangen and resupplying power zeitversetzt, is a chal-

WE DON'T HAVE THE KNOW-HOW NECESSARY TO CONTROL THE STORAGE SYSTEM CORRECTLY. THE FRAUNHOFER IFF FILLS A GAP HERE.

lenge for control engineering. Battery manufacturers have approached us over and over but we have declined every time because we don't have the know-how necessary to control the storage system correctly. The Fraunhofer IFF fills a gap here.

When the outcome of the field test in Neuhardenberg is good, what form could cooperation with the Fraunhofer IFF take in the future?

Time will tell. Tests are being run with the battery from the Fraunhofer IFF at the moment. We simply had to try it out. We don't know yet what will come of it, though. While the Fraunhofer IFF is evaluating the test technically, we are looking at the results from a business perspective. Many more capabilities than we see at present will probably emerge.

Would it be conceivable to equip other energy parks of yours with the storage system?

If it pays for us, we'll do that but storage systems are still very expensive at present. That makes it difficult to generate the necessary revenue with the proposed plans for its use. We expect prices to drop drastically, though.

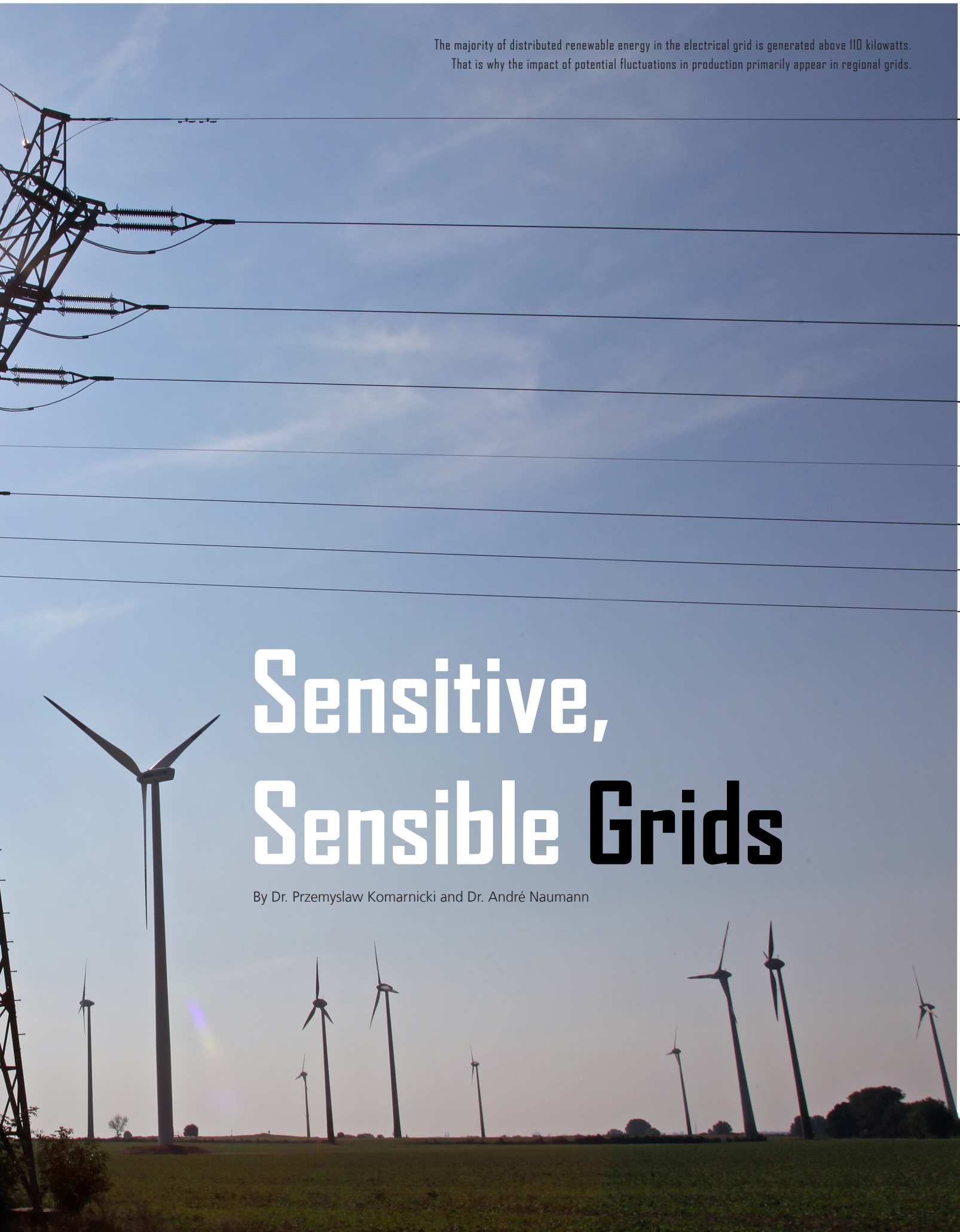
Could you explain the energy market mechanisms in somewhat more detail?

The Renewable Energy Act induced many companies to sell power regardless of the particular price. Enerparc even established a company of its own, Sunnic, to sell power. Since utilities used to only worry about getting as much power out of solar power systems as possible, most of the solar panels point south. Now, there is strong incentive to make production flexible and convergent with actual demand. This results in the production of electricity in a kind of dromedary distribution: Little power is available mornings and evenings. The curve reaches its peak at midday. Aligning the power systems eastward and westward would result in a kind of camel distribution: The systems would produce a lot of power mornings and evenings and less at midday. This would make it possible to organize the production of electricity significantly more uniformly.

BRIEF CV

Stefan Müller

Cofounder and COO of Enerparc AG, Stefan Müller (*1967) has been in charge of operative business since 2008. He earned a Diplom degree in engineering, acquired experience at home and abroad, and worked at BP Solar for nearly ten years. In the five years before starting his own company, he worked for Conergy in Asia where he built up its operative business. During that time, Stefan Müller was in charge of two hundred employees in eight countries in the Asia-Pacific region and integrated all of the relevant fields of renewable energy business in its corporate structure.



The majority of distributed renewable energy in the electrical grid is generated above 110 kilowatts. That is why the impact of potential fluctuations in production primarily appear in regional grids.

Sensitive, Sensible Grids

By Dr. Przemyslaw Komarnicki and Dr. André Naumann

The German electrical grid is highly charged, literally and figuratively. While consumers, industry and residential customers expect a continuous and largely uninterrupted supply of electricity at the lowest possible prices, grids are increasingly reaching their performance limits.

When sufficient wind and sun are available, the power in Germany is increasingly supplied entirely by the now over 1.5 million distributed sources rather than by conventional power plants. More and more frequently, the amount of power produced exceeds the load. Both have to be constantly kept in equilibrium, though. This is complicated by scheduled and unforeseen failures of individual lines caused by repairs or storm damage, for instance.

The power flow is controlled in the control and operations centers of transmission and distribution system operators and major public utilities where large wall monitors display power lines in operation and points at risk of overloading. Although there have been hardly any major failures in recent years, system operators view the regulation of the grid with concern. They liken it to driving a heavy SUV with a sputtering engine off road while having to maintain a constant engine speed.

One of the problems is that few of the existing power lines transmit data directly to the control center. Rather than being measured in the distribution grid, at best, the amount of power actually transmitted by a line is calculated from the data delivered by power plant operators and major transformer substations. This results in numerous uncertainties, which either do not utilize the individual power lines' potential for transmission fully or can even cause overloading. Then, especially when compounded by other events such as a rapid load variation or a nearby line failure, difficult-to-control situations looms, which, in the worst case, causes failures.

This is why the research project SECVER was launched in December of 2013. SECVER is the acronym for Distribution Grid Security and Reliability toward a Future Energy Supply System. Research organizations, electric utilities, systems operators and technology firms are collaborating in this project under the coordination of the Fraunhofer Institute for Factory Operation and Automation IFF. They intend to collaborate on the development and testing of new solutions with which the electrical grid can be continuously and reliably maintained in a stable state despite fluctuations in supply from distributed green power producers

Whereas the overhead line monitoring being tested in Schleswig-Holstein is intended to use temperature data to determine available capacities, SECVER is determining the actual power flows in the 110 kV high voltage grid

SECVER is determining the actual power flows in the 110 kV high voltage grid in a transformer substation in the Harz test region.

The phasor measurement unit transmits data packets to headquarters by satellite.

in a test region in the Harz region. Several field partners such as the regional grid operator Avacon and Siemens are involved. The latter intends, among other things, to ensure that the power flows and voltage values measured at the different points in the line can be transmitted as compressed data sets by LTE in real time. The ultimate objective of the project is to monitor the system and to control grid equipment automatically. Other values such as active and reactive power are also included. Since large power plants supplying the transmission system operators are still taking care of frequency stability, it is not part of the project in the regional grid at present.

The equipment used appears to be quite simple at first glance. Transducers connect a small, flat sheet metal housing the size of a CD player to the line and a GPS receiver. Other devices about twenty kilometers away capture the data and ascertain the phase shifts of the AC voltage, which is in the microsecond range in such lines. The outcome is a so-called phasor measurement unit that transmits data packets to the control center. For the time being, evaluation and control is being done in a testing laboratory rather than directly in the control center. Converting them would have entailed too much work. A wind and solar park and a biogas plant are connected. Although the complexity is limited at first, the size is optimal for the general development of a technical basis for communication among different manufacturers' systems using the load data from the grid. Standard communication protocols can be used for this. At the same time, work is being done on designing high security standards into this data transmission over public networks.

The first experiences are now available from the test region in the Harz region where ten such measurement points are in operation and others are supposed to be set up. Some of the lines have potential to transmit as much as ten, in some cases, even twenty percent more before critical values are reached. The limits have been reached other places, though. The findings can already enter into the operation of control centers and also influence planning of grid expansion.

» How can the electrical grid be continuously and reliably maintained in a stable state despite fluctuations in supply from distributed green power producers? «

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Managing Energy Smartly

By Manfred Schulze

Researchers from the Fraunhofer IFF in Magdeburg have developed a novel, dynamic management system that compensates for the volatility of renewables. Integrated in a facility control system, it will efficiently control companies' power consumption in the future.

Photo: Fraunhofer IFF

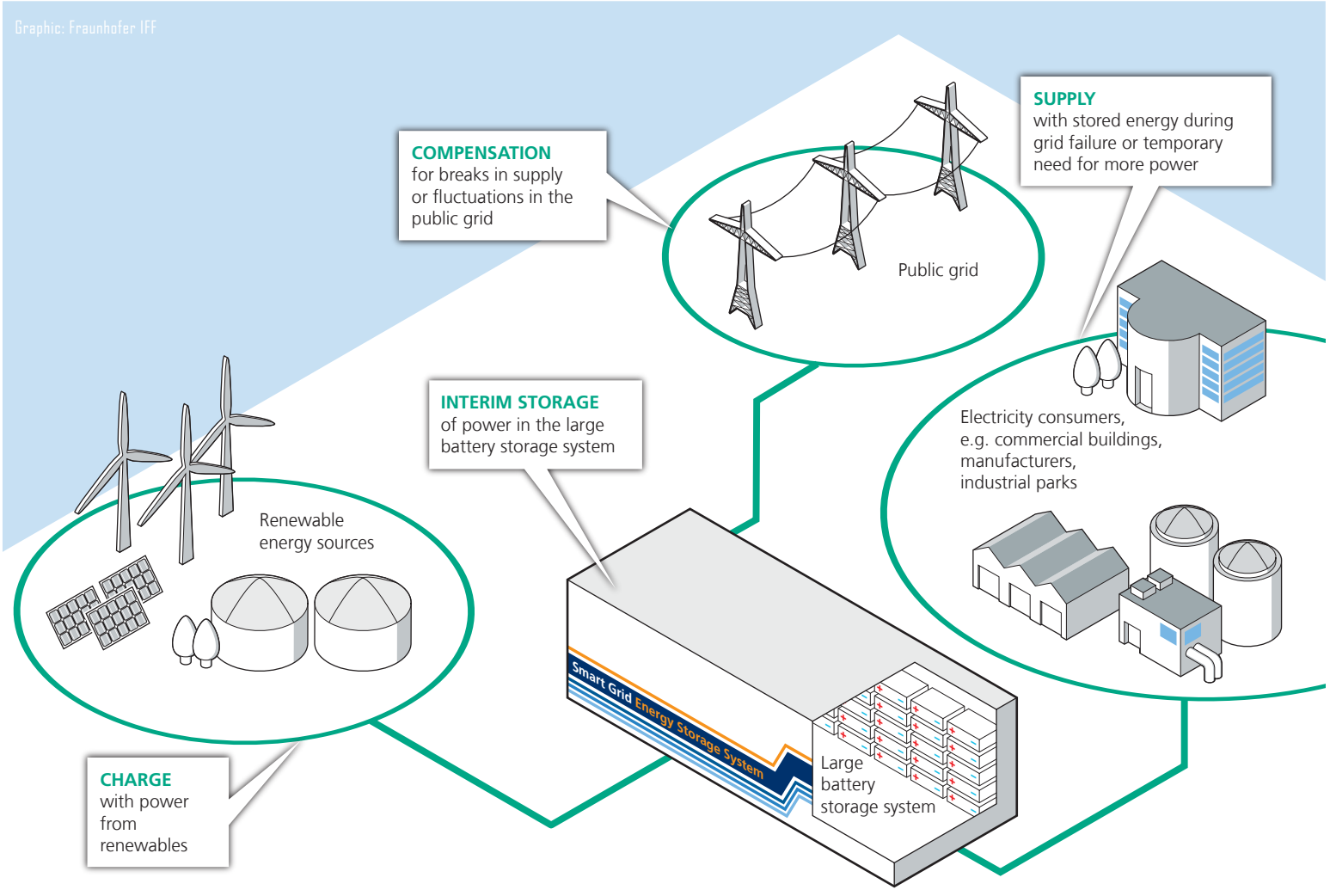
Energy management is now standard, even in most small and medium-sized enterprises. Exemption from the Renewable Energy Act surcharge or reimbursement of electricity tax are no longer possible without a certified energy management system.

Such energy management systems include annual inspection of power flows for their efficiency and the elimination of peak loads by temporary disconnecting inessential consumers in a company. Another step forward could definitely be taken, though.

The researchers from the Fraunhofer IFF in Magdeburg developed dynamic energy management software in order to configure a complex system that controls load and supply and to boost efficiency further. "The system is suited for very complex corporate energy processes. It can monitor them and then control them optimally," reports Alexander Pelzer from the Fraunhofer Institute for Factory Operation and Automation in Magdeburg.

Together with colleagues from Otto von Guericke University Magdeburg, the computer scientist develops such dynamic control strategies, which not only facilitate plant operation optimized for total consumption on the load side but also smartly integrate the widest variety of energy sources. "Since the additional expenditures for power are

Graphic: Fraunhofer IFF



Integrated in the facility control system, the energy management system will efficiently and continuously control power consumption in larger building complexes and production facilities in the future on the basis of ecological or economic criteria.

» Depending on the basic conditions there, as much as twenty percent of the energy consumed in a company can be cut without reducing output. «

high, the trend is moving more and more toward self-generation. That ranges from rooftop solar collectors and wind turbines to biogas plants and cogeneration plants and even connecting storage units and load controlling systems of one's own," explains Dr. Przemyslaw Komarnicki, who is in charge of this project at the Fraunhofer IFF.

When such sources, which sometimes fluctuate greatly, are integrated, weather forecasts have to be adjusted continually. This can mean a lot of manual work. On top of that, load forecasts based on the production schedule and the necessary use of plants and machinery have to be made every quarter hour. The new energy management software, most recently presented to the professional public at the 2014 Hannover Messe, does this and controls all of the processes fully automatically. The Fraunhofer energy management system is thus fully integrated in the Factory 4.0 system in which even plants and machinery already communicate.

The new energy management system can be upgraded substantially: The sources supplying energy and the individual loads in a large commercial building, at a medium-sized manufacturer or for the infrastructure of an entire industrial park can be controlled so that not only peak loads are eliminated but also the certainty of supply is increased, by using local energy storage systems for instance. This is made possible by customizing the dynamic energy management software. This is preceded by a comprehensive analysis of the corporate processes and demands and successive implementation of the system during normal operation.

The algorithms employed function according to a principle that entails forecasts of values, optimization of processes, and control. Naturally, constraints such as job orders with time limits or the technical specifications of systems have to be observed. "By aiming to integrate energy efficiency and reliability in the dynamic system, we are going far beyond the rigid system of a pure energy management system in compliance with DIN EN ISO 50001," explains Dr. Komarnicki. Depending on the basic conditions there, as much as twenty percent of the energy consumed in a company can be cut without reducing output. Those would be top values, though, which can only be achieved under ideal conditions and by factoring in the energy sources of electricity, heat and compressed air. "Our own goal is to boost efficiency by at least ten percent every year," says Alexander Pelzer. That too,is definitely a quantity to be taken seriously, especially when extrapolated for the consumption of an industry sector.

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Photo: Fraunhofer IFF

Inside the large battery: Dr. Przemyslaw Komarnicki explaining its working principle to Saxony-Anhalt Minister Prssident Reiner Haseloff.

Power in Reserve:

Large Battery Storage System Passes First Major Test

By Manfred Schulze

The fat red button on a console in front of around one hundred guests and staffers boosts the adrenaline level a bit. "It is the first public test of the new large battery storage system we have been assembling since the summer of 2014. Naturally, something unforeseeable can always happen," says Dr. Przemyslaw Komarnicki, who is heading the project at the Fraunhofer Institute for Factory Operation and Automation IFF. Of course, everything was tested repeatedly in advance in trial runs but everyone is familiar with the vagaries of actual demonstration, particularly when the state's minister president himself will be pushing the button and, thus, disconnecting the entire institute's power supply from the grid. "I think everything will go perfectly, though," says the expert confidently.

A freight container with loud humming inside stands right behind the Fraunhofer IFF's Virtual Development and Training Centre in Magdeburg. Large control cabinets stand in the front, black boxes connected with thick power cables are stacked on both sides toward the back. A total of eight lithium-ion battery assemblies are housed here, twelve individual modules always interconnected in one block. "Each of the cells delivers 3.7 volts and is connected in a series. The modules, on the other hand, can also be connected or disconnected individually so that the entire system does not have to be shut down in the event of a local failure," explains Dr. Christoph Wenge, on hand at the battery storage system as a contact during the large-scale test.

The auditorium does not go dark; the lights do not even flicker slightly when the power flow reverses on the schematic once the button has been pushed. Instead of flowing from the grid and into the battery, electricity now flows from the storage system to the consumers in the institute. The computers and machinery there consume around 120 kilowatts of power. The system also has to handle rapid load variations, when the air compressor starts for instance. Even though a small solar collector on the roof with a peak of ten kilowatts supplies everything the sunny fall day yields, the large energy storage system can handle that for around four hours. Then it has to go back on line.

"Naturally, the storage system is much more than a pure emergency power unit. The South Korean technology group SK innovation has designed it not only to absorb peak loads like a smart backup battery but also to help stabilize the public grid as needed," says Komarnicki. That is why it has also been designed for one megawatt of power. Units with five and even thirty megawatts are already being planned for use in the field. Pushing the second red button is intended to demonstrate this. This will reconnect the grid, demonstrating that the storage system lives up to its official name, Smart Grid Energy Storage System (SGESS), a smart storage system for convergent supply infrastructures.

The storage system actually continues discharging when reconnected. The remaining sixty plus percent would still be enough for a good two hours, although part of the power, 100 kilowatts of power, now additionally flows into the grid of Magdeburg's public

» Grid costs: Distributed siting of larger numbers of storage systems would definitely reduce the need for investments in new lines. «

Dr. Christoph Wenge, Fraunhofer IFF

Photo: Fraunhofer IFF

The Fraunhofer IFF's large battery storage system in Magdeburg's Port of Science.

utilities. Whenever much wind is produced or loads are weak, the power would flow through the smart control system differently: The storage system would charge and simultaneously relieve the grid of excess power.

Buffering peak loads in companies, supplying operating reserves during fluctuations in the grid, and buffering switching operations are potential use cases of large battery storage systems already possible today. Research on long-term storage systems for the energy transition are is still needed, though. What is more, their cost of around € 1000 per kilowatt hour of storage capacity currently make them too expensive for purely commercial use. Chanyul Lee, CEO from SK innovation, puts this in perspective, though. "We are working intensively on the technical improvement of batteries since much is still possible, both in terms of energy density and price," he says. At any rate, the new large energy storage system's lithium-ion cells have numerous advantages over the batteries common earlier, most notably in terms of durability and load capability. They can be charged and discharged several thousand times. Dr. Christoph Wenge calculates the present capacity is 0.5 megawatt hours, approximately as much as 760 average car batteries. Although it is significantly lighter than lead, the storage system still weighs in at twenty-six tons.

Even though the use of large battery storage systems will probably remain limited to the aforementioned use cases for the time being, costs can be cut tremendously nonetheless. "Peak loads are always the most expensive part of the energy bill in companies. If we succeed in cutting just these peaks, double-digit percentages can definitely be cut off power bills in individual cases. The effects for grid costs are even more significant. Distributed siting of larger numbers of storage systems would definitely reduce the need for investments in new lines," explains Wenge. Not to mention the system's reliability in general: Costs for companies confronted by a power failure without backup would quickly mount beyond imagining. The software system that will control the large battery storage system and eventually be implemented in a complete dynamic energy management system will now be developed and tested at the Fraunhofer IFF in the coming months.

Przemyslaw Komarnicki is completely relaxed a few minutes after the test has ended, while most of the guests are taking a close look at the storage system and having it explained to them. Everything went as planned, at least the guests did not notice otherwise. "The occurrence of surprises in research now and again and the need to react quickly is routine for us," he says.

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2015 Schedule of Events

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Leipzig

March 5, 2015
3rd Spare Parts Logistics Forum
Nürnberg

April 16, 2015
Supply Chain Day
Worldwide

April 29, 2015
German-Brazilian Logistics Conference
Rio de Janeiro

May 5-8, 2015
transport logistic
Munich

June 2015
3rd Chemical Logistics Forum

October 28-30, 2015
32nd International Supply Chain Conference
Berlin

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From NEMO Network to Regional Growth Core:

By Mario Spiewack

"Fluss-Strom" Is Harnessing Hydropower

Propeller, turbine or water wheel: the researchers want to know how to maximize efficiency.

Photo: Fraunhofer IFF

The idea of harnessing the power of running water has fascinated sharp minds for many years. Unlike that from windmills, the mechanical energy from rivers was already viewed as reliable energy earlier, something highly valued in the energy transition today. Whereas wind delivers good yields on fewer than half of all days and solar power fluctuates depending on the transition from day to night, cloud cover and seasons, rivers only rarely carry so little water that they entirely run dry as an energy source. Now it appear as if rivers' flow force is bound to experience a revival, too.

A replica of a historic ship mill stands on the left bank of the Elbe in the middle of Magdeburg. This energy source and a number just like it floated firmly anchored on the river until the start of the last century and took advantage of the river current. At a medium water level, the current still surges toward Hamburg at around 1.7 meters per second. Theoretically, the area from the German border to the river's mouth would suffice to erect 150 000 such approximately ten-meter-long floating energy sources.

Ship Mills: A Nearly Forgotten Form of Energy Production

Ship mills, which were reliable machines throughout the Middle Ages, have long since disappeared from public consciousness since their removal because they were obstacles to shipping and, not least, also because they only used mechanical energy. The electrical grid producing cheap power from coal, which rapidly expanded around 1900, was this technology's death knell.

Today, major run-of-the-river hydroelectric power plants such as the Rheinkraftwerk in Iffezheimhere are located where ship or river mills once characterized the appearance of many flowing waters from the sixth century onward. These plants constitute a major intrusion in the particular flowing waters and are usually connected with the need to dam up that body of water. High-tech hydroelectric power plants with turbine units have replaced earlier ship mills with the most basic elements of a floating platform and an undershot water wheel. Such large power plants can, however, be built only after a time consuming permit process and only at select suitable locations.

This nearly forgotten form of energy production with small mobile hydroelectric power plants such as ship mills represents a considerable potential as energy prices steady mount and increased percentages of renewables gain prestige.

Producing Electricity from Flowing Waters

This potential prompted the formation of a collaborative partnership, the NEMO network, in Magdeburg in 2008. Its mission is to produce electricity from flowing waters. The engineers decided the plants should be mobile. They should be mass producible, have maximum efficiency, and be fully operational when transported to their sites of operation. The experts additionally the environmental impact of the slow-running water wheels a priority. The small hydroelectric power plants should not disturb fish.

The small hydroelectric power plants are modularly designed technological solutions and products. The main plant components are the floating platform, a transformer, a debris deflector, and generator and control systems. Different prototype have been built in the network's individual projects in recent years.

Prototype Field Trials

One of them, called VECTOR, was produced in a partnership between the Fraunhofer Institute for Factory Operation and Automation IFF and Sibau Genthin GmbH. This floating and mobile plant is in active use on the Elbe in Magdeburg and the Elbe-Havel Canal in Genthin to continuously test the flow transformer and all kinds of peripherals.

The Fraunhofer researchers and their partners tested different manufacturers' turbines and wheels and created first mathematically models from the measured data. New blade materials, advanced turbines, and, above all, the conversion of flow energy into electricity have given rise to entirely new demands on the design and use of run-of-the-river hydroelectric power plants. For instance, very lightweight fiber-reinforced aluminum foam propellers are being used. The river's power above a current velocity of approximately 1.5 meters per second suffices to produce 1 to 4 kW or more of power with a small turbine with a diameter of approximately 80 cm, depending on its design. Several systems in combination can deliver over 30 kW of power even in tight space.

The VECTOR is currently on the banks of the Elbe-Havel Canal at SIBAU Genthin GmbH in Genthin, its owner and the project partner. It has been equipped with a more powerful drive unit. "This enables VECTOR to reach a speed of up to seven knots," says CEO Heinrich Baumgärtel. "Now we can freely simulate the flow velocity of bodies of water – a significant advantage for the tests," explains his project partner Frank Mewes from the Fraunhofer Institute in Magdeburg.

For about two years, the widest variety of systems have been being attached to the catamaran and then tested. The data obtained have been analyzed for the particular manufacturer. The initial goal was optimized machinery with yields that could generally be improved by one to two percentage points. The increase in the efficiency of newly developed water wheels and turbines is significantly higher. The data provide basic knowledge, too. Experience, partly because so few small power plants are in use worldwide, and assured measured values have both been lacking. What turbine propeller geometries and what materials prove best at which current velocities? Robustness and running expenses determine whether such plants and especially micro power plants that produce just a few kilowatts of power will be cost effective later. The RIVER RIDER, the first floating micro hydroelectric power plant, lies in the outlet of Wendefurth Dam. It was developed by the partners in the Technologiekompetenz Fluss-Strom network and implemented by BÄNECKE Industrieservice und Wasserkraft and generates base load power.

The River Rider Tandem in Forst, Neisse.

The Innovative Regional Growth Core Program

is a funding action of the Federal Ministry of Education and Research that is part of its Entrepreneurial Regions innovation initiative for new German states. It is intended to inspire developments with major economic potential in the new German states. Usually, such economic potential is only fully exploitable when several regional companies' develop complementary products or systems.

The RIVER RIDER Tandem is located on the Rhine near Niederheimbach in Rhineland Palatinate.

Mainzer Stiftung für Klimaschutz und Energieeffizienz, Stadtwerke Mainz, Enertainer Energy GmbH and MAINOVA AG refined the principle of ship mill energy production. The result is the RIVER RIDER Tandem now installed on the Rhine near Niederheimbach. This ship mill is specially designed for run-of-the-river hydroelectricity and does not need any barrages. Anchored in the water, it generates up to 8 kW of power continuously. This type of plant has a large range of uses and generally does not disturb nature. The two undershot water wheels with connected generators convert the Rhine's flow energy into power.

Methods and assessment systems that reduce the time and labor required to verify a positive environmental impact will be developed together with network partners next year in order to make the complex permit process required by water and environmental agencies somewhat easier. To this end, underwater camera systems will be developed, which will show whether turbines disturb fish. The cable connection for the transport of power to land and simple but dependable integration in the local grid will also be refined for maximum cost effectiveness in the coming months.

From NEMO Network to Regional Growth Core through an Innovation Forum

The Technologiekompetenz Fluss-Strom NEMO network of companies, small businesses and research organizations was established over three years ago in order to make the river power usable without any negative environmental impact. The network has grown to thirty-four members.

The Technologiekompetenz Fluss-Strom network has received the State of Saxony Anhalt's Environmental Alliance's Climate Mitigation Award (2012), the Hugo Junkers Award (2013) and the Capital City of Magdeburg's Environmental Award (2013) for technological developments in environmentally compatible run-of-the-river hydroelectricity.

The Fluss-Strom PLUS Innovation Forum arose in the wake of the Renewable Energy Act and ensuing requirements to increase the percentage of power produced from renewables.

Network and development work and the Innovation Forum's results have motivated the network partners to build upon the regional growth core Fluss-Strom PLUS, an alliance of seventeen companies and seven research organizations, including the Fraunhofer IFF in Magdeburg.

Funded by the partners, the Technologiekompetenz Fluss-Strom network of companies and research organizations intends for the envisioned growth core to use cost efficient and environmentally friendly hydroelectric power plants, especially for freely flowing waters, to develop energy sites with low hydropower potential. The challenge will be finding the right solution for a particular hydropower site in the future.

www.flussstrom.de

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Concentrated Biomass Know-How from One Source

By Stefan Voigt and Dr. Ina Ehrhardt

Photo: Fraunhofer IPF

Biomass is in. What demands attention, though? The wiki BIO:logic pools research findings, experience and tips and, for the first time, provides information from one source.

The weather is frosty but the premises are comfortably warm. The cozy warmth has its price, though. Energy is expensive and prices are rising. Biomass can furnish a response to rising energy costs. It is the most important and most versatile renewable in Germany and can be used in solid, liquid or even gaseous form. Profiting from this renewable energy source requires the right know-how, though. What demands attention when one wants to use wood pellet or woodchip heating systems instead of steadily depleting oil or natural gas cozy to heat one's own four walls cozily? Who delivers the raw materials? What costs are incurred? At what price can biomass be sold? And what pitfalls are lurking?

The search for answers to such questions about biomass has primarily demanded a lot of patience and stamina because the answers are dispersed on numerous websites all over the Internet, discussed and explained at conferences, and described in books but are not concentrated in one place. Research studies and an international conference held a few years ago by researchers at the Fraunhofer IFF revealed great need for an information platform.

Knowing Where to Look!

Researchers at the Fraunhofer IFF have now created such a knowledge platform. They are pooling the information that exists on biomass for the first time. The project was funded by the state of Saxony-Anhalt from the European Regional Development Fund ERDF. In a first step, the researchers brought farmers, forest owners and their contractors as well as representatives of the Ministry of the Environment to one table and devel-

Photo: Fraunhofer IFF

oped a common structure for the platform in workshops. The outcome is a clear and well thought out structure. A first subsection concerns the types of biomass that exist and the applications for which each is best suited. How are the different types of biomass used? In the second menu section, users find information on business and operation. The third addresses technologies. What harvesters are needed to process biomass? A fourth section compiles information on processes. How is biomass grown and where is it produced more or less as a by-product? What partners exist? Who can be approached with questions about how to find buyers for biomass? The researchers also incorporated a section for resources on the platform with space for everything that simplifies biomass recovery, e.g. spreadsheets.

Photo: Fraunhofer IFF

A farmer putting willow branches through a woodchipper.

Rather than reinvent the wheel and revise the texts circulating on the Internet, the researchers' intend the BIO:logic knowledge platform to link knowledge and provide users these links to find more information. The platform is a wiki, i.e. a collection of websites that every registered user can edit, revise, create or even delete. Even sites that do not exist yet can be linked. The advantage is that users can not only use the wiki to procure information but also to contribute their own experiences and knowledge. Users who just want to read and explore the wiki do not have to register. Reading does not require any access authorization.

From Energy Consumer to Energy Supplier

Since forest timber is too good for energy recovery and, thus, not a good option when switching from fossil fuels to biomass, the BIO:logic platform made information on short rotation plantations one of its main foci. Fuel wood, i.e. fast growing tree species such as poplar or willow, is planted on farm fields. The trees are felled every three years and the stumps regrow the following three years before being felled again. Harvested branches and twigs can be chipped and burned in special heating systems. Plantations need less care than other farm fields and are harvested off season, i.e. in winter. Growing timber on short rotation plantations is still something quite new, however, and is still in its infancy so to speak but there are already many research findings. What tree species best resist pests? Should short rotation plantations be fertilized? What demands attention when harvesting?

» With the wiki, there is a neutral base of information for the first time, which provides users good and comprehensive information. It gives this big topic a good structure and is thus really valuable. «

Hans-Georg von Engelbrechten, Farmer

In order to add more findings and experiences than these to the wiki, the researchers from the Fraunhofer IFF also accompanied some farmers who intend to establish or are already cultivating such plantations. One is Hans-Georg von Engelbrechten, a farmer from Saxony-Anhalt who has specialized in fuel wood since 2006. "Since I've owned a short rotation plantation for several years and also plant them as a contractor, I contributed my know-how to the wiki in a in kind of field report. It includes a a model that interested individuals can transfer to their operations," he says. He is thrilled at the wiki: "Biomass is an important and wide ranging topic, which is part of the base of my business 'heat from wood'. With the wiki, there is a neutral base of information for the first time, which provides users good and comprehensive information. It gives this big topic a good structure and is thus really valuable."

For most farmers, short rotation plantations are a new realm for which having the right information on hand is essential. The first obstacles already appear when selecting the land. A field with fertile soil is not suited. Grain should be planted there, for instance. Caution is advised when land is frequented by a lot of game because deer like to eat young shoots. Putting up fences or planting less popular species on land as a border can be helpful. Best suited are fields that cannot be cultivated practically because, for instance, they are too far away. Attention has to be paid to a number of things here, too. One of the farmers accompanied combated annual spring flooding on the field, which ultimately destroyed the trees. He obtained good yields from other land, though, and now heats his premises with his own biomass.

Users Bring a Wiki to Life

The researchers have incorporated all this and much more basic information in the wiki. A version for test users is already running. The researchers intend to activate BIO:logic for all users at the end of 2014 and, thus, help them with their decisions about biomass. Then it will be up to the users to keep adding to the wiki and fill it with life. Research organizations can contribute the results of their research, companies their latest findings and information, and farmers their experience. Anyone interested in biomass will be able to find specific information. After all, a wiki lives from its users.

http://s.fhg.de/biologic

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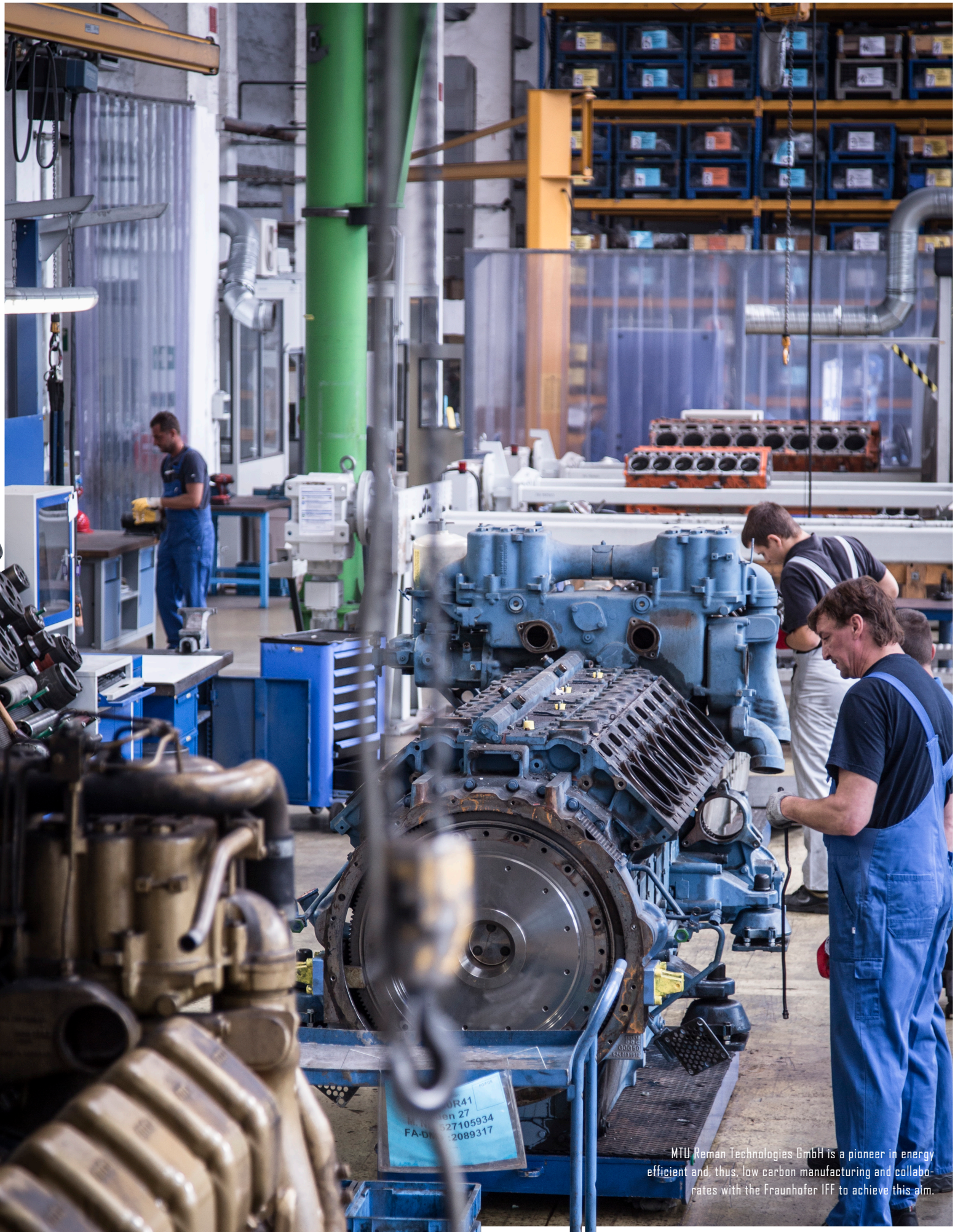

MTU Reman Technologies GmbH is a pioneer in energy efficient and, thus, low carbon manufacturing and collaborates with the Fraunhofer IFF to achieve this aim.

Photo: Fraunhofer IFF

Identifying Energy Guzzlers in Manufacturing

By Marc Kujath

Companies that want to stay competitive have to organize their manufacturing efficiently, especially wherever resource and energy consumption is concerned. Researchers at the Fraunhofer IFF are analyzing the locations of the levers worth adjusting.

Times are not particularly rosy for manufacturers and businesses: Cheap products from Asia are edging into the market and raising the price pressure on domestic firms. Rising energy and water prices are doing the rest to the exacerbate situation. They have become the major cost drivers in German industry. This means that companies that want to stay competitive have to organize their manufacturing as efficiently as possible, i.e. use resources optimally. Such energy efficiency generates two benefits: lower operating costs and (partial) exemptions from the surcharge to develop renewables (Renewable Energy Act). When companies can prove that they are cutting energy consumption and, thus, complying with ISO 50001, the surcharge drops, graduated according to total electricity consumption from one hundred percent to a fraction (< ten percent) of the .624 cents per kilowatt hour due otherwise.

"Road Map" for Higher Efficiency

Researchers in the Fraunhofer innovation cluster ER-WIN®, short for Smart, Energy Efficient Regional Value Chains in Industry, are studying how such energy optimized manufacturing might look for particular factories and what solutions are helpful. Lead managed by the Fraunhofer IFF, numerous development and industry partners are working hand-in-hand and providing manufacturers relevant assistance.

The goal of economizing on energy is confronting factories and companies with numerous question: Which machines are energy guzzlers? How can suitable meters be installed at low cost? How should big data be properly evaluated and processed to be able to extract correct information and make decisions? In which systems are technological improvements expedient and how can excess material and energy be recovered? And, last but not least, how flexible must a company be in its energy use to adapt its manufacturing better to fluctuations in energy availability and prices? How can it benefit from this? It might be cost effective to allow high-energy machines to run especially when power is inexpensive, i.e. at night or as a function of the Leipzig Power Exchange's dynamic price. The researchers' efforts to model different constraints mathematically and to optimize them reveal that this goal is anything but trivial. After all, reliability of manufacturing processes or high night differentials for staff are also counterproductive or count as knockout criteria.

MTU Reman Technologies GmbH, a Pioneer

The staff at MTU Reman Technologies GmbH were asking similar questions. Systems and processes for the remanufacturing of components and engines are being developed in the technology center that remanufacturing of MTU and MTU Onsite Energie diesel and gas engines and systems. In the remanufacturing process, clients' used engines are taken back and disassembled in a standardized procedure, remanufactured and made fit for another service life. This provides clients low cost alternatives and additionally saves valuable resources.

MTU Reman Technologies GmbH is a pioneer in energy efficient and, thus, low CO_2 manufacturing. "We wanted to perform a screening that identified where the most energy is consumed," reports Martin Altrock, who, as maintenance and energy manager at MTU Reman Technologies, is in charge of energy efficiency. "With the help of the analysis, we intend to verify whether we are on the right path or whether there are still sinks that we aren't even looking at. Among other things, we had planned to install meters but weren't sure where to install them best."

Identifying the Energy Guzzlers among the Systems

Where do the researchers from the Fraunhofer IFF begin when they comb through a large factory like MTU Reman Technologies GmbH for energy guzzlers? After completing a basic survey, their first step was to analyze the amount of power each system consumes. The researchers entered the manufacturing facilities outfitted with portable measuring instruments and examined some thirty to forty machines more closely and clustered them in ten to twelve machine groups. The outcome was a curve of power consumption as a function of time. They used this load curve to read how long machines run and at what power, when they have to be set up, i.e. when tools or workpieces are changed, and how these setup times affect power consumption. The researchers used this information to compile an energy portfolio. A machine that requires a lot of power and runs for a long time is a critical system. The power consumption of a system that operates only a short period, on the other hand, is not very high and more in-depth analyses would hold forth less potential for improvements.

The researchers identified several large scrubbers at MTU Reman Technologies GmbH as particular energy guzzlers. They are electrically heated to maintain the necessary flexibility as layouts change during the company's growth phase. Another crucial point is the use of compressed air as fuel at many machines, to supply tools or to sandblast remanufactured components extensively. Since virtually unavoidable leaks in the supply system makes compressed air the most expensive

Equipped with portable measuring instruments, Fraunhofer researchers examined some thirty to forty machines more closely. The outcome was a time curve of power consumption and the compilation of an energy portfolio.

The sometimes up to over 1,000 components that make up an engine are cleaned and remanufactured at MTU Reman to do their job again – virtually like new – in a remanufacture engine. The remanufacturing of cylinder heads particularly consumes a lot of energy.

form of energy, not only boosting the usable percentage (commonly around ten to fifteen percent) and coordinating compressor operation but also generally reducing consumption promises to increase efficiency considerably. All told, Martin Altrock is surprised by these findings: "Although we were already focusing on compressors and had identified them as the biggest evil, we hadn't expected this percentage over the actual manufacturing equipment. We hadn't been focusing on the energy consumption of the main consumers in manufacturing identified by the researchers from the Fraunhofer IFF. We were looking more at the large machining centers, which, however, aren't some of the major energy consumers per se. Our collaboration with the Fraunhofer IFF sharpened our perspectives and established the basis of evaluation in our next steps."

One Part Is Not Like Another

More than just a"classic look" at machines offers substantial energy saving potential. Analyzing the individual components of the remanufactured engine exactly is worthwhile, too. The researchers term this focus "energy differentiation of products". The sometimes up to over 1,000 components that make up an engine are cleaned and remanufactured at MTU Reman to do their job again – virtually like new – in a remanufactured engine. Reducing the energy consumed in the process necessitates analyzing the individual steps of the process separately and evaluating their performance because the differences are great. Whereas most components can be remanufactured quite energy efficiently, others are true "gluttons". The crankcase and shaft, oil pan and cylinder heads were expected to consume a lot of energy but these high-resource components were not expected to account for seventy plus percent of the power consumed in the process. The intercooler follows with another, tidy ten percent of total consumption because of the ultrasonic cleaning to enhance its quality. The other engine parts consume the remaining percentage of electricity, in short, a fraction, which can be disregarded in the first step. The researchers call their analysis of components' energy consumption an ABC analysis. It is made possible by combining measured energy values and the production schedule.

Other elements of ER-WIN's® set of methods and tools are load curve analyses, Sankey diagrams and value stream maps. They were all used since a complex consumption structure had to be assigned to the factory on the

Martin Altrock is maintenance and energy manager at MTU Reman Technologies GmbH. Based in Magdeburg, the company is the technology center for standard remanufacturing of MTU engines. MTU Reman Technologies develops, embedded in the research and development organization for MTU-Motoren und -Antriebssysteme, the systems and processes used worldwide for standard remanufacturing. The company is owned by Rolls-Royce Power Systems AG.

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>
> Martin Altrock, MTU Reman Technologies GmbH

basis of the only total supply of energy available (energy accounting). Forty-five percent of power consumption at MTU Reman Technologies GmbH goes into manufacturing, twenty-five percent is needed in the subsequent, comprehensive inspection of the remanufactured engines and the remaining thirty percent flows into the infrastructure, i.e. buildings, lighting and offices.

Formulating Actions Precisely

The researchers use their methodology's findings to formulate a number of recommendations for action: How could high-energy components be remanufactured more efficiently? Are the process and load parameters ascertained suitable as quality indicators later? How can stationary measuring systems be used in the future to capture reliable data for an improvement benchmark? Is the remanufacturing process chain organized energy efficiently enough or are hidden reserves in circulation? Starting points for machinery are also evident: How can their utilization be increased? Can units and supply components be connected and disconnected by smart logic of programmable logic controller (PLC) as necessary now and then during downtimes? How can the setup times in particular be shortened or even eliminated entirely? Although the machines cannot actually be used during setup, they need just as much energy as in normal operation. In this case, the complex machining centers in manufacturing were diagnosed. If nothing else, long and complex setup additionally caused longer cycle times. That is why the researchers from Magdeburg specializing in logistics see reserves in the factory's total performance here. Not least, long cycle times and larger inventories mean tied up capital. Other detailed studies of the energy priorities identified in the process promise organizational improvements that render extensive and costly investments superfluous.

"We are very satisfied and surprised at how detailed and clearly everything was studied. This analysis will enable us to formulate actions precisely," explains Martin Altrock. "Our collaboration additionally revealed that the findings will enable us to demonstrate compliance with the majority of the requirements of ISO 50001 certification." With success: The Fraunhofer IFF's study provided certainty in the successfully completed auditing and certification process and, not least, limited the cost and labor in the company.

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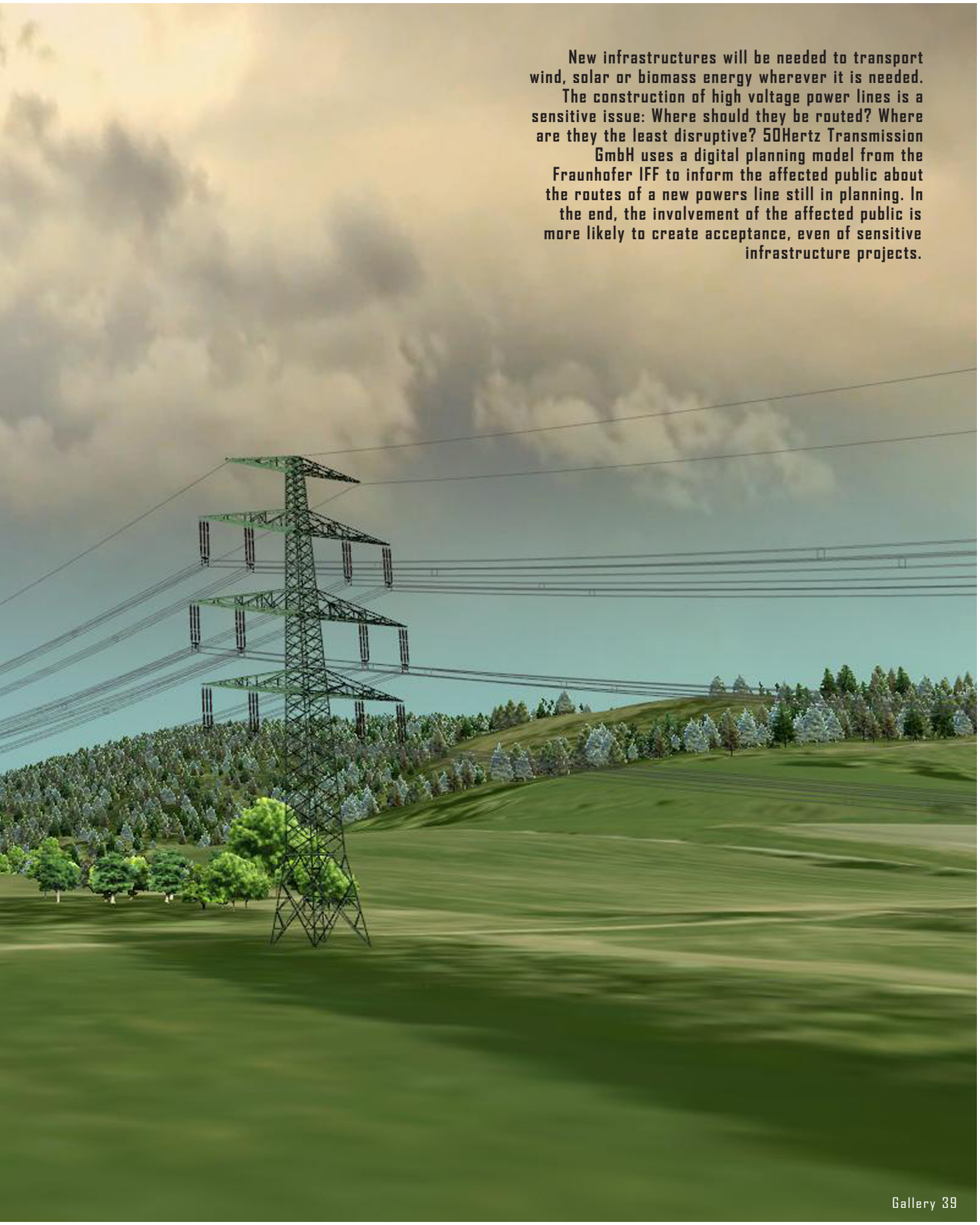
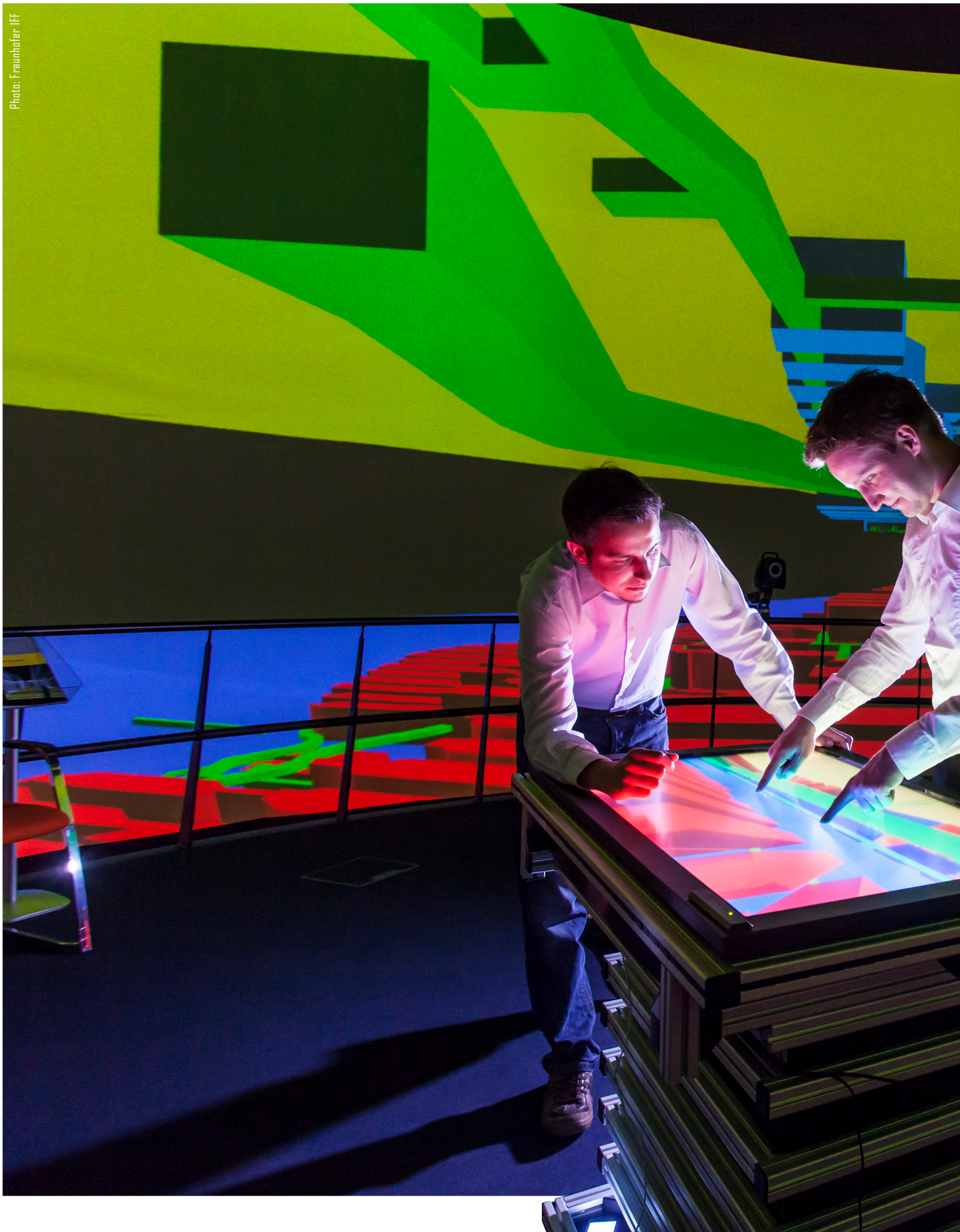
Photo: Fraunhofer IFF



New infrastructures will be needed to transport wind, solar or biomass energy wherever it is needed. The construction of high voltage power lines is a sensitive issue: Where should they be routed? Where are they the least disruptive? 50Hertz Transmission GmbH uses a digital planning model from the Fraunhofer IFF to inform the affected public about the routes of a new powers line still in planning. In the end, the involvement of the affected public is more likely to create acceptance, even of sensitive infrastructure projects.



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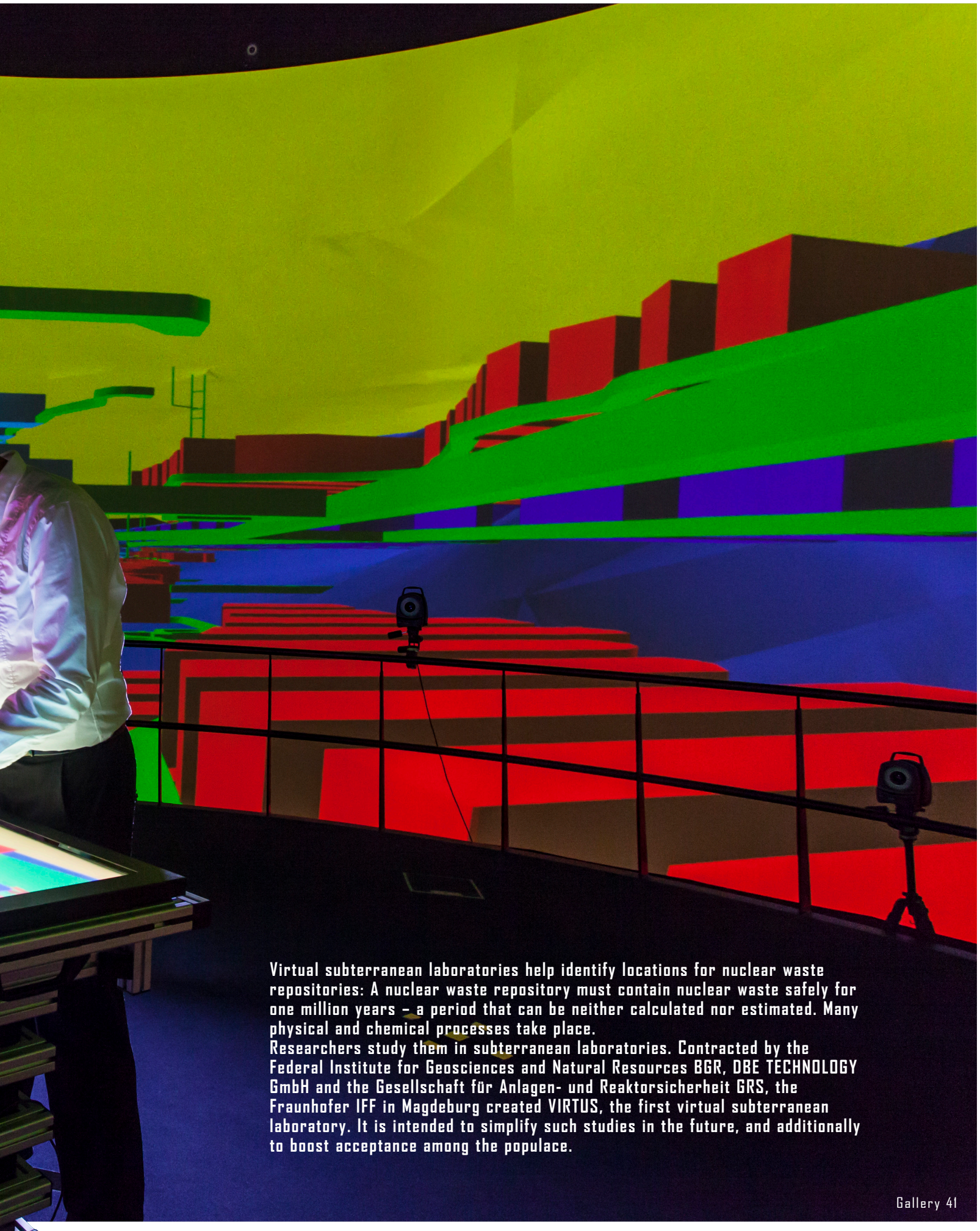


Virtual subterranean laboratories help identify locations for nuclear waste repositories: A nuclear waste repository must contain nuclear waste safely for one million years – a period that can be neither calculated nor estimated. Many physical and chemical processes take place.
Researchers study them in subterranean laboratories. Contracted by the Federal Institute for Geosciences and Natural Resources BGR, DBE TECHNOLOGY GmbH and the Gesellschaft für Anlagen- und Reaktorsicherheit GRS, the Fraunhofer IFF in Magdeburg created VIRTUS, the first virtual subterranean laboratory. It is intended to simplify such studies in the future, and additionally to boost acceptance among the populace.

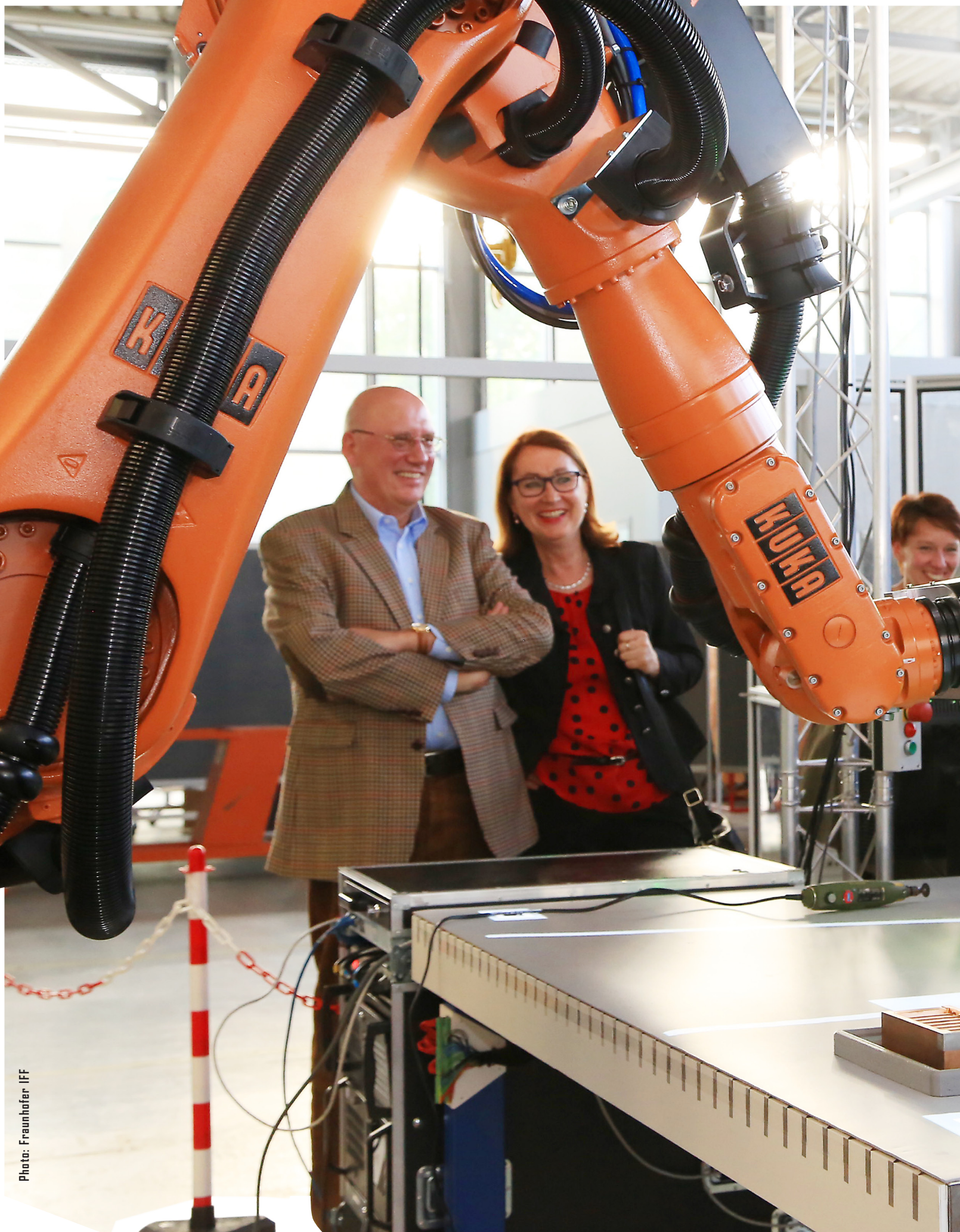


Photo: Fraunhofer IFF

A shortage of skilled labor, an aging workforce and the consequence are increasingly imposing demands on workplaces in manufacturing companies. On the Long Night of Science, Magdeburg Mayor Lutz Trümper tried out examples of technical and learning assistance systems in the workplace. Using the machining of high pressure die casting molds as an example, the project STROBAS is demonstrating how a robot's payload and precision help workers perform strenuous physical labor. Trümper is using the circular input device to guide the robot.

Professor Michael Schenk Awarded Honorary Membership in BVL

Prof. Michael Schenk, Director of the Fraunhofer IFF in Magdeburg and member of the BVL's Scientific Advisory Board, was awarded honorary membership in der Bundesvereinigung Logistik BVL . The logistics expert was recognized for his exceptional personal commitment at the 7th International Scientific Symposium on Logistics in Cologne on June 4, 2014.

Chairman of the BVL's Scientific Advisory Board, Prof. Werner Delfmann (l.), and BVL President, Prof. Dr. Thomas Wimmer (r) presented the certificate to Prof. Schenk.

For fifteen years, Professor Schenk has been active as a member of, among other things, the Board and the Research Council and as chairman of the jury for the Science Award for Supply Chain Management. He was instrumental in establishing the International Scientific Symposium on Logistics as a separate professional logistics event.

A mathematician, Schenk is a recognized expert in logistics and factory planning. He became the director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg in 1994. He has held the Institute of Logistics and Material Handling Systems' Chair of Logistics Systems at Otto von Guericke University Magdeburg since 2003. (akw) ■

Colloquium in Honor of His 65th Birthday

Prof. Juri Tolujew (center) surrounded by his colleagues from ILM.

Prof. Juri Tolujew celebrated his sixty-fifth birthday on March 30, 2014. The Fraunhofer IFF and the Institute of Logistics and Material Handling Systems ILM of Otto von Guericke University Magdeburg honored the logistic expert with an academic colloquium. Always looking for new methods of modeling and simulation for manufacturing and logistics, he has not only brought his expertise to bear in many industry projects but has also imparted his knowledge to countless students.

Tolujew earned a degree in automation in Riga Automatisierungstechnik before his carier brought him to Dresden as a young doctor 1977. To this day, he teaches block seminars in Riga. He came to Magdeburg in 2001 for an international research project. Now his work at the university is done but he will continue his research on real-time logistics systems at the Fraunhofer IFF for a while.

Prof. Juri Tolujew is on the road a lot, privately, too. He travels with his wife all over Europe, touring historic sites and landmarks. (nk) ■

Among his guests. Prof. Schmucker (center) greeting Prof. Ulrich Berger from Brandenburg University of Technology Cottbus, J. Philipp Städter, Gruaduate Assistant at Brandenburg University of Technology Cottbus, Dr. Günther Ihlow, CEO of TTI GmbH and Dr. Harald Schmicker, CEO of H&B Omega Europa.

Dr. Detlef Mlynek, CEO of SYMACON Fertigungsautomatisierung GmbH, and Dr. Reiner Storch, CEO of AEM Dessau GmbH.

Marianna Ackermann from IKAM and Corinna Kunert from MDKK, both former Fraunhofer employees, came to extend their congratulations and enjoyed seeing many former colleagues again.

Dr. Khalid Kallow, CEO of TeCNeT, Stefan Sauermann, CEO of RIPAC-LABOR GmbH Golm, and Holger Breter from the Zentrum zur Förderung eingebetteter Systeme e.V. enjoying themselves.

Unbelievable, but Sixty!

He has been here from the start: Prof. Ulrich Schmucker was part of the Fraunhofer IFF's founding team. He is still here after over twenty years, now as the manager of the Virtual Engineering Business Unit. In March of 2014, colleagues, staffers and business partners congratulated the automation experts on his sixtieth birthday.

Born in 1954, Prof. Ulrich Schmucker attended Moscow State Lomonossow University from 1972 to 1977 where he earned a degree in theoretical mechanics. He worked in the Department of Mechanics at the Academy of Sciences in Berlin from 1977 to 1983 and headed the Sensor Systems Group in the Department of Automation at the Academy of Sciences from 1983 to 1991 where he worked on industrial robots and sensor systems (doctorate in 1986, Habilitation in 1990). Dr. Schmucker headed the Factory Automation Department at the Fraunhofer IFF Magdeburg as of 1992 and the Automation Division from 1997 to 2006. He has been the manager of the Virtual Engineering Business Unit of the Fraunhofer IFF since 2007 and additionally a supernumerary professor for mobile robots at Otto von Guericke University Magdeburg since 2008. His work interests include virtual engineering, mechatronic system modeling and simulation, robotics, handling systems, and sensor systems. (akw) ■

Sven Kiessling from LANXESS subsidiary IAB Ionenaustauscher GmbH based in Bitterfeld and Prof. Schmucker have been collaborating closely for several years.

Schmucker had to be well prepared for the gift from his staff: Beate Ziller puts a helmet on his head ...

... to keep him safe when he is high in the air or white water rafting.

Jörg von Garrel is Professor in Riedlingen

Two hearts beast in the breast of every Fraunhofer researcher: one for applied research closely tied to industry and one for academia. Dr. Jörg von Garrel is now moving into academia – he is now a professor at Riedlingen Distance University.

He will start teaching the subject of basic business administration specialized in process management for all degree programs on August 1, 2014. He will also be acquiring and overseeing research and consulting projects for Riedlingen Distance University.

Dr. Jörg von Garrel started working at the Frauhofer IFF in Magdeburg in 2006. A member of the Logistics and Factory Systems Business Unit, he predominantly lead managed projects dealing with corporate development. At the same time, he was writing his dissertation, which examines collaboration among organizations, particularly in terms of the influence of employees who are directly involved. Most recently, he was active in the ER-WIN® business office: In this Fraunhofer Innovation Cluster "Smart, Energy Efficient Regional Value Chains in Industry", he encouraged and helped companies pursue innovative paths to use energy and resources more efficiently and thus boost their competitiveness in the long term.

"I'm going to miss the institute a lot. My colleagues and I get along very well and spent a lot of time together on weekends, too. I liked working here very much and can really recommend the Fraunhofer IFF to anyone," he explains with a light northern German dialect that reveals his origins. His new job allows him geographic flexibility and he can also work where he comes from. This was also a decisive argument for a change. This makes his departure less difficult. It is also not final – Prof. von Garrel will stay on at the Fraunhofer IFF for a while part-time. (akw) ■

After earning his doctorate on 2012 and working eight years at the Fraunhofer IFF, thirty-seven-year-old von Garrel often contemplated entering academia. When he received his certificate of appointment from President Julia Sander on August 1, he had achieved his goal of one day becoming a professor.

Dr. Markus Koch (2nd from.r.) after going through the doctoral initiation at the Otto von Guericke monument. Also present are Robert Schüler, Dr. Tobias Reggelin, Dr. Sebastian Trojahn, doctoral adviser and chair holder Prof. Michael Schenk and Prof. Juri Tolujew (l. to .r.).

Three Tests Passed

Normally, you are finished once you have submitted and successfully defended your dissertation. You are awarded your doctorate. Not so am Institute of Logistics and Material Handling Systems ILM at Otto von Guericke University Magdeburg where you have to pass and get through another test: the traditional doctoral initiation at the Otto von Guericke monument in downtown Magdeburg.

Dr. Markus Koch had to submit to this, too: Immediately after his defense, his colleagues from the university and the Fraunhofer IFF pulled him through Magdeburg. Upon arriving at the Guericke monument next to city hall, a lighthearted, ironic encomium was read aloud and a specially created mortarboard was set upon his head. His doctoral adviser, Prof. Schenk, honored Dr. Markus Koch with the additional title of "Doctorus Objecticus Modellicus", once he had emptied the obligatory half liter mug of beer. He may now use this title that alludes to his dissertation "Object Analyses for the Modeling and Simulation of Logistics Systems" in addition to his official doctoral title.

Markus Koch was born in Gübs near Magdeburg in 1985. After completing the core requirements for his degree in engineering management, Koch spent nine months of his undergraduate studies in Terre Haute, Indiana, USA where he wrote his Master's thesis on mesoscopic simulation and defended it by video conference.

The young scholar was happy to return to Magdeburg, even though he travels to faraway lands time and again: "The city has developed well and I really enjoy the applied project work with my colleagues at the university and the Fraunhofer IFF, "says the logistician. He has planned something fitting for the future: He wants to use his recently passed boater license to explore inland waterways and lakes. (akw) ■

Christian Blobner Takes Charge of the EU Office

Christian Blobner follows Dr. Eberhardt Blümel.

Whoever wants to do business internationally ought to be multilingual if possible. Christian Blobner speaks English, French and even some Japanese. The thirty-four-year-old, who has been working at the Fraunhofer IFF since 2006, has been in charge of the institute's EU Office since September 1, 2014. He succeeds Dr. Eberhard Blümel, who went into retirement after twenty-two years at the Fraunhofer IFF.

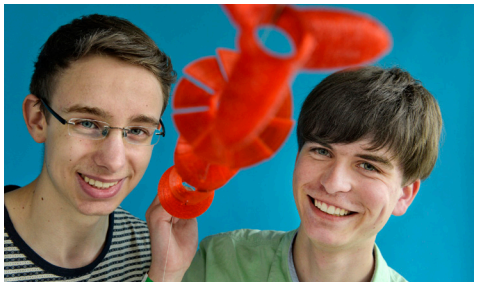
From now on, Blobner will be the main contact for any issues concerning EU projects. He was predestined for this job. The Diplom degree-holding economist, studied international trade theory, economic policy and environmental economics at Otto von Guericke University Magdeburg. He also has a B. A. in business management from Napier University in Scotland. Eight years ago, he started at the Fraunhofer IFF as a member of its former International Competence Center Logistics ICCL. Since then, he has successfully made his mark, especially in international projects with an EU focus.

The father of two children is approaching his new job proactively, as he says. The EU Office should become even more of a service provider for researchers at the Fraunhofer IFF. "It's about more than just being a disseminator of information," he says. "I would like to reach out to my colleagues even more. The EU Office should help them develop new international projects. That concerns such questions as how doe I establish the necessary project structure and what partners do I need?" Naturally, the latest information from the EU and on current basic political conditions and funding opportunities will continue to enter into his consulting activities. That will also benefit industry and research partners, who will also profit from his know-how in the future. (mar) ■

Jugend forscht Winners in 2014 Are from Saxony-Anhalt

Germany's best future researchers recognized coveted awards in different categories in Künzelsau on June 1, 2014. Lukas Höhne (17) and Lukas Gräfner (16) from Saxony-Anhalt won the President of Germany's award for exceptional work. They developed an innovative 3D printer that is particularly suited to produce axisymmetric parts. Maximilian Seidel (19) and Lisa Schuchhardt (18), also from Saxony-Anhalt, developed a special method to decontaminate soil.

Prof. Johanna Wanka, Federal Minister of Education and Research, these outstanding achievements: "For many participants, the competition is a formative experience and the first important step toward a future career in research,"according to Wanka. (akw) ■



Lukas Höhne (right) and Lukas Gräfner (left) from Paul Gerhardt High School in Gräfenhainichen won the German President's Award at the 49th National Finals of the Jugend forscht competition.

Marc Kujath is working in the ER-WIN® Innovation Cluster.

Directly from the University to an Industry Project

Marc Kujath is the name of the new research manager in the Logistics and Factory Systems Business Unit at the Fraunhofer IFF. In 2013, the native of Wolmirstedt was still enrolled in the Institute of Logistics and Material Handling Systems at Otto von Guericke University in Magdeburg. He came to the Fraunhofer IFF in 2013 as a student assistant and also wrote his Diplom thesis here.

Having graduated, Marc Kujath is now one of the research managers at the Fraunhofer IFF. He was hardly seen around the institute at first because he was immediately sent to VW in Elwangen for an industry project. Under Prof. Werner Schreiber, he devoted himself to analyzing energy efficiency in battery research. The young research has already had stints in the corporate world, for instance, in equipment procurement for the Port of Hamburg in 2011. "I like working all over the world," says Marc Kujath, "but most of all at home in Magdeburg." (akw) ■

Editorial Notes

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Outlook

Meet up with researchers from the Fraunhofer Institute for Factory Operation and Automation IFF at these events.

January 27 – 29, 2015
23rd LEARNTEC International Trade Fair and Convention for Learning with IT, Karlsruhe

January 28 – 29, 2015
2nd VDI Industry 4.0 Conference, Düsseldorf

March 24 – 27, 2015
Anuga Food Tec, Cologne

April 13 – 17, 2015
Hannover Messe, Hannover

April 16 – June 3, 2015 (Wednesdays)
Logistics Guest Lecture Series, Magdeburg

May 30, 2015
10th Long Night of Science, Magdeburg

June 23 – 25, 2015
18th IFF Science Days, Magdeburg

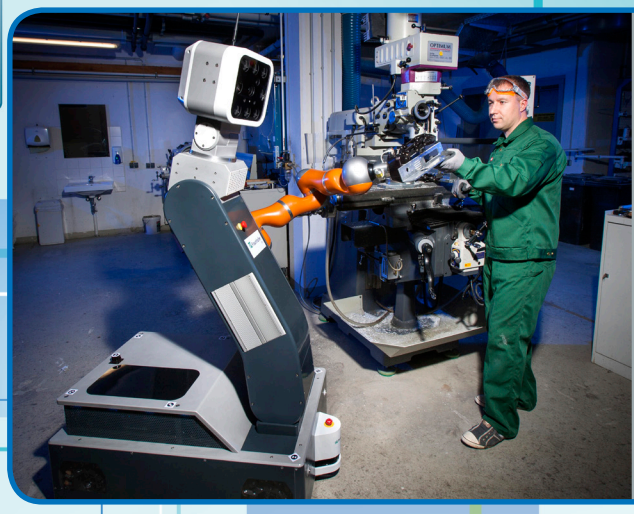
June 24 – 25, 2015
12th Conference on Digital Engineering for the Planning, Testing and Operation of Technical Systems, Magdeburg

June 24 – 25, 2015
20th Magdeburg Logistics Days: Reliable and Sustainable Logistics, Magdeburg

June 24 – 25, 2015
Conference on Assistive Robotics and Human-Robot Collaboration, Magdeburg

June 24, 2015
23rd Cooperation in Plant Engineering Industry Working Group, Magdeburg

June 24 – 25, 2015
36th VDI/VDEh Maintenace Forum, Aachen



18TH IFF SCIENCE DAYS

JUNE 23 – 25, 2015

Fraunhofer IFF

What digital methods and tools will enable companies to implement Industry 4.0? What role will humans play in networked manufacturing and logistics? Take part in the discussion about current applied research and solutions with experts from industry, business, research and academia in conferences on human-robot cooperation, digital engineering, and logistics at the 18th IFF Science Days.

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