

Current developments and examples of sustainable energy technologies



## Cities as innovation drivers

Technological building  
blocks for sustainable  
urban development

Tomorrow's cities fulfil the need of a high quality of life, and are characterized by responsible, economical management of our resources. Sustainable urban development emphasizes intelligent systems and integrated solutions for buildings, mobility and energy supply. In close cooperation with the European initiatives for Smart Cities, Austria is developing pioneering strategies and implementing them in pathbreaking pilot projects.

## Smart urban development European und national initiatives

Today more than half the world's population and two-thirds of Europeans are living in cities or urban areas; the figure for Austria is 64 %. The global trend is upwards; the process of urbanization will continue in future, and the city will become the dominant environment in social and economic terms all over the world. Europe's cities generate the bulk of our affluence; at the same time, though, they face huge economic, ecological and social challenges. Climate change, migration, secure energy supply systems and sustainable mobility are among the issues calling for pioneering strategies and solutions.

The hallmark of Smart Cities is intelligent system design bringing together new technologies and services for buildings and infrastructure, generating and distributing energy, mobility, industrial production and trades. In future all the relevant sectors should be linked up and attuned to one another with the help of integrated planning and modern communications technologies. Tomorrow's cities combine climate protection with a high quality of life, are attractive as business locations and contribute to reducing energy and resource consumption permanently.

At the EU level the issue of sustainable urban development plays a key role in the Strategic Energy Technology Plan (SET-Plan), in the Horizon 2020 framework programme for research, in the European Innovation Partnership Smart Cities and Communities (EIP SCC), in the transnational Joint Programming Initiative JPI Urban Europe and in various transnational cooperation schemes and initiatives.

### Austrian activities

Since late 2010 the Federal Ministry of Transport, Innovation and Technology (BMVIT) and the Climate and Energy Fund have collaborated on funding the development of strategies, technologies and solutions for climate-friendly, energy-efficient urban economic activities and lifestyles.

In step with EU initiatives, the pilot calls "Smart Cities Demo" (Climate and Energy Fund) to support trend-setting pilot projects have been launched in Austria. In addition, the BMVIT successfully started the JPI "Urban Europe" in 2010, a transnational research programme under the aegis of the EU Council of Ministers, in which basic system-relevant issues to do with urban development are tackled. Within the framework of "Building of Tomorrow" (BMVIT) flagship construction projects are supported; the recently launched programme "City of Tomorrow" (BMVIT) is meant to accelerate the development of new technologies, technological (sub)systems and urban services.

In this programme Austrian towns and cities are developing strategies and arrangements for the Smart City and have already started to implement these successfully in specific pilot projects. From the initiatives mentioned, here are some examples to show the wide range of Austrian activities. ■



## Smart City Vienna Model for intelligent urban development in Europe

All over the world the City of Vienna, with its 1.7 million inhabitants, is seen as an example of exceptional urban quality of life. The city aims to secure this status long-term by means of comprehensive measures for a sustainable future in terms of energy and the climate. Under Mayor Häupl's aegis the project "Smart City Vienna" was launched by the department responsible for urban development and urban planning in 2011. As part of the Climate and Energy Funds programme "Smart Cities Demo", "Vision 2050", a "Roadmap for 2020 and beyond" and the "Action Plan for 2012-2015" have been drawn up in a stakeholder process.

Vienna's Smart Cities activities are embedded in various transnational and European programmes. Vienna cooperates with other European cities and international business and research partners, e.g. in the project TRANSFORM (Transformation Agenda for Low Carbon Cities, part-funded within the EU's 7th Framework Programme for Research). In TRANSFORM plus pilot projects are implemented in "smart" city districts, and the overall urban strategy is advanced, with the support of the Climate and Energy Fund.

### aspersn – Vienna's Urban Lakeside

At Aspern a 240-hectare site, once an airfield, is being developed into a brand-new, multifunctional city district with residential accommodation, offices and a section for small-scale businesses, science, research and education. The Urban Lakeside is one of the largest urban development projects in Europe; here affordable accommodation for 20,000 people, plus 15,000 jobs, top-rate public transport and infrastructure, are under way.

As part of the BMVIT funding programme "Building of Tomorrow", the central project aspern plus addresses the issues of open space and microclimate, inter-building energy distribution and consumption, implementing specific demonstration buildings to surplus-energy standard and monitoring systems to evaluate the buildings' performance. As a first pilot project the Vienna Business Agency's aspern IQ Technology Centre went up in 2012.

### Liesing Mitte - Zero Emission and Urban Farming

The Liesing Mitte project connects three dissimilar urban areas ("In der Wiesen", the Liesing Industrial Zone and Atzgersdorf Zentrum) up to create a model Smart City district. The focus is on (i. a.) deploying intelligent building technologies in new construction and renovation and on setting up smart grids, thus making it possible to tie in surplus-energy buildings as suppliers of energy. The targets are to reduce the district's carbon-dioxide emission

*„Vienna intends to enhance its competence in the fields of climate protection and energy efficiency at the forefront of the EU Smart City process, with the City administration, researchers and businesses working together. National and European research funds are a vital catalyst to support the process of transforming Vienna into a Smart City.“*

*Ina Homeier, Project management Smart City Vienna, MA 18 – Urban Development and Urban Planning*



Photo © Gerhard Kodym



*Diversifying open spaces in Liesing Mitte "Garteln Hoch 3 / In der Wiesen Ost"*  
Source: STUDIOVLAY



step by step to zero emissions by 2050, to lower energy and raw-material consumption by a factor of 10 and to shift to 100 % renewables as sources of energy. Social considerations, such as making these innovations affordable for low-income households, play a key part here. Around one hundred different individual projects have been slotted into a road map. Designing the open spaces as areas which the future residents can use is an important aspect. Urban farming projects in subsidized housing construction are intended to improve the quality of the surroundings, avoid people moving to the country and re-establish their awareness of what makes good food. ■

### TRANSFORM plus: Smart Urban Labs

For aspern Urban Lakeside a "Smart Citizen Assistant" is being developed – a tool to provide data on residents' energy consumption and important local information to (mobile) terminal devices. In the pilot project "e-delivery on demand" a low-cost logistic pooling model for electric-powered vans is being thought out for the Liesing Industrial Zone.

## PROJECTS



Phases of construction at surplus-energy cluster Reininghaus Süd,

Source: Dipl.-Ing. Martin Grabner ECR-Team, Graz University of Technology, Institute of Urbanism

## Smart Future Graz „Urban building blocks“ self sufficient in energy

Graz is a fast-growing city with limited space for settlement. That is why urban development in Graz is focussed on packing more into parts of the inner city with excellent infrastructure, which are to be made into energy-efficient, resource-conserving, low-emission residential areas with a very high quality of life. In the strategic project “I live Graz” future actions have been defined for the Smart City Graz in the fields of the economy, society, ecology,

mobility, energy and facility management. Apart from providing grade-A accommodation, the city’s main aims are to provide attractive public spaces, to set up a network of attractive routes for walking and cycling, to mesh development in with public transport facilities and to reduce motor traffic’s share of trips.

### Smart City Project Graz Mitte

A new urban district self-sufficient in energy is to take shape in the heterogenous area (once an industrial zone) close to the main railway station. Here energy technologies for the intelligent “Zero Emissions” city are to be demonstrated for the very first time via an inclusive planning process. The project involves

- > testing new components and systems such as new solar modules, solar cooling, urban solar power generators, façade-integrated elements, mini-CHP units, Smart Heat Grids
- > implementing demonstration facilities (the research-oriented **Science Tower**, the pilot PV unit “Grätzel-Zelle”, a power centre plus local power grid, a **solar updraft tower**, and housing developments and premises for small-scale businesses featuring pioneering building technologies)
- > strategies for sustainable urban mobility, including electric-powered vehicles

Citizens are brought into the process by means of active community organizing, providing information and ways of taking part, and via an interdisciplinary panel of experts. Constant dialogue with partner cities in Austria and abroad is intended to promote learning processes, reflection and the spread of results.

*The first step toward realizing the smart urban district Graz Mitte is putting up the **Science Tower**, which the firms of FIBAG and SFL Technologies have been entrusted with. This tower, 60 m tall, is being erected north of the Helmut List Hall; it is intended not only to accommodate science and research facilities, but also to serve as a research platform for new building technologies. Wrapped around its outside the tower has a twin-skin façade consisting entirely of translucent green and orange photovoltaic panels of “Grätzel-Technologie” design. The “Grätzel-Zelle” is a dye-sensitized solar cell which converts sunlight into electricity.*



Source: markus pernthaler architekten zt gmbh



### ECR Energy City Graz Reininghaus

As part of the flagship project “Building of Tomorrow”, strategies have been worked out for structuring, building and running Graz Reininghaus as an urban district self-sufficient in energy, as has an overall energy strategy. Here pilot facilities are intended to become internationally pathbreaking “building blocks of urban sustainability”.

The overall energy strategy is primarily focussed on linking up surplus-energy buildings (which produce more energy than they consume) and feeding the surplus energy into a communal grid. For the energy framework plan energy consumption, supply and distribution, building services engineering and urban development aspects (e.g. geothermal energy, suitable orientation of structural shell, solar exploitation of roofs and façades, using process heat, CHP facilities, etc.) have been investigated.

The **surplus-energy cluster Reininghaus Süd** is one of the first construction projects to have been implemented. Here twelve separate blocks of flats have been coupled together into a multi-functional cluster of buildings. An office and shopping complex in front screens the project off from a busy road nearby.

The **solar updraft tower** generates electricity from an updraft of warm air and excess heat from a district heating system. It is shaped as a rotation hyperboloid 45 m tall, with a chimney-like tip. The outside shell consists of translucent coloured solar cells. A turbine to generate electricity is located at the bottom of the inner flue. Part of the energy input is derived from the updraft of air which warms up between the core and the outer shell when the sun shines.

The warmed air flows out from the top of the chimney, and air drawn in at the bottom warms up. To make it possible to generate electricity at night, too, part of the insolation is converted into heat in thermal solar collectors; this and excess heat from the district heating system is stored in the thermal storage unit in the tower's core. At night this heat is used to warm up the air in the chimney.



Source: markus pernthaler  
architekten zt gmbh

The surplus-energy approach combines a variety of measures: the individual buildings have been designed to take maximum advantage of renewables (geothermal energy tapped via energy piles, and photovoltaics), while synergies have been created between the blocks of flats and the office complex. To even out peaks in generation and consumption, the power centres in the individual blocks of flats have been linked up and power-sharing with the office and shopping complex implemented. ▣



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„Smart City“ refers to a city which combines a high quality of life with climate protection and resource efficiency.

**What are the specific measures that the planning department envisages to push the “Smart City” approach in Graz?**

To do this we deploy a variety of packages (energy, mobility, quality of architecture, providing public open space and parks, citizen participation, ...), which are defined in line with the specific requirements of the project in question; for implementation they are subsequently incorporated in binding contracts.

**Consuming less energy but maintaining quality of life, consumption and mobility – how is that supposed to work?**

Investigations show that if a residential area is developed compactly, with adequate public-transport links and proper infrastructure, this has a favourable effect on the modal split (how people move around). The technological innovations tested in the pilot projects are intended to improve energy efficiency considerably. Involving local agents alongside this is meant to spread awareness of the opportunities available with these new technologies.

**Which pioneering technologies and services will be particularly important in future when “smart” urban districts are taking shape?**

User-friendly technological applications make a sustainable modal split possible (car-sharing fleets, electric bicycles, information management in public transport). Applications for building services lower running costs. Monitoring functions (apps) reveal how much each separate measure can contribute to saving energy and reducing CO<sub>2</sub> emissions.



Stadtwerk Lehen, Source: Fotohof © Andrew Phelps



Restructuring of Salzburg Lehen, Source: SIR

## Salzburg – from Smart Grid to Smart City New energy strategies for worth living urban quarters

As a Smart Grids Model Region, the City of Salzburg has a large repertoire of emission-reducing initiatives for climate protection. Building on this, the city has defined its vision for 2050 in a master plan and established a roadmap for developing into a Smart City. To restructure the energy system it is essential, amongst other things, to expand and optimize the district heating grid in line with city development strategies, make more use of renewable energy sources, reduce energy consumption massively in buildings and provide new options for mobility.

### Innovative use of solar energy in the Lehen district

One of the flagship “Building of Tomorrow” projects is the restructuring of the Lehen district in Salzburg, where numerous building projects have been in progress since 2007. Parts of the overall project are being implemented within the framework of the EU initiative Concerto II “Green Solar Cities”.

On premises once occupied by the municipal utilities company, 287 apartments for rental, the new city gallery, a student hostel and a nursery school have been built. The existing office block has been renovated and equipped with modern offices, laboratories



Source: SIR

The “Parklife” project, an old people’s home combined with an apartment block for young families, is a European showcase project in the category energy-efficient sustainable construction using solar power. The planning for this was commissioned as part of a EUROPLAN competition for young architects.

*„A special feature of the project is that various construction modules involve close cooperation between a number of participants. The goals have been written into a quality agreement, and a special steering committee chaired by the City of Salzburg has been set up. That is how the overall energy strategy and neighbourhood-wide open space planning became possible.“*



*Inge Strauß, Salzburg Institute for Spatial Planning & Accommodation (SIR)*

and conference rooms. The far-reaching renovation of the adjacent old neighbourhood, Strubergassensiedlung, has been carried out using the most up-to-date technologies. The showcase project “Stadtwerk Lehen” with its sustainable energy strategy represents an important Austrian contribution within the research cooperation framework of the International Energy Agency (IEA-EBC Annex 51 / Energy Efficient Buildings and Communities).

Energy on the premises is provided through a system which complements district heating with solar energy. The building Stadtwerk Lehen was equipped with a thermal solar facility with a collector area of 2,000 m<sup>2</sup>. The heat is collected in a central storage facility with a capacity of 200,000 litres. A solar heat pump enhances the system and increases the output by another 15 to 20 %. The heat is distributed via a low-temperature microgrid to flats and offices, as well as to renovated apartment blocks nearby. A photovoltaic facility with a rating of overall 20.16 kW on the roofs of the apartment blocks provides electricity for the shared facilities.

The next step was to conduct a building structure analysis in Salzburg in order to identify further neighbourhoods in need of a comprehensive renovation approach with sustainability in mind.

## Rosa Zukunft – Smart Grid technologies in the field

Internationally Salzburg counts as a front runner in the development of intelligent solutions for electricity distribution grids. In close cooperation between researchers and industry, new technologies for tomorrow's electricity grids have been developed and put to the test since 2009 in Austria's first Smart Grid showcase region.

In the pioneer project HiT (buildings as interactive participants in a Smart Grid) all relevant Smart Grid low-voltage elements are linked up in an integrated building strategy. The project encompasses planning, constructing, running and monitoring an apartment complex with 130 flats (rented out and owner-occupied) for various groups of occupants. Here key issues to do with generating energy from renewable sources, building technologies and storage facilities, and



Residential building Rosa Zukunft, Source: thalmeier architekten

electric-powered mobility, are investigated under real-life conditions. The apartment complex has an intelligent energy management system able to control energy production and consumption (e.g. through automatic load redistribution) and to make use of existing storage facilities (e.g. batteries in electric vehicles). Environmentally friendly energy production from photovoltaic units and cogeneration are just as much part and parcel of the overall strategy as sustainable mobility for residents. ■

## Villach – Vision Step I Smart test areas and strong public participation



Centre of Living Lab, Leopold Hrazdil Straße, Source: Meine Heimat

Working together with well-known partners from industry and research (AIT Energy Department, CTR Carinthian Tech Research, FH Kärnten and the four companies KNG Kärnten Netz GmbH, Infineon, Alpine Energie, Siemens, RMA Ressourcen Management Agentur, Symvaro GmbH and PwC Advisory Services GmbH), the City of Villach is taking the first steps toward implementing Smart City Villach in the project Vision Step I.

In the smart city test area “DEMO site” in the city neighbourhood of Auen a string of synergetically coordinated measures are being implemented. The aim is to increase energy efficiency and to produce more renewable energy locally, while improving residents' quality of life at the same time.

A key part of the plan is upgrading the electricity network to a smart grid. Smart electricity meters are deployed in 1,300 households in the test area, and measuring equipment and controllable local grid substations are incorporated. The data acquired form the basis for load flow analysis, network modelling and control unit development. At FH Kärnten's Energy Labs smart grids are dynamically tested with various load patterns and in conjunction with photovoltaic units.

The project in Villach is characterized by its open innovation approach, which combines technological developments with user innovation. The Smart City Energy Club (SCEC) platform serves to promote responsible energy use: citizens can track their own energy consumption via smartphone or the web and interact with the rest of the community. In the LIVING LAB experts and citizens collaborate in the early stages of introducing and implementing new technologies. The Smart Tenant Workshop in Villach is designed as a communication platform for tenants, the city, real-estate administrators, energy providers and researchers. The overall aim here is to show that as a supplement to intelligent technical solutions social learning contributes considerably to the successful realization of a Smart City.

In the course of the project new funding and business models are being developed, offering citizens the chance to invest in renewable-energy projects (e.g. in photovoltaic facilities). ■



Photo © Puch Johannes

*„In smaller cities like Villach, too, we will be able to maintain and further develop a high standard of living in future largely by means of resource-saving energy use. Within the framework of the research cooperation scheme Vision Step I, Infineon focuses on innovation and affordability in the field of intelligent energy storage, thus strengthening the technological and economic basis of Smart City Villach. But we should also start soon enough on creating awareness in the general public, as the individual will be consumer and producer at the same time in future, which involves new responsibilities and challenges.“*

Monika Kircher, CEO of Infineon Technologies Austria AG

## Transnational cooperation Smart Cities activities in the D-A-CH countries

Through its activities and programmes aimed at the “sustainable city”, Austria has laid the groundwork for setting up programme networks and research collaboration arrangements at the EU level. Transnational research cooperation is increasingly important as regards putting the European research area on a firmer footing.

An example of this is the current collaboration between Germany, Switzerland and Austria in this field, aimed at making Smart City pilot projects part of a transnational network. The first such project involves collaboration between the cities of Karlsruhe (Germany), Winterthur (Switzerland) and Salzburg (Austria).

All three cities count as pioneers with regard to sustainable city development, and are already doing a good deal, e.g. in the fields of Smart Grids and electric-powered vehicles. By swapping their experience, the three cities (in their differing circumstances) can learn from one another and create synergies which will help to implement innovations quickly and cost-effectively. The insights gained from this cooperation will then be published so that other cities and agents in the three countries may profit from them. ■



*„Many cities in German-speaking lands have had municipal energy strategies for a long time. When one asks about implementation and documented successes (i.e. getting visibly closer to the long-term climate protection goals), the picture looks rather less impressive: Even cities with high ambitions are a long way away from the targets, such as 60 % decarbonization. There are isolated success stories, but a lasting strategy for realization which systematically makes the most of local potential has yet to be developed. That is precisely the aim of the first D-A-CH project. Other cities are already waiting eagerly for what is to come in Salzburg, Winterthur and Karlsruhe, and especially how it is done!“*

*Reinhard Jank, researcher involved in the research initiative “Energy efficient Cities” funded by the Federal Ministry of Economics and Technology (BMWi), Berlin, Germany*

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