Vienna, November 2021

FACT SHEET SIEMENS & ASPERN SMART CITY RESEARCH (ASCR)

The **only research project of its kind in Europe,** based in Vienna

Optimal solutions for the energy transition of a smart neighborhood

Background	aspern Seestadt in Vienna is one of the largest urban development areas in Europe. Vienna, the fifth-largest city in the EU, is set to pass 2 million inhabitants in 2027. The creation of an entirely new neighborhood in the northeastern part of Vienna, in the 22nd district, is to be completed by 2028. Experts predict that around 70% of the entire world population will live in cities and urban areas by 2050, and that this rate will continue to rise. It is also highly relevant that 40% of energy consumption in Europe stems from buildings.
aspern Seestadt	2.4 million m² of land, 50% green and open space, around 10,000 apartments for over 25,000 people, more than 10,000 workplaces.
Business objective	The basic objective of ASCR is to develop market-oriented, scalable, and economical solutions for the energy future in urban areas and to make the energy system more efficient and more climate-friendly. In the course of this energy research project, the only one of its kind in Europe, complex but crucial energy policy questions from essential areas of the energy system are being answered – on an interdisciplinary basis and using real data gathered at aspern Seestadt. The concrete applied research will benefit not only the city of Vienna and its residents but also other communities, urban areas, and interested stakeholders far beyond Austria.
Shareholders	Siemens AG Österreich (44.1%) Wien Energie GmbH (29.95%) Wiener Netze GmbH (20%) Wirtschaftsagentur Wien (4.66%) Wien 3420 Holding GmbH (1.29%)
Unique project structure	**Teamwork:** Researchers, engineers, and users collaborate closely to evaluate new solution approaches based on state-of-the-art technologies **Application-based approach:** New solution approaches are optimized for practical use in an extensive test environment

	Data analysis as an innovation driver: Process and user data are collected and analyzed, providing the basis for the optimization of the entire system and the intuitive discovery of new product and solution ideas
Team	This is currently the only cooperation model of this scope. Over 100 people from different scientific disciplines of the parent companies are directly involved in the research.
Research areas	**Smart buildings:** Buildings are becoming active participants in the energy market. Based on their own production of renewable energy and storage capacities, they utilize advantages from variable energy prices and automatically offer their flexibility to other market participants. This reduces their consumption of external energy and optimizes energy costs. Another factor is the optimization of costs and investments throughout the lifecycle of a building. Ideally, a digital twin is created on the basis of the Building Information Model (BIM) during the tender collection process. This is then turned into concrete building documentation in the course of construction and updated as needed when the building is modified or expanded. Together with the advantages offered by virtual reality and data analytics technologies, service and maintenance processes can be substantially optimized, and also adapted effectively as the energy market evolves (e.g. energy collectives, lower grid tariffs under the application of temporary volume limits by the grid operator, etc.). **Smart grids:** The transformation from a passive to active and intelligent distribution network; research into and the provision of solution concepts with the goal of upgrading the current distribution grid infrastructure for the energy transition while ensuring the expected level of supply quality. Background: Grid customers have substantially changed their behavior over the years compared with the original infrastructure planning assumptions. This includes feeding locally generated power and additional major loads such as electromobility and heat pumps, as well as the substantially higher peak loads arising from the simultaneity factors. The existing low and medium voltage grids are also currently being operated without any measurement and control systems. The following aspects are important: o Creating transparency: The goal is to obtain a sufficiently precise view of the load flows in the individual grid segments by installing sensors. o Tapping existing grid potential by creating control options for the grid operator: Certain loads such as charging stations and customer supply systems make it necessary to reduce load peaks in the grid on short notice. This is the only way to make the most efficient use of the existing infrastructure. o Creation of a comprehensive data basis and tools for future grid planning in a rapidly evolving energy market. o Work on optimal coordination in the smart grid: To this end, existing operational processes are being evaluated to identify necessary adaptations

	and expansions. In addition to ensuring that the system components are plug-and-play, a key focus here is the automation of operational processes to the greatest degree possible, the provision of information in a form suitable for distribution grid operators, and the creation of corresponding tools for operation. **Smart ICT:** The domains of smart buildings and smart grids are very similar in terms of the respective technical tasks. They both need an extensive data basis that must be prepared appropriately for operation and optimization. These domains must also be increasingly interlinked. Smart buildings and smart grids should interact in the future, use the infrastructure efficiently, and thus minimize the need for investments. The needs of residents will be met without limitations and the operating costs optimized in daily operation. This is only possible with the use of state-of-the-art technologies like digital twins, the Internet of Things, artificial intelligence, and machine learning. **Smart users:** The necessary digitalization of the energy system is significantly increasing the complexity of the overall system for its users. Because of this, options need to be created so that the complexity can largely be managed by the system itself (machine learning and artificial intelligence) and so that users can have their needs met by the system as simply and transparently as possible by interacting with the system. This will be made possible by providing information (such as consumption profiles) and possible actions in a user-friendly manner. **Electromobility**: Solution concepts for larger parking lots that will need to be fitted with a high density of charging stations but with limited electrical output at the grid connection point. Customer-friendly management of the charging processes using local battery storage and local generation play a key role here. **Energy collectives:** The goal is to evaluate the current legal, organizational, and technical frameworks in terms of the concrete establishment of a renewable energy collective. How the technical system of an energy collective including shared equipment such as storage and generation systems can communicate with the systems of other market participants (distribution grid operators, energy providers, service providers, etc.) is also being investigated.
First program phase **(2013–2018)**	Establishment of the necessary research infrastructure as the basis for the collection of real-time data and practical testing of solution concepts **Involved buildings:** Three research environments that were built, evaluated, and optimized using the most modern building technologies (BEMS): o Residential building: 213 apartments o Educational campus: 900 persons (full-day primary school with 23 classes, 12 daycare groups) o Student dormitory: 313 spaces on an area of 7,000 m^2

	Grid equipment: o 12 low-voltage grid stations o 5 battery systems o 24 transformers of different types o 100 low-voltage grid sensors o 500 smart meters in the target buildings o Extensive sensors **Networked research and self-learning systems:** o Self-learning algorithms o Big data systems with around 1.5 measured values per day **Financing:** €38.5 million (€17 million from Siemens) plus €4.5 million in public funding
Successes and results from the first phase	o 70 answered research questions o 15 prototype solutions in the fields of smart buildings and grid infrastructure o 11 patents filed o Optimization of the energy use in the buildings through a BEMS (building energy management system) o Realized virtual power plant (DEMS) as a system that makes the flexibility of buildings usable o Transformation of the local passive power distribution grid into a smart power grid with active grid management and the corresponding adaptation of the buildings (smart grid ready) o Findings from the integration of electricity storage systems as a foundation for collective use o New analysis methods and data visualization options for power utilities, grid operators, and building operators
Second and currently running program phase (2019–2023)	The developed and optimized prototype building and grid systems are being refined into economically viable and practical systems for residents, grid operators, building operators, and energy providers. The previously collected data play a key role in this. The goal is o Communication of buildings with their occupants, the smart grid, and the energy markets via aggregators, energy service providers, and trading platforms o The smart charging of electric and hybrid cars o The analysis of new approaches for the provision of thermal energy for decentralized heating and cooling The addition of further buildings within and outside of aspern Seestadt to the research environment:

	- Technology center (5,600 m^2 of space for offices and engineering laboratories, currently home to around 25 innovative companies and startups) - SeeHub List garage (managed charging of electric vehicles), office section and sports facilities - Käthe-Dorsch-Gasse (residential complex in the 14th district). Power supply with a focus on an autonomous heating and cooling solution based on renewable energy. A geothermal probe array, various heat pumps, and photovoltaic systems are being used - Lighting concept in the Ebreichsdorf, Unterwaltersdorf, and Guntramsdorf primary schools - Floridsdorf clinic (use of the waste heat from the InterXion data center) - UNO City (large-scale heat pump) - And more **Financing:** €45 million (€20 million from Siemens) plus €2 million in national and international public funding
Digitalization and its value-add in terms of climate protection	Digitalization and the technological elements on which it is based lay the foundation for innovative solutions: - Industrial Internet of Things: Simple connection and distributed interaction of a large number of sensors and smart devices - Digital twin: Representation of modern cyber-physical systems, allows optimized planning, use, and maintenance - Machine learning: Helps intelligent assets to understand their surroundings without extensive engineering and to independently recognize situations - Artificial intelligence: Combines the fundamental modules of digitalization and allows independent decisions and holistically optimized systems based on the gathered knowledge Measures needed to protect against cybercrime are taken into account from the beginning. Open source software is also used to a high degree.
Examples of newly developed and refined products and solutions for the design of efficient energy systems	- SICAM A8000 - SICAM EGS – Enhanced Grid Sensor - SICAM Microgrid Controller - PSS®SINCAL - Charging management - Distributed energy optimization (DEOP) - Building energy management system (BEMS) - Desigo CC - BIM viewer - Digital building lifecycle - Room thermostats - Use of Building Information Modeling (BIM)

Successes and findings from the second phase:	**Transparency, cost savings, flexibility, economic efficiency, low resource use, reduced carbon emissions, and (energy) efficiency through** o Considerable carbon emission reductions through optimally coordinated generation and storage components based on renewable energy sources. Under the right conditions (e.g. availability of solar/ground water), urban buildings can already be operated in a thermally autonomous manner and with a high share of self-generated energy. o Energy providers and grid operators now have access to a system that allows previously unused flexibility in buildings to be tapped and marketed (with the realized virtual power plant concept [DEMS]) o The developed system applications for grid planning and operation (use of active grid management) make the economical use of smart grids viable. o The developed systems make the test buildings “smart grid ready”: If these concepts are implemented consistently in urban development, high peak loads and thus expensive grid expansions can be avoided. o The integration of power storage systems into the grid infrastructure helps grid operators to cover peak loads while ensuring high supply quality. The shared use of power storage systems by additional users (e.g. power generating and distribution companies) seems to be the only way to achieve economically efficient operation. The findings will now be applied to the design of grid-friendly energy collectives. o Grid and building operators as well as energy providers now have access to new analysis methods for novel operational management processes and business models. o It is now also clear that supplying power to a smart neighborhood absolutely requires close cooperation between urban developers, builders, residential use, energy providers, and technology providers. Load shifting in households proved to be possible only to a limited degree.