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Algorithms for smart grids

Friederich Kupzog and Andreas Lugmaier are doing joint research on the future of energy.

Research across organizational boundaries works best if the people involved know each other well. And that is the case with Andreas Lugmaier from Corporate Technology (CT) in Vienna and Friederich Kupzog from the Austrian Institute of Technology (AIT). They test the technologies they invent for smart grids in Vienna's new district Seestadt Aspern.

The two researchers have now received an award in the category "Open Innovation".

Andreas Lugmaier (left) and Dr. Friederich Kupzog

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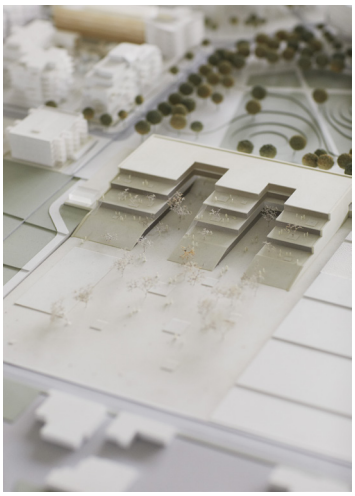

Andreas Lugmaier (right)
and Dr. Friederich Kupzog

Inventors of the Year 2017

"When we talked about an Internet of Things for the power grid ten years ago, everyone thought that was absurd. Today, that is exactly what we develop new solutions and applications for."

The wind is blowing in Seestadt Aspern. On the outskirts of the new district, a lot that was left vacant during the first phase of construction is being filled. It is loud and dusty. But the further you go into the neighborhood, the prettier it becomes. The architecture of the apartment towers is modern and varied. Most of the residents have lovingly decorated their balconies and the interior courtyards with flowers. There are many playgrounds, a big school, community gardens to grow vegetables in and even a few swimming pools. The experiment of a drawing-board city that will one day provide living space and jobs for 20,000 people seems to be working. However, Seestadt Aspern is not just a new residential area: The largest urban development area in Europe is also a "living" energy research laboratory for the future of smart cities. A consortium consisting of Siemens, Wiener Netze, Wien Energie, Wirtschaftsagentur Wien and wien 3420 AG has set itself the goal of implementing research findings here and demonstrating how cities of the future can be run in a climate-friendly and cost-efficient manner.

For this purpose, the cities need smart grids, and that is precisely the field in which Lugmaier and Kupzog work. "Low-voltage distribution grids are practically still operated blindly today. That means all the grid operator does to estimate whether the grid needs to be upgraded is count how many new customers are coming along," Kupzog explains. "But to make future power grids more efficient and suitable for renewable energy, home battery storage or electromobility, you need more information than that. With the help of measuring sensors such as smart meters and distribution transformers as well as technologies based on the industrial Internet of Things (IoT), this information can be collected much more easily in the future," adds Lugmaier. One example of IoT applications is the two inventors' new software, which analyzes grid data and thus recognizes which path the electricity takes in the low-voltage grid – that is, on the "last mile" to the energy customer. There are distribution boxes in the streets with switches that can be operated manually to direct the energy flows in the low-voltage grid. In the past, there was only one way of determining their current switching state: Service technicians had to carefully document switchovers or check the state on site, if necessary. Setting up a dedicated communication structure would often be far too much effort.

In the smart grid laboratory at CT in Vienna, the two researchers have demonstrated that their software works. The lab contains a replica of a smart distribution transformer from which a miniature low-voltage grid supplies power to two consumer units, which would be buildings in a real-life setting, for example. In a city environment, low-voltage grids are often laid out as a ring on the last mile. This means buildings can be supplied with power from two alternative sides, which is important whenever a construction site or fault prevents power flow from one side. These power line sections can be easily connected and disconnected with the help of switches in distribution boxes. "We are using real measured data to test how well the switch position can be determined with our software," Kupzog explains. The voltages also change during switching, and this is registered by the measurement sensors installed in Seestadt Aspern and can be evaluated by the software.

In the near future, when many buildings and electric cars will not only consume power but also feed power into the grid, the lower distribution level, i.e. the low-voltage grid, must be optimally geared to this. The software for which the two researchers have been honored is only one component of many. "Together with Siemens CT, we are doing research on various apps that can be used to bring smart distribution transformer stations up to date with the latest technology during operation," explains Kupzog. The cooperation between AIT, Siemens and Wiener Netze as the operator of Vienna's power grid works very well, as Robert Grüneis, Managing Director of Aspern Smart City Research GmbH, explains: "The future of the energy industry is shaped in strongly growing cities. When power is generated locally, for example in buildings or with electric cars, smart grids are necessary to guarantee supply security. To be able to find and implement these solutions, you need experts like the employees at Siemens CT, who have excellent domain and communication technology know-how." All partners agree that what is being created in Seestadt Aspern is nothing other than THE model for the future of energy.

"When we talked about an Internet of Things for the power grid ten years ago, everyone thought that was absurd," says Kupzog. "Today, that is exactly what we develop new solutions and applications for," Lugmaier adds.

Friedrich Kupzog's field of research is the combination of energy and IT. The 38-year-old studied electrical engineering and information technology at RWTH Aachen University and earned his doctorate at TU Wien. He subsequently set up a research group for energy and IT at TU Wien's Institute for Computer Technology. In 2012, Kupzog moved on to the Austrian Institute of Technology (AIT), where he works as a researcher. He is particularly interested in test methods for smart grids. The state holds a majority stake in the institute, which has 1,300 employees. AIT's central task is to develop innovations in areas like energy, healthcare or mobility.

Renewable energies have been the researcher's focal point ever since he studied electrical engineering at Graz University of Technology. **Andreas Lugmaier** (43) also completed a year of study at the Technical University of Denmark, since the Scandinavian country was a leader in the development of wind energy from the very beginning. Afterwards he worked at AIT in the Renewable Energies division, which is where he first came into contact with Friederich Kupzog. Since 2007, Lugmaier has been working for Siemens. Today he heads the Industrial Networks research group at Corporate Technology in Vienna, which focuses on developing technologies and solutions based on the industrial Internet of Things. Lugmaier has filed ten invention disclosures and is responsible for 16 individual patents that are protected in nine patent families.

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