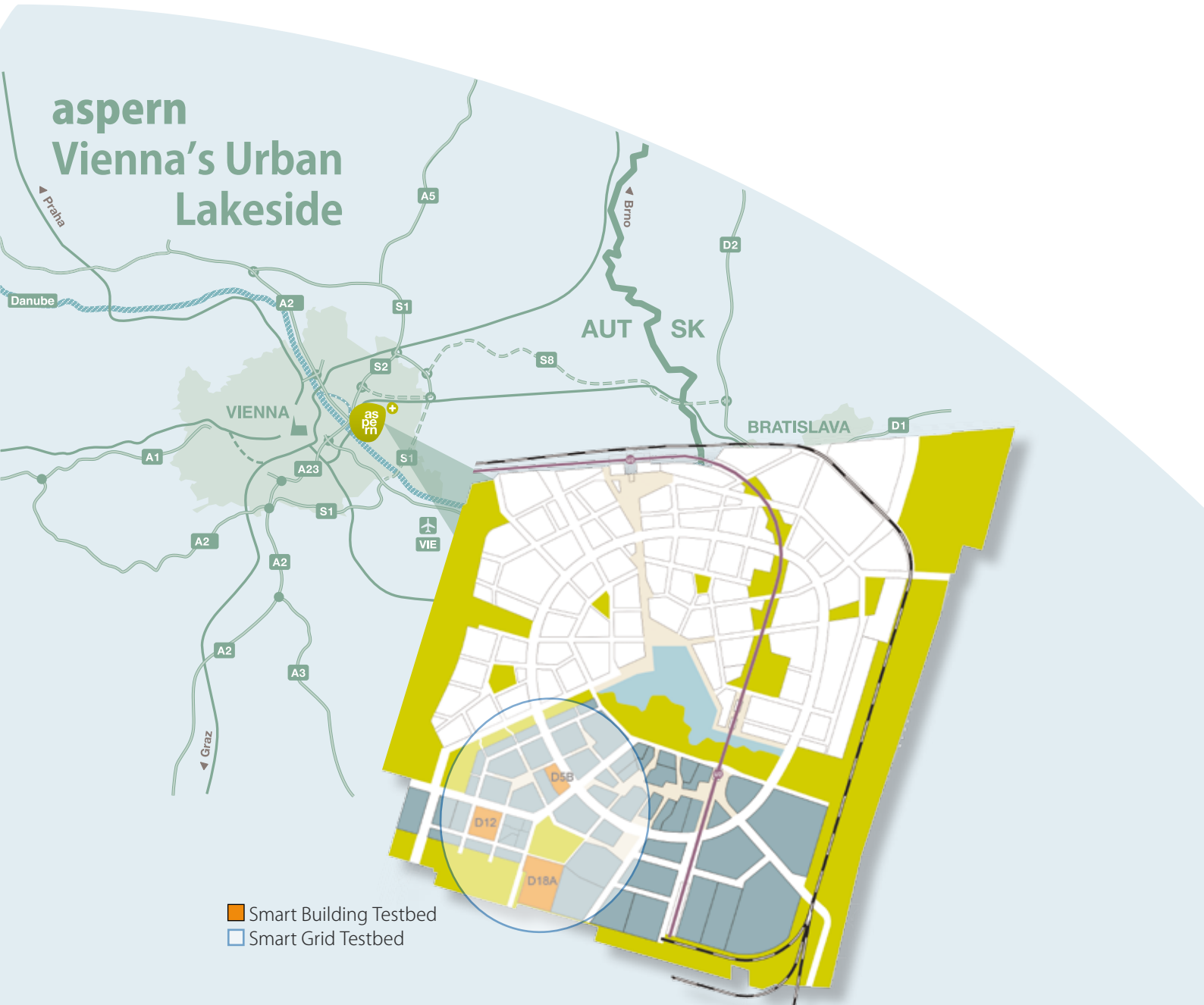
ASCR
Aspern Smart City Research

Aspern Smart City Research

Energy research shapes the future of energy

Partner of SMART CITY WIEN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Smart Building Testbed
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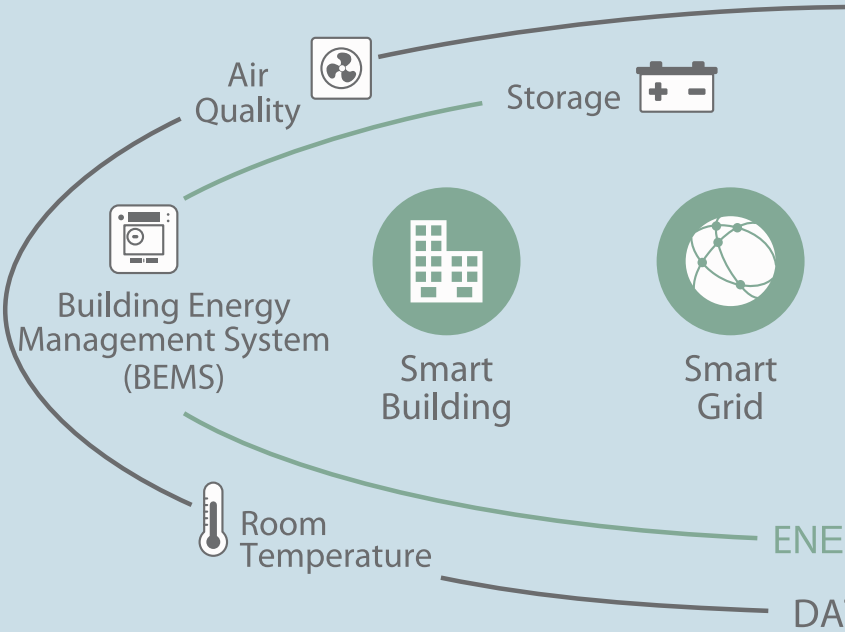

OPTIMAL HARMONISATION OF:

GENERATION ✓

DISTRIBUTION ✓

ENERGY EFFICI

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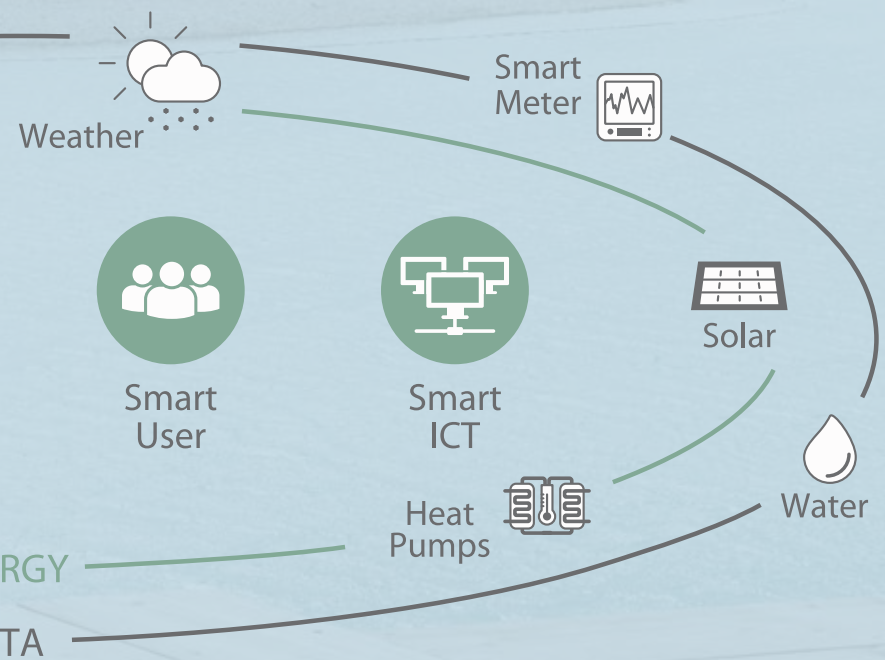


STORAGE

CONSUMPTION

ENCY

Aspern Smart City Research GmbH & Co KG (ASCR)

Seestadtstrasse 27/2/Top 19, A-1220 Vienna
Telephone: +43 (0)1 908 93 69
E-mail: office@ascr.at
Web: www.ascr.at

Contact persons:

Bernd Richter, Infrastructure
E-mail: bernd.richter@ascr.at

Andreas Schuster, Research
E-mail: andreas.schuster@ascr.at

Oliver Juli, Grant Management
E-mail: oliver.juli@ascr.at

Energy efficiency as a research field

Aspern Smart City Research cooperation project

»The goal of this project in **aspern** Urban Lakeside, unique in Europe, is to optimise urban energy production and consumption and thus boost energy efficiency and reduce CO_2 emissions. One key aspect of our research is integrating the local residents.«

Reinhard Brehmer
ASCR Managing Director

»We are conducting research at the level of buildings, networks, ICT and energy users. We are developing new technologies to ensure the optimal integration of buildings and energy distribution networks.«

Georg Pammer
ASCR Managing Director

Reducing CO_2 emissions and ensuring a failure free supply of energy are the fundamental goals of the energy transition, which is characterised by increasingly decentralised energy production, prosumers, new storage technologies and their locations.
It is not yet completely clear how this development will turn out since business models as well as various technical solutions are still lacking.

Aspern Smart City Research GmbH & Co KG (ASCR) is a joint venture between a network operator, an energy generation and supply company, a technology company and the City of Vienna.

This cooperative partnership was established to develop some of the technical solutions that are required for the future energy environment and especially in a new real-life urban district with active customers.

This involves innovative approaches towards building automation systems and using the energy flexibilities of buildings and the energy market in ways that enable residents to cooperate and accept the new systems. Furthermore, optimal methods are being developed to capture detailed network status data and also use it for network planning. All these solutions are based on comprehensive ICT, testing and developing convenient big data models, and suitable analytics.

Ownership structure

Pooling know-how in ASCR

Credits: Rita Newman

» It is essential for Austria that we have such a pioneering project for energy research in Vienna – a unique European showcase. We are laying the foundations for optimising the energy of entire urban areas. «

Wolfgang Hesoun
CEO
Siemens Austria

» I am proud that we have succeeded in establishing this unique research programme in aspern Urban Lakeside because innovation is the key to the future of Vienna as a business location. «

Renate Brauner
Deputy Mayor and Finance Councillor

Credits: pertramer

The research company ASCR was established by Siemens, Wien Energie, Wiener Netze and the City of Vienna. Never before has there been a cooperation model of this size and nature. More than 100 people from various scientific fields are directly involved in this research project.

ASCR
Aspern Smart City Research

Siemens AG Österreich (44.1%)

Siemens Austria is one of the country's leading technology companies. Its business activity is focused on areas of electrification, automation and digitalisation. Siemens is one of the largest global manufacturers of resource-efficient technologies. The company is a leading provider of energy transmission solutions and a pioneer of infrastructure services as well as automation and software solutions for industry.

Wien Energie GmbH (29.95%)

Wien Energie supplies more than two million people, 230,000 businesses, industrial facilities and public buildings as well as 4,500 agricultural businesses in and around Vienna with electricity, natural gas and heat. The production of electricity and heat stems from waste recycling, cogeneration plants and renewable energies such as wind, water, solar power and biomass. Wien Energie focuses on the decentralised generation of energy and on energy services.

Wiener Netze GmbH (20%)

Wiener Netze is a company of Wiener Stadtwerke and combines the planning, operation and maintenance of all energy networks under one roof. Roughly two million customers in Vienna and the surrounding area are connected to the electricity, natural gas and district heating grids.

Vienna Business Agency (4.66%)

Vienna Business Agency supports the sustainable promotion of Vienna as a business location. It backs national and international companies with funding, real estate and urban development measures as well as free services and advice.

Wien 3420 Holding GmbH (1.29%)

Wien 3420 was established to develop the new district of aspern Vienna's Urban Lakeside in Vienna. Together with partners, it is responsible for space utilisation, urban planning, zoning support and infrastructure development.

Facts and Figures

Information on ASCR at a glance

ASCR's core team, from left to right:
Gerhild Kircher, Finance,
Reinhard Brehmer, Managing Director,
Georg Pammer, Managing Director,
Bernd Richter, Infrastructure, Victoria Solitander,
Grant Management , Andreas Schuster, Research,
Melisa Kis-Juhasz, Assistant, Oliver Juli, Grant Management,
Christoph Gerstbauer, Research (no photo)

ASCR is implementing one of the most innovative and sustainable energy efficiency showcase projects in Europe. Apart from the size and structure of the research company (utilities and industry with close ties to the City of Vienna), it is above all the integrative approach that stands out. Real data is used for research on complex correlations and on integrated elements/components. This is unique in Europe.

Economic sectors involved:
Automation technology, building engineering, energy technology, information technology, communication technology, mechanical engineering, mathematics, motive and market research, psychology, spatial planning, legal sciences, sociology, engineering physics, environmental technology, economics.

Start

The research company Aspern Smart City Research GmbH & Co KG (ASCR) launched its activities on the 1st of October 2013.

Location

The head office of ASCR in **aspern** Vienna's Urban Lakeside is the **aspern IQ** technology centre of Wirtschaftsagentur Wien, Seestadtstrasse 27, A-1220 Vienna.

Budget

The available budget until 2018 amounts to EUR 38.5 million.

→ 2013 ---------- 2014/2015 ---------- Q4 2015–Q4 2016 ---------- 2016/2017 ---------- 2018 ←

Kick-off phase:

Establishment of ASCR

Preparatory phase:

Engineering, planning and construction of technical infrastructure, launch of Smart Cities Demo Aspern (SCDA) project

Research phase 1 Baseline phase:

Occupation of buildings, data collection without intervention, model calculations, first user surveys, first network analyses

Research phase 2 Management phase:

Data collection including management of individual building components, further network analyses, user interaction

Closing phase:

Finishing of current research aspects, preparation and interpretation of results

aspern Vienna's Urban Lakeside

One of Europe's largest urban development projects is taking shape on a former airfield

Vienna's Urban Lakeside

Aspern Airfield was opened in 1912 and at the time was among the largest and most modern airports in Europe. As it still functioned as an important air base for the air force in the two world wars, it was passed over into the hands of the Austrian Aero Club after the signing of the State Treaty, and was used principally for pilot training and aviation sports. In subsequent years, air transportation was increasingly shifted to the current Vienna International Airport in Schwechat. Aspern Airport was finally closed on the 1st of May 1977.

Today, this area in north-east Vienna has found a new purpose. It is being developed into a modern, multi-functional city district , called Urban Lakeside. Over a total area of 240 hectares that corresponds roughly to the size of 340 football pitches, new buildings are being constructed with a planned gross floor space of more than 2.2 million square metres. The investment totals roughly EUR 5 billion. By 2029, more than 20,000 people will live and work in this modern Urban Lakeside smart city area.
aspern Urban Lakeside wants to establish itself as an innovative and significant business location. Already, numerous production and service companies and also research and education institutions are settling here.

Families are another priority for the Urban Lakeside. Numerous nurseries, private child-care institutions and schools are to be constructed on the former airfield. In terms of mobility, the focus is placed particularly on green means of transport. Cycling, car-sharing and the many options of public transport offer a number of attractive alternatives to private cars. The numerous green spaces are designed to allow many ways of relaxation; almost 50 percent of the area will be devoted to open and green public spaces.

The methods of construction used are exemplary and unique, too. Roughly 600,000 tonnes of excavated material was prepared in the Urban Lakeside building logistics centre to be used as construction material on-site. The concrete gained from demolishing the runways of the former airfield has also been given a new purpose. It has been recycled to build roads and paths. This way, 125,000 lorry trips were avoided to and from the Urban Lakeside up to 2014, which corresponds to a reduction of roughly 1,400 tonnes in CO_2 emissions.
The Urban Lakeside is well on the way to making a name for itself throughout Europe.

Credits: Wiener Linien/Johannes Zinner

The future of energy begins today

Research with real energy data in aspern Urban Lakeside

» One key topic that is part of the ASCR research programme is the feasibility and scalability of our research. Our ultimate goal is to apply our knowledge for entire cities, for example for multiple districts in Vienna. «

Andreas Schuster
Research

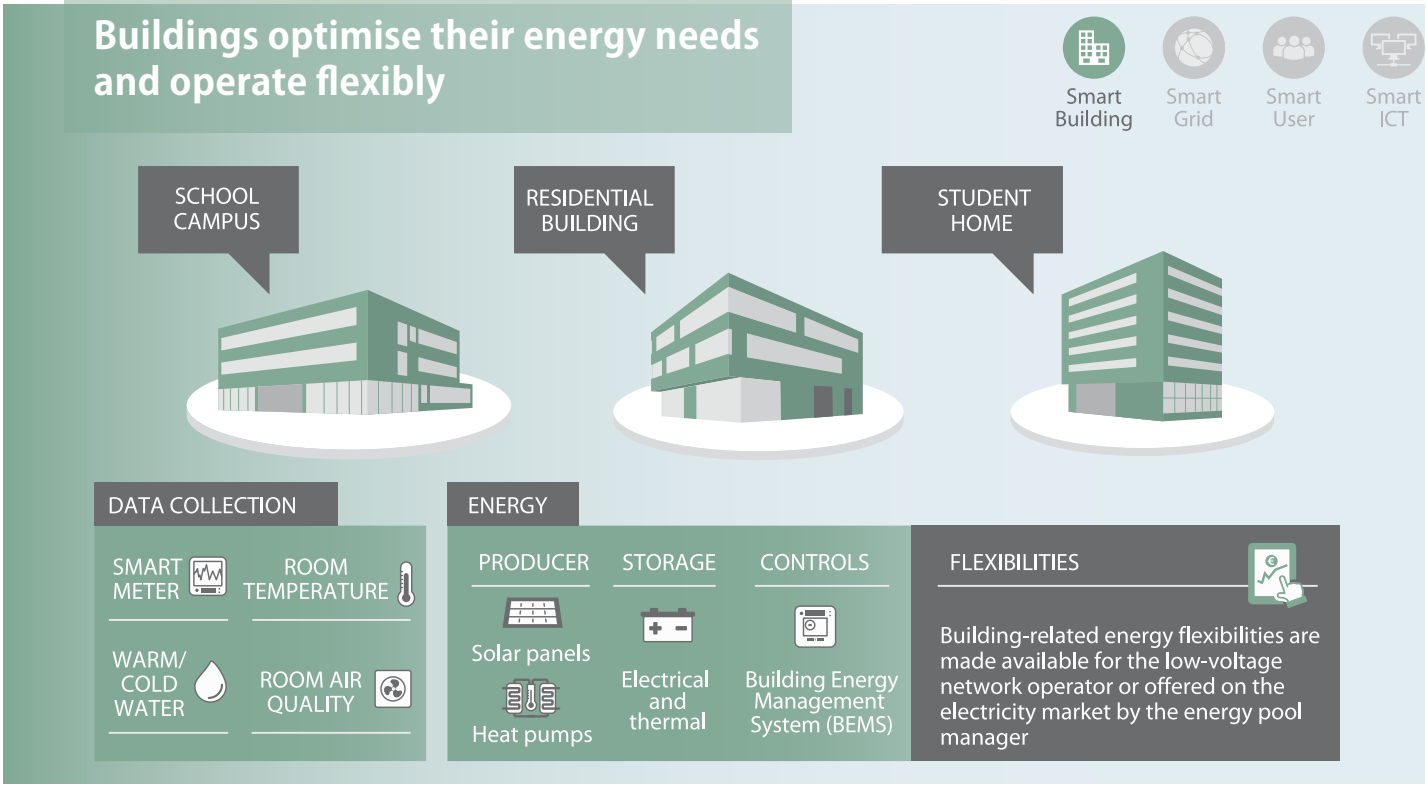
A weather change is forecasted for tomorrow.
The smart buildings therefore use the sun's rays to store energy now. This stored energy will even partly be traded on the energy market. The smart grid interacts with the buildings, sends energy in various directions and also functions as a communications platform.
This approach does not impair the smart users at all: On the one hand, they receive valuable building information and on the other hand they can, if they wish so, control the apartments remotely. In simple terms, this is what the future of energy will look like.

The expertise of the research company Aspern Smart City Research (ASCR) is used to bring this future a bit closer to reality. Based on national and international experience, ASCR is exploring not only individual aspects in **aspern** Urban Lakeside, but also the entire system: Buildings, the electricity grid, communication and information technologies as well as user behaviour are all captured in a large-scale energy research programme.

Contact person:
Andreas Schuster (Research)
andreas.schuster@ascr.at

Smart Building

Buildings optimise their energy needs and operate flexibly



Solar thermal system on the roof of the school campus

»We have intentionally installed much more infrastructure than is normally necessary for the facilities to operate. This way, we can test various approaches and weigh them up against each other to achieve optimal energy/cost solutions.«

Bernd Richter
Infrastructure

Three buildings – a residential building, a student home and a school campus (currently a nursery school and primary school) – constitute the smart building research objects of ASCR. Equipped with photovoltaic panels, solar thermal panels, hybrid panels, heat pumps and various thermal as well as electrical storage facilities, the buildings of tomorrow are genuine prosumers. They not only use energy, they also produce and store it. Complex ICT systems facilitate the optimal management of the production, distribution, consumption, storage and transmission of energy.

Optimised own consumption

One of the priority areas for ASCR is optimising buildings' "own" use of energy. The reason is that today's building optimisation systems lack an essential component: They cannot predict the future. But that is about to change. Intelligent building management systems focus on calculating estimated energy requirements with due consideration of weather forecasts and other data. Additionally, they can provide information about the condition of individual building units and in that way support the forward planning of maintenance.

Building flexibility

Aside from optimising own energy consumption, the research company is primarily interested in the potential of buildings to make energy flexibility available outside their walls. Consequently, one of the most important questions is how can buildings use their flexibility in the future to support local medium- and low-voltage networks, or alternatively participate as an active player on the electricity market?

Flexibility pooling

To master these challenges, aggregation levels must be created with a few buildings, and in the future even with up to several thousand buildings. At least two systems are required for this purpose. One is located in the building itself, a Building Energy Management System (BEMS), which calculates the electricity consumption of the building and any flexibility at regular intervals. The other, the Energy Pool Manager, acts as an interface between the individual buildings and the electricity exchange.

In order to be able to participate in balancing energy markets in the first place, you need intelligent electricity networks, which not only need to know about the network status at any time, but can also forecast it. Furthermore, a new legal framework is required for this.

Smart Building Testbed – three buildings:

- **Student home with over 300 places**
  Photovoltaic panels (250 kWp)
  Battery storage (120 kWh)
  E-cartridges (2 x 8 kW)
  Smart measuring and control technology (Smart MCT)
- **School campus (currently nursery and primary school)**
  Two heat pumps (510 kW)
  Solar thermal panels (90 kW)
  Hot water storage
  E-cartridges (70 kW)
  Photovoltaic panels (58 kWp)
  Smart MCT
- **Residential building with 213 apartments**
  Seven heat pumps (800 kW)
  Solar thermal panels (90 kW)
  Photovoltaic panels (15 kWp)
  Hybrid panels (20 kWpel + 60 kWpth)
  Sole storage (40,000 kWh)
  Hot water storage
  Battery storage (roughly 20 kWh)
  Smart MCT

Heating centre in student home

» Buildings today have primarily been consumers in the energy network. However, the thermal inertia of buildings offers an ideal playing field to use the available flexibility and thereby support the energy transition. «

Mike Pichler
Smart Building Subproject Manager

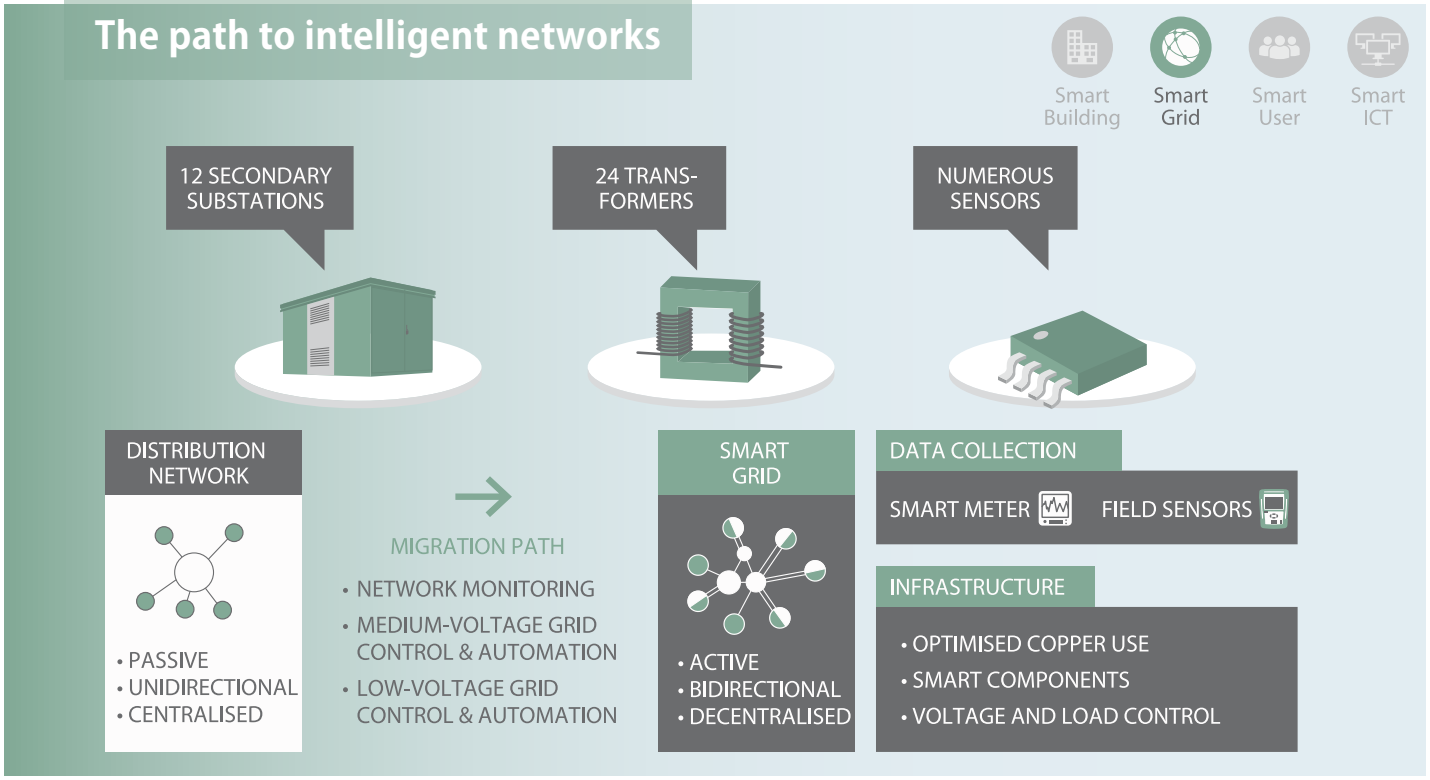
Contact person:

Christoph Gerstbauer (Smart Building)
christoph.gerstbauer@ascr.at

Bernd Richter (Infrastructure)
bernd.richter@ascr.at

Smart Grid

The path to intelligent networks



Secondary distribution panel at the transformer station in the school campus

Twelve secondary substations, 24 transformers and many sensors constitute the basic infrastructure of the ASCR Smart Grid Testbed. This alone is not enough to make the electricity network intelligent, but ASCR is exploring how to turn a traditional network into an intelligent network.

Smart grid migration path

The approach adopted here is based on optimal use of existing copper reserves and integrated smart ancillary technologies. Not overnight, but continuously, along the smart grid migration path. This serves as a guideline for the transition from a passive distribution network to a smart grid, which stands out thanks to its bidirectional load and communication flows.

»The advantage of the ASCR Research Testbed is that we are exploring the whole system in a project for the first time – mapped on the smart grid migration path – and can therefore make the solutions as economically optimal as possible.«

Alfred Einfalt
Smart Grid Subproject Manager

Smart Grid Testbed:

Main components:
12 secondary substations
24 transformers (RONT, Amorph, Ester-MIDEL, aluminium, standard oil)
Smart meters (more than 500)
Grid monitoring devices (more than 100)

Grid monitoring

Data is acquired at the start of the migration path. The electricity network status, i.e. utilisation down to the low-voltage level, must be made transparent. The low-voltage networks make up the largest part of the electricity network and are the most active areas in terms of grid dynamics and fluctuating voltages. Data collection is carried out by smart meters and self-configurating field sensors – including power quality measuring devices (P855) or grid monitoring devices (GMDs). Smart meters have already been tested, but they only provide rough data. Additional measurements and sensors do generate higher costs, but they also enable a more accurate picture of the network status.

How many sensors are needed?

A core issue of the ASCR research programme is therefore to determine the minimum required coverage with sensors that will provide a detailed enough picture of the network status for optimal network operation (and network planning) whilst keeping aspects of economic efficiency in mind.

Planning and low-voltage management

Further down the smart grid migration path, the data can be used to make management decisions that do not require any physical network expansion for the time being. They represent an efficient alternative to vague worst-case planning. Without active network intervention, specific network data enables infrastructure to be used closer to its physical limits and provides early warnings when thresholds or set KPIs (key performance indicators) are threatened to be exceeded.

If these limits are exceeded, quick action can be taken based on available data that prevents any adverse effect on the quality of supply. Historical data plays a significant role with long-term network planning, too. It facilitates the definition of accurate expansion measures by means of relevant evaluations, extrapolations and simulations. Active grid intervention can help to raise the efficiency of electricity network infrastructure. This, however, requires these components to be as fault-tolerant as possible. Furthermore, they should not generate any significant additional costs during the rollout and in operations. This can be ensured by means of system solutions whose components support functions such as zero touch, plug and play, and plug and automate.

INFOBOX

Smart Cities Demo Aspern (SCDA)

Together with nine partners, ASCR launched the Smart City Demo Aspern (SCDA) project in 2014 with a budget of EUR 8 million. The three year project involves around 120 people. Research is being conducted especially on the usage of energy flexibilities, the active management of the low-voltage grid and the intelligent interlinking of buildings and the low-voltage network with ICT. The involvement of users is also a key component of the project.
As part of the Smart Cities initiative, the Austrian Climate and Energy Fund is supporting the SCDA project with a funding sum of EUR 3.7 million.

» Grant projects are a key reference for faster market success, both at national and international level.«

Oliver Juli
Grant Management

SCDA consortium

Consortium management and project management:
Forschungsgesellschaft Aspern Smart City Research GmbH & Co KG (ASCR)

Industrial partners:
Siemens AG Österreich, Wien Energie GmbH and Wiener Netze GmbH

Academic partners:
Austrian Institute of Technology GmbH (AIT)

Partner of City of Vienna:
Municipal Authority / Urban Planning – Project management **aspern** Urban Lakeside and Municipal Department 18 Urban Development and Planning

SME partners:
Moosmoar Energies OG, TB Käferhaus GmbH and SERA energy & resources e.U.

SCDA
Smart Cities Demo Aspern

SCDA contact person:
Oliver Juli (Grant Management), oliver.juli@ascr.at

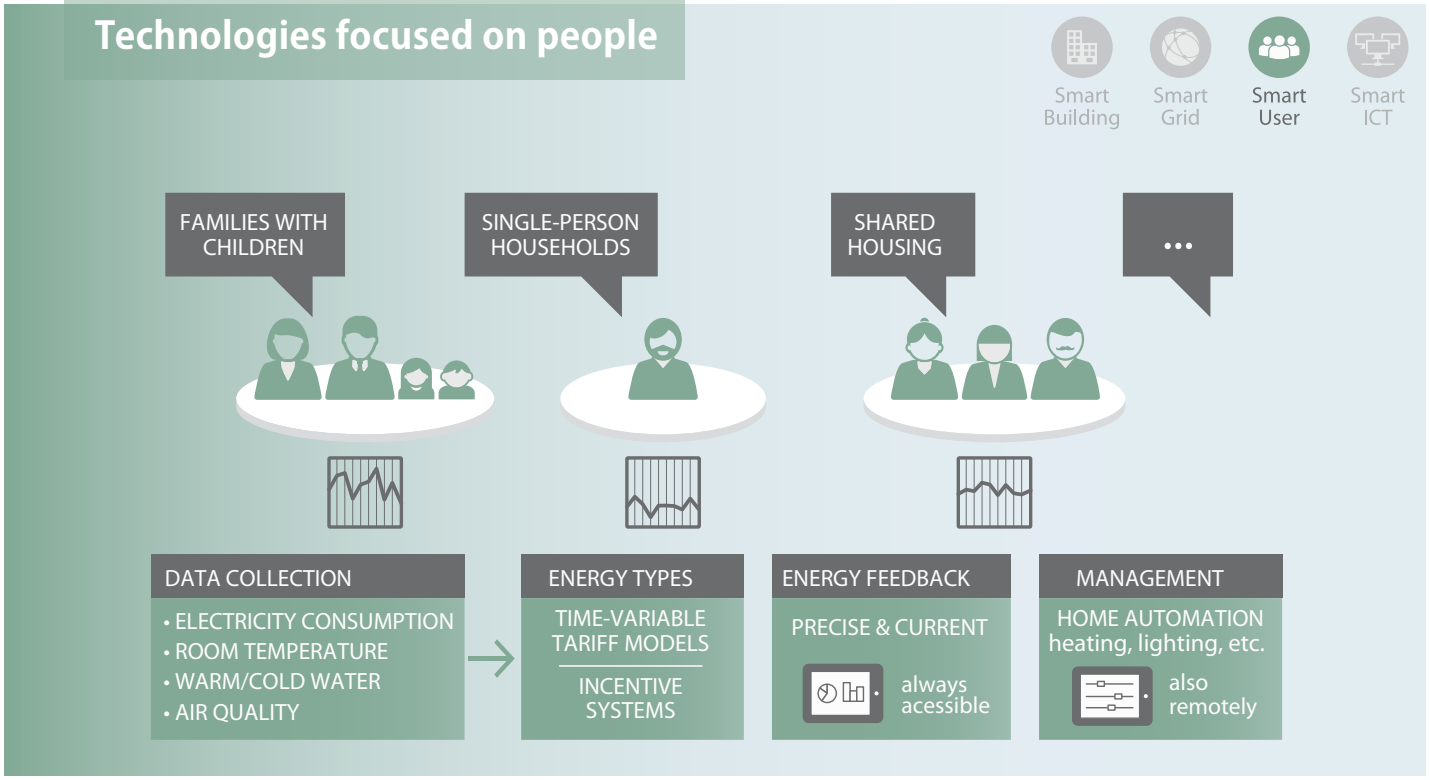
Contact persons:

Alfred Einfalt (Smart Grid)
alfred.einfalt@siemens.com

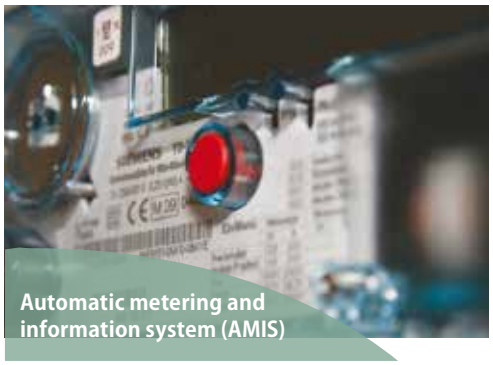
Thomas Karl Schuster (Smart Grid)
thomas.schuster@wienernetze.at

Smart User

Technologies focused on people



Credits: Siemens



Automatic metering and information system (AMIS)

Users represent a particularly important part of the ASCR research activities because it ultimately depends on them how much energy the building requires and to what extent it can offer flexibilities.

However, the research programme only includes households that have declared their written approval, permitting their data of energy consumption and of the ambient air control system (electricity, hot and cold water, room temperature, room air quality, etc.) to be used for research purposes.

Why is user data vital for ASCR?

The aim is to find out how the buildings work in an optimal way. Due to this, we need information on current utilisation habits and future needs. Consequently, the cooperation with users will be continuously supported and accompanied until 2018 based on a social science approach.

Smart MCT and innovative products and services

As the basis for home automation, smart measuring and control technology (smart MCT) is installed in the participating households and controls the air quality and temperature of the residence with an aim to optimising the building's own consumption.
Users are still always able to intervene with the smart MCT, i.e. to set air quality and temperature levels themselves, even remotely from a tablet or smartphone.

Additionally, they can test innovative products and services to control their individual energy consumption (e.g. time-variable tariff models). This in turn helps the research team in developing innovations.

The aim, however, is to promote sustainable, cost- and energy-efficient usage by means of incentives and raising awareness. The paradigm of today is: Generation follows consumption meaning the production is adapted to the consumption. In the future, it must be possible to adapt consumption more towards fluctuating renewable energy generation.

INFOBOX

Smart City Vienna

The Smart City Vienna Framework Strategy is a long-term umbrella strategy until 2050 with the goal of further raising the quality of life for all residents in Vienna whilst conserving resources.

In this respect, Vienna wants to be an international pioneer and is therefore working not only on carbon dioxide (CO_2) targets, but also has the whole smart city process in mind. Every urban living environment is being considered and genuine innovations are targeted in the areas of energy, traffic, health care, building and communication. In this context, the ASCR research programme makes a valuable contribution to the framework strategy.

More information on Smart City Vienna can be found here: www.smartcity.wien.at

Interview with Susanne Geissler (Smart User research):

How can users' reservations about providing data be overcome?

Data is provided voluntarily and with written approval. All the data collected as part of the ASCR research activities will only be used for the duration of the research programme and will be treated confidentially. We are working together with the users to ensure an uninterrupted energy supply for everyone now and in the future. To achieve that in a sustainable way, we need the help of detailed consumer data.

How is contact made and data collected?

With the support of surveys, easy and clear information and other methods, we can enhance the willingness to use innovative technologies, explore user expectations and which of new technologies provided are accepted and used. User involvement is a key component for the success of the research project. Information prepared for target groups, discussion opportunities and regular information events are important for the cooperation between users and the research team.

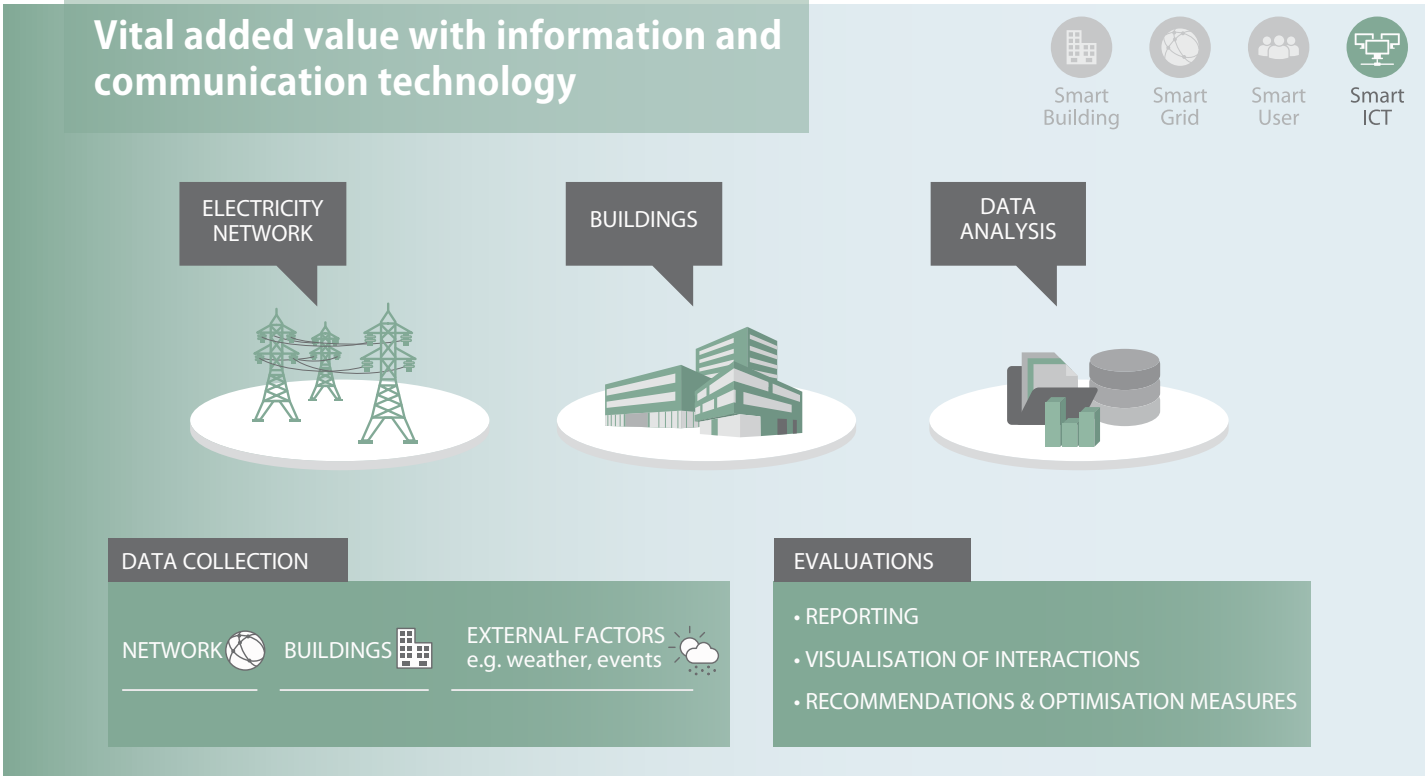
What is the collected consumer data used for?

It helps to develop innovative energy services and products in a targeted manner. Technology should make people's daily lives easier. This is why ASCR also wants to cover all questions with the users in open discussions.

Contact person:
Susanne Geissler (Smart User)
susanne.geissler@sustain.at

Smart ICT

Vital added value with information and communication technology



With due consideration of data protection guidelines, smart ICT uses all of the data obtained from the buildings and the network (temperature, room air quality, electricity consumption, voltage, etc.) and external data (for example weather or other related events) to analyse the interaction and the interdependencies between the network and the buildings. The essential factor is the integrated view of data from various domains.

Digital reproduction of reality

Using real data from the test field, the ASCR research team creates a digital reproduction of reality in order to simulate any energy concepts as well as optimisation measures. The objective here is to develop scalable and feasible solutions for urban energy balance. One example of a smart ICT question is: How do various strategies of optimising the buildings' own energy consumption influence the grid and vice versa? What influence does active network management (integration of plug and play technology, etc.) have on buildings with regard to their flexibilities?

Self-learning systems

Since building occupancy and network capacity utilisation constantly change, the models on which the simulations run must be adjusted on a continuous basis. The models and thus the internal building and network control mechanisms also refine themselves by means of adaptive self-learning algorithms.

What data models are employed?

Big data methods are used to cope with the enormous data volumes from the various domains. Numerous different data models can be used depending on the area of application. As a part of the ASCR research programme, both large centralised data models as well as decentralised models in the style of the Hadoop software framework are tested. Smart data analyses lead to optimised own consumption or energy distribution, and potential problems with voltage fluctuations, for example, can be recognised at an early stage.

Smart ICT Testbed:

Main components:
Central data warehouse: Teradata DM670C (6x Dual Core Prozessor, 256 GB RAM, 12 RAID1 disks with 6TB capacity) Hyper-V environment with 25 virtual systems (556 GB RAM, 12 TB HDD)

» We digitally reproduce the Urban Lakeside with its real data, and can therefore simulate any energy concepts and optimisation measures to develop transferable energy solutions for entire cities.«

Gerhard Engelbrecht
Smart ICT Subproject Manager

Contact person:

Gerhard Engelbrecht (Smart ICT)
gerhard.engelbrecht@siemens.com

Legal information:

Publisher:
Aspern Smart City Research GmbH & Co KG (ASCR)
Seestadtstrasse 27/2/Top 19, A-1220 Vienna
Telephone: +43 (0)1 908 93 69
E-mail: office@ascr.at
Web: www.ascr.at

Editorial team:
Siemens, Wien Energie, Wiener Netze
Concept and text:
communication matters + Christine Sonvilla

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Christina Lehner, primart

Photos:
Markus Rössle

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