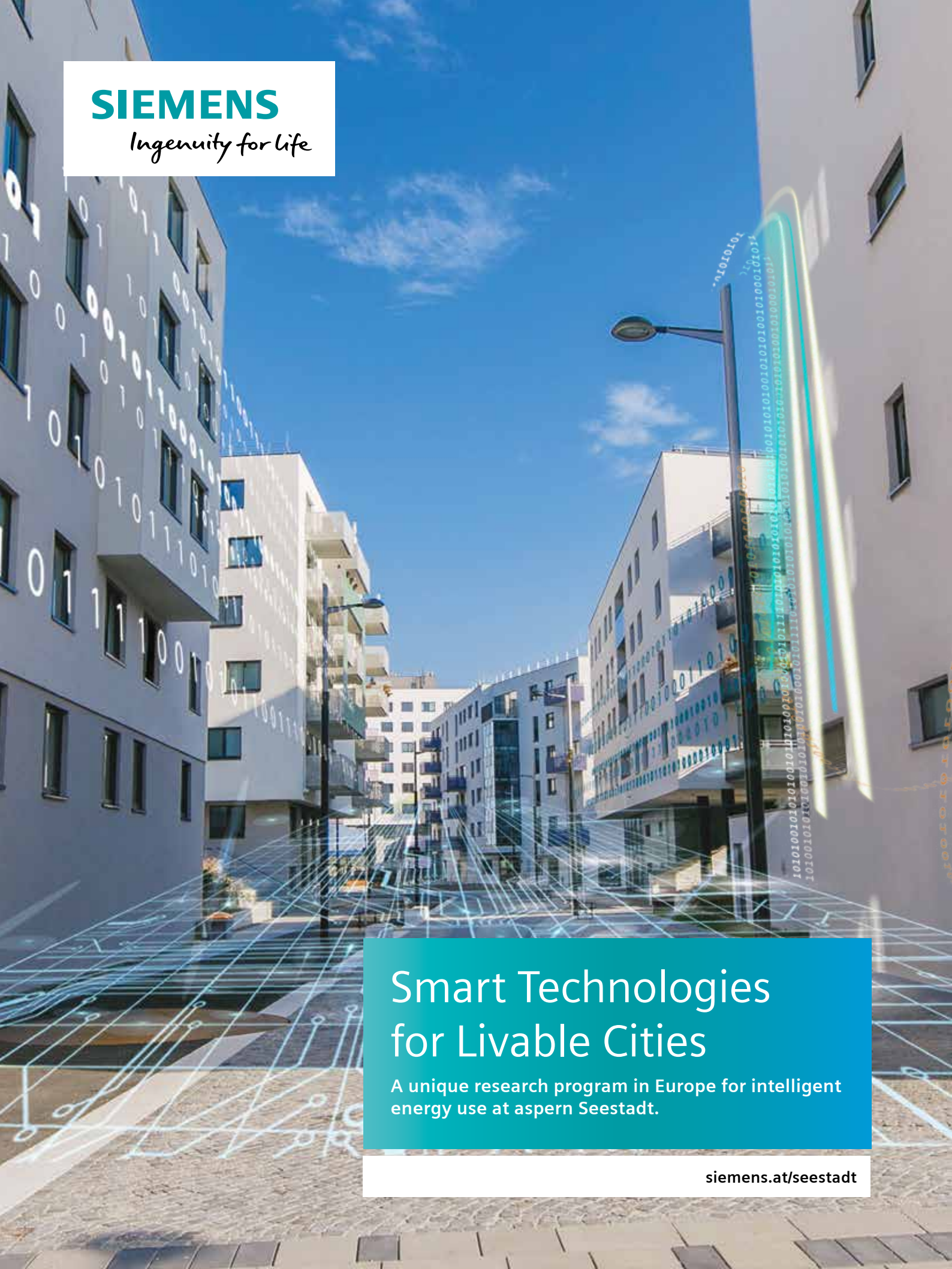

SIEMENS
Ingenuity for life
Smart Technologies
for Livable Cities
A unique research program in Europe for intelligent
energy use at aspern Seestadt.
siemens.at/seestadt

Editorial

Photo: Rita Newman

Wolfgang Hesoun, CEO of Siemens AG Österreich

The energy transition in Europe is already in full swing. There is an ample supply of sustainably generated power. However, the options for marketing this energy are still limited. There is still a need to upgrade the grid infrastructure and to adapt the systems in the buildings, grids, and market to create a single end-to-end system.

Siemens is playing a key role in developing exactly such solution concepts at aspern Seestadt. We are testing new Siemens technologies for optimizing buildings and energy systems in a real environment – taking consumer needs into account – and are helping to shape one of the largest urban development projects in Europe. The energy system includes intelligent buildings and an intelligent power grid designed to meet the requirements of future smart markets. Many of the technologies that are required are already available, or are currently being developed. In Aspern, we are combining this into an overall system and are refining the system from an overarching perspective.

The results to date are promising and have gained international recognition. Aspern Smart City Research was among the 250 projects from 45 countries evaluated at the Smart City Expo World Congress 2016 in Barcelona and went home with one of the three World Smart City Awards.

This impressively shows that we are on the right path to a sustainable future!

Wolfgang Hesoun

A unique research project

The project by the numbers

The Living Lab at aspern Seestadt consists of: 3 buildings that serve as research objects, 2 reference buildings, 12 grid stations with 24 transformers, 530 smart meters, 100 sensors for the low-voltage network, 111 participating households, 6 batteries, and 1 data center that records around 1.5 million datasets per day.

We are strong in concert with our partners

Researchers from Siemens have been collaborating with Wien Energie, Wiener Netze, the Vienna Business Agency, and Wien 3420 since October 2013 through the research company Aspern Smart City Research (ASCR) to implement one of the most innovative and sustainable energy efficiency demonstration projects in Europe. A key aspect of these efforts is the integrative approach. Real data are used to research complex relationships as opposed to isolated elements. The plan is to develop solutions that can be applied to entire cities in the future.

The topics at a glance

- Intelligent buildings that communicate with a smart power grid and make their energy flexibilities available for market-participants.
- Low-cost monitoring of the current grid load down to the customer connection-point.
- New methods for grid planning that enable efficient and needs-oriented grid expansion.
- New technologies that identify grid bottlenecks at an early stage and that avoid possible overloads by means of decentralized control components.
- Intelligent concepts for information and communication technologies for a smart energy system and data analysis for potential new business areas.

Better living:
In the smart city
aspern Seestadt

Solutions for the new energy world

Our power grids have become more complex. It used to be that energy only flowed in one direction like on a one-way street, namely from the power plant to the consumer. Now, there is more and more twoway traffic. Consumers are becoming "prosumers". They are generating energy themselves and feeding it back to the grid.

Future power supply systems will consist of millions of small and some larger decentralized generating units. This will raise the technical complexity of and requirements placed on the infrastructure in order to keep the energy system stable. The challenge is intelligently connecting decentralized power generation, buildings and households that are simultaneously consumers and producers, with new storage technologies and managing the system effectively. This involves not only technical solutions but also market policy, legal, and economic aspects.

The energy supply system of tomorrow is coming ever closer thanks to the work of the researchers at aspern Seestadt.

* ICT: Information and Communications Technology

Smart Building

A residential building, a dormitory for students, and an educational campus (currently a nursery school and primary school) serve as research objects. Equipped with photovoltaic panels, solar thermal panels, hybrid panels, heat pumps and various thermal as well as electrical storage facilities, they are able to generate and store energy. In addition to optimizing consumption, a key topic of research is how buildings can participate in the energy market.

Smart User

Ensuring that buildings function optimally requires knowledge about current and future usage patterns. Half of the occupants in a residential building are participating in the research program and are providing data about their energy consumption and room climate (consumption of electricity and hot/cold water, room temperature, air quality, etc). Smart Users profit from an App that supports remote control of their appartments. They can set temperature levels and change ventilation parameters. Additionally they get detailed information about their power consumption and energy tariffs.

Smart Grid

How can we transition from a traditional to a smart grid? Through the optimized use of copper reserves and installation of smart secondary technologies. The current status of the grid must be depicted in a transparent manner. In a first step transparency on the grid asset utilization down to the customer connection point has to be provided. Self configurating sensors and smart meters deliver the necessary data to support grid optimization. In a second step intelligent control recognize bottlenecks and prevent overloads by using flexibilities.

Smart ICT

According to the legal requirements regarding privacy all available data from the buildings, the grid and the smart users and weather information are collected and stored in the ASCR data warehouse. Applications which are developed on a common information and communication platform make the data available for research domains and smart users. Methods for data analysis generate new results to allow building systems to be maintained optimally.

Smart Building: Desigo CC building management platform at aspern Seestadt.

The Buildings at aspern Seestadt talk to us

The buildings at aspern Seestadt are equipped with systems from Siemens Building Technologies. The innovative building management platform Desigo CC is a key element in the building infrastructure and connects all subsystems. Numerous sensors provide information about the various operating states of a building.

The focus is on user comfort. There must always be enough energy to ensure the comfort of the occupants. The main research topic is the optimization of the building energy costs based on a maximized utilization of self generated energy, flexible energy tariffs and the provisioning of flexibility to energy market partners. Therefore the building needs the ability to forecast the own enery consumption as well as the own production. Together with an energy price curve and information on potential revenues on flexibility offerings the Building Energy Management System (BEMS) is able to optimize the energy costs.

By offering flexibility to the energy market Smart Buildings contribute to the stability of the overall energy system. All processes necessary for this flexibility trading as well as the cost optimization have to be fully automated and only the results have to be made transparent for the users.

This also allows a prognosis of a building´s energy needs and internally generated power and forecasts of the available flexibilities. The latter refers to a building´s "ability" to increase or decrease the power drawn from its own sources and to offer power to the balancing energy market. This intelligent system can be applied to other buildings and cuts energy costs without impacting comfort.

A prototype of a BEMS is currently beeing tested in Seestadt Aspern. The first results have been very encouraging. The cost optimization and the flexibility trading can be performed with high accuracy. Sudden weather changes are compensated and the comfort of the occupants is not affected at any time.

There is always sufficient hot water and heating energy. This is based on the weather forecast and user behavior. These data are used to create the ideal timetable for the buildings to optimally distribute, use, and store energy. If the weather forecast proves to be inaccurate or if consumption changes over the course of the day, the system tries to compensate for these deviations automatically and to adapt to the new conditions.

Specialists from Siemens create simulation models for test buildings to show the energy, cost, and CO_2 savings actually achieved by the optimization measures. Real data from Aspern is used to ensure that the models behave exactly like the actual buildings. Initial results are expected at the end of 2017. The existing software solution is also being simplified further to reduce the costs and time required for startup.

Smart Grid: The link between fluctuating generation and consumers.

Energy of the future: Reliable, green, clever

The electrification of the power system is in full swing, and heat pumps are increasingly replacing oil and gas heating systems. Electric cars are becoming more common. Smart buildings and decentralized generation units are reversing the flow of energy. This is pushing existing power grids to their limits. The grid operator must know the exact load of the distribution grid and needs new control functions to guarantee supply quality. In the smart grid research area, we are developing solutions that will facilitate the sustainable, economical and reliable operation of future power grids.

Transparent distribution networks

With intelligently distributed sensors, smart meters and power quality measurement devices, an existing low-voltage distribution network can be made transparent all the way to the customer connection point without installing a sensor in each grid node. Nodes that are not measured can be estimated with sufficient accuracy. The measured and estimated values are linked with the current switching state of the grid, verified using a grid model, and made available in a central database.

Improved grid infrastructure planning

Initial prototype applications allow grid technicians to recognize inefficient grid segments or segments that are becoming critical at a glance. Future grid loads are to be extrapolated using historical data and assumed, changing prosumer behavior. This can be used to assist with long-term grid expansion planning and to achieve considerable efficiency increases.

Reliable supply

The rapid development of prosumer technology is resulting in greater and greater peak loads that the grid must cover. This is why local grid capacity monitoring is so important. Distributed control components will protect grids against overloads in the future. They employ different measures to automatically ensure that given grid limits are not exceeded. These include voltage control, limiting the maximum charging power of home chargers stations and using building flexibilities without impairing occupant comfort.

The near-real-time recording and processing of data is one of the major strengths of this unique project.

Efficient research in real time

Testing the overall system in real time

We intend to make the research results from Aspern available to our customers soon as standard products. To this end, the developed solution approaches are implemented and optimized under real conditions as prototypes in an extensive field testing system.

Products from the SICAM family form the basis for this at the field level. They are complemented by Spectrum Power 7 as the control system, Energy IP with the Meter Data Management application, network sensors and smart meters. Additionally the following actors supplement the components: a transformer with a tap changer, smart buildings with an interface to the grid, remote-controlled switches, and five storage units with the associated inverters.

Digitalization cuts costs

The implemented solution approaches allow control functions to be optimized. Initial operational experiences are providing valuable insights into necessary system management functions. Combined with the plug-and-play functionality of the system components, this minimizes installation and operating costs. In the future, automation systems for distribution grids will need to adapt automatically to grid changes such as line switching during maintenance work, especially in distribution grids.

Scalable and compatible customer solutions

One example of how new technologies can be made available for existing systems is the A8000 automation platform from the SICAM product family. The platform architecture is already designed for the future.

Separate apps are being developed in Aspern for individual decentralized control functions. These can be installed in the corresponding components as needed – without interrupting operations. The special device design ensures that the apps cannot negatively impact each other.

Future power systems will be operated in an economic and flexible manner for the benefit of the consumers.

Intelligent information and communication

In the past, a stable energy system was implemented by controlling centralized power plants in a way that they delivered exactly the amount of power needed by the consumers at any time. This is becoming more and more difficult with the rapidly growing share of decentralized generation, which usually depends on the weather and is independent of the actual energy demands.

New energy products are booming

At the same time, more and more new technologies including smart buildings, e-mobility, battery storage units, and smart meters are storming the market as the basis for new energy products. This is resulting in a highly complex system that can only be operated reliably with a smart information and communication system.

For this, data from the newly added prosumer components and components in the lower distribution grid levels must be collected and provided to the affected market partners in a way that allows them to grow their core business without hurdles while at the same time creating a stable and reliable overall system.

Centrally collecting and providing data

In Aspern, all data needed for research and future market models is collected in a central data warehouse. This includes the consumption and operating data of the smart buildings, the data from the distribution grid, and weather forecasts and current weather data.

The central provision of current data allows for the greatest flexibility in data analysis and application development. However, the individual requirements of the data suppliers in terms of confidentiality and security must also be complied with when recording and disseminating data.

Historical data and transparent prosumer behavior allow future grid loads to be projected.

Intelligent applications for accurate analyses

Intelligent data processing

One of the most important objectives of smart ICT is drawing relevant conclusions from current data and deriving requirements for controlling system components, while another is looking further ahead to generate predictions for grid loads and prosumer behavior, among other factors.

Smart buildings and the distribution grid are being modeled in Aspern to this end. These models are verified and optimized using the actual data from the test bed. The "digital twins" that are created in this manner can be used to conduct simulations, tests, and analyses to the extreme without being limited by the need to avoid negative effects on residents and prosumers in real life. Working from the results of simulations, applications can be developed for purposes such as recognizing critical operating conditions in the grid.

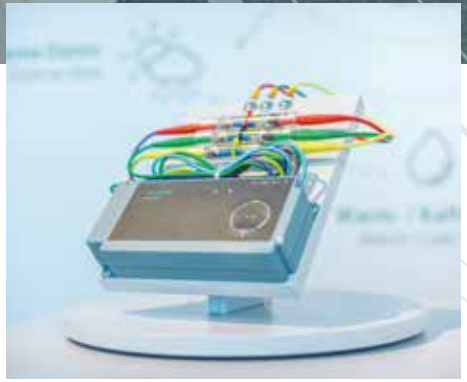
Another focus in the development of future applications is the provision of forecasting algorithms, for example to predict the energy needs of buildings or the load flow in transformer stations. The goal is to create combinations of optimized forecast methods that can be used as universally as possible for the individual parts of the power system.

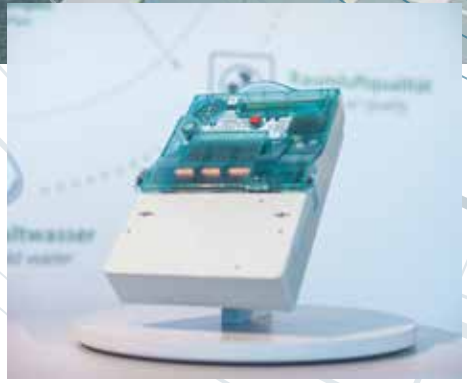
In addition to developing applications, the search for correlations between the data from different domains also plays an important role. The information gained in this manner can be applied in many different ways including predictive maintenance models for system components in buildings and the search for new business models for market partners.

Open for all domains of an energy system

The smart ICT solution approaches are developed in Aspern in such a way that they can be used for the individual domains of an energy system as well as for any combination of domains. They can also be provided locally on an IT platform or as a service from the cloud.

Research close up:
The Demo Center at the Aspern technology center.





Basic information about the ASCR research and demonstration project (in the areas of building, grid, ICT, and user) is presented on boards, in presentations, and by means of photos and videos at the Demo Center. The central question is how intelligent networks and efficient management can increase energy efficiency and cut CO_2 emissions in an urban environment.

Promoters present research results and reports from the field in a clear and interesting manner. The target groups are specialists and experts, government officials, technical schools, universities, and the general public.

Cool control with the smart home control

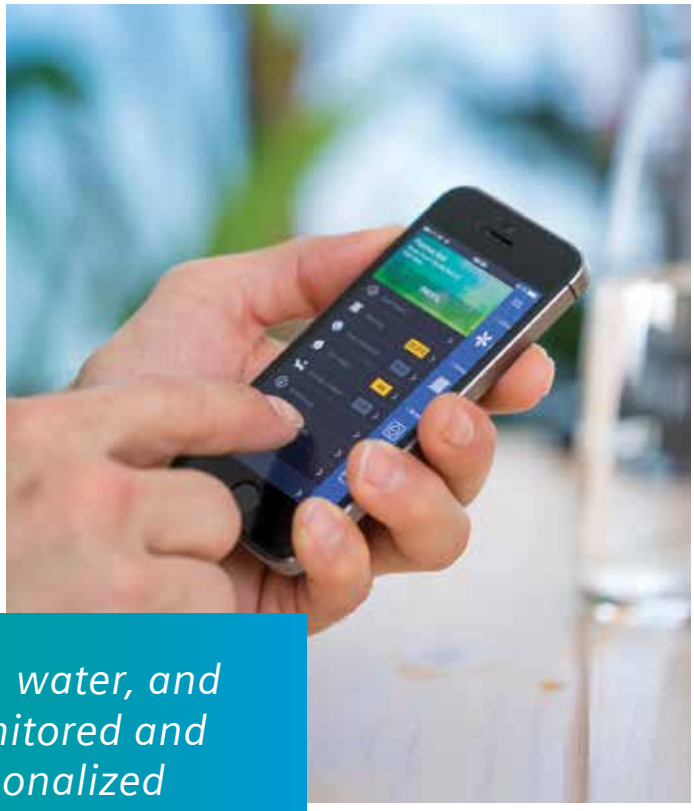
Using electricity and heat more ecologically and economically – with just a few clicks from the couch or the metro. That is a reality for the 111 Seestadt households that are actively participating in the ASCR energy research project.

ASCR has developed an app together with the software experts from EMAKINA that allows users to monitor their energy consumption at any time and to control heat, ventilation, and electrical sockets from their mobile devices. For example, they can turn on their heat while returning from a winter vacation, or can quickly switch off all electrical outlets while on their way to work.

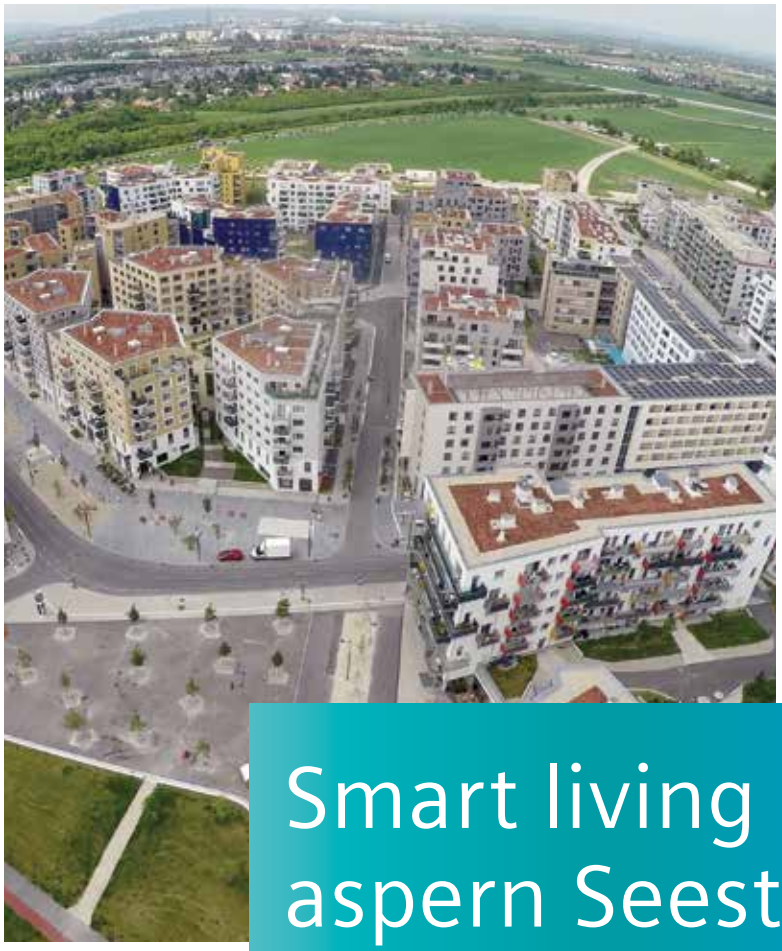
At the same time, the data generated through the app is important for the research results. Evaluating the data provides exact information on whether and when the residents use the control functions to actively reduce their power consumption. This allows the research to be compared with hard facts.

To make sure that this works as intended, the users in aspern Seestadt also profit from the refinement of the app. For example, a time-variable electricity rate is to be added for a defined group. This would enable these users to activate their flexible power consumption, for example charging an e-bike, at times when electricity is especially cheap.

The technologies we are currently testing on a small scale will later be applied to entire cities to make our power system more efficient and climate friendly.



Heating, electricity, water, and the like can be monitored and controlled in a personalized dashboard.



Smart living in aspern Seestadt in Vienna

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