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SMART GRIDS SHOWCASE REGION: SALZBURG

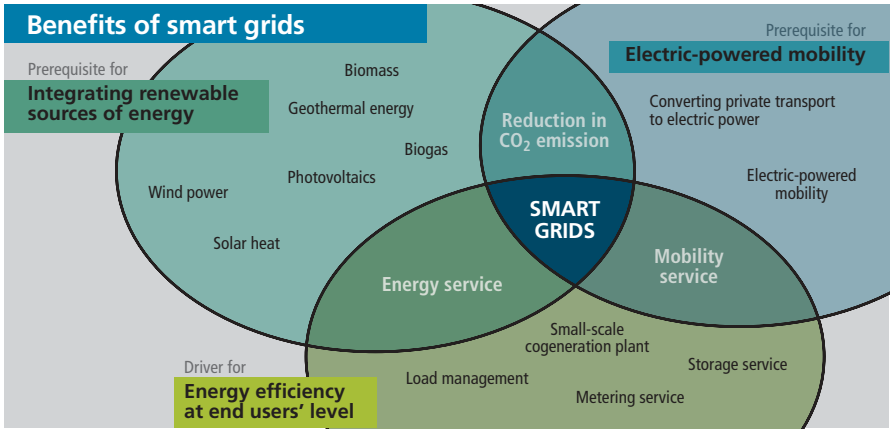
INTEGRATED INFRASTRUCTURE IN SALZBURG

bmvit
Austrian Federal Ministry of Transport,
Innovation and Technology

T O P I C

SMART GRIDS – AIMS AND POTENTIAL

■ Austria's energy and environmental policy targets include reducing CO_2 emissions by 16% and increasing the share of gross end-use energy consumption accounted for by renewable sources to 34% by 2020. By that date renewable sources should cover 10% of consumption in the transport sector. In the case of buildings no materials or gases at all relevant to global warming should be emitted by 2050. The development of smart grids in the engineering sense involves automating energy supply infrastructure to a greater extent: this applies particularly to the distribution networks and to integrating end users' energy-consuming equipment into the energy supply industry's management and monitoring systems. Going further, implementing smart grids means extensively restructuring the electricity supply system, which will affect each and every stakeholder. In this sense smart grids are a prerequisite for the politically mandated strategy of making more use of renewable energy. For Austria the issue is not whether, but on what scale, how rapidly and with what priorities smart grids can and should be implemented in showcase regions. Identifying market segments, and developing business models that can be put into commercial practice within a narrow time frame, play a key part here. New services based on energy and instrumentation technology and designed to make the use of energy and material more efficient provide starting-points for this. Where local suppliers feed a fair amount of power in at varying rates, smart grids can help with operating a stable, reliable network, e.g. if demand is adjusted to match the supply of renewables and the network capacity available. Innovative mobility services are already laying the foundation for expanding electric-powered mobility in future. Rapid development of smart grids and electric-powered mobility provides an opportunity for Austrian firms to occupy related market niches. Obviously of interest here: environmental and efficiency technologies, automation engineering, instrumentation, sensor technology and linking real-world and ICT applications together: "Internet of Things".



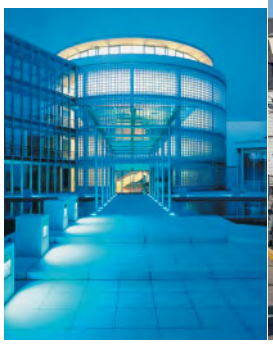
Source: Salzburg AG

The issue of reliable, efficient energy supply to provide services and products (both essential and convenient) is critical for a sustainable economy.
The aim of the BMVIT subprogram "Energy Systems of Tomorrow" is to develop technologies and strategies for an efficient, flexible energy supply system based on exploiting renewable sources of energy and capable of meeting our energy needs indefinitely.
Deploying a wide range of technology-related modules and concomitant activities is intended to provide impetus to this sector, and thus open up new opportunities for Austrian business.

A report published by The Climate Group ("Smart 2020") estimates that, worldwide, smart technologies will deliver around 600 billion Euro of cost savings and around 7.8 billion t of CO_2 emission savings in 2020. The British government's Stern Review estimated employment in the low-carbon energy sector at around 25 million worldwide for 2050; the Rocky Mountain Institute anticipated emission reduction providing around 3.2 million new jobs in the USA for 2020. While a comparison with Austria is not easy, because the initial situations in the various countries differ so much, all authors reach the same general conclusion, that the potential for cost savings and employment is considerable; this has indicative significance for Austria, too. In their brochure "Internet of Energy" the BDI – Federation of German Industries – anticipate massive market penetration by smart grids and electric-powered mobility by 2020. Meanwhile numerous stakeholders and authors are taking this road map seriously. At the same time there is strong competition for leadership in innovation; in particular, the topics "electric-powered mobility" and "smart metering" are currently attracting keen interest, with China and the USA each investing more than 7 billion US dollars in these areas. Given this worldwide competition and the pace of developments, it is essential to form effective alliances and to focus all the resources available.

The showcase region of Salzburg has excellent links both within Austria and abroad. It can pioneer the way for other parts of Austria, and speed up the development of smart grids and the associated market segments in Austria. With the know-how on hand, a strong position in renewable sources of energy, an infrastructure already in good shape, high standards of energy and resource efficiency, and innovative firms, Austria is in excellent shape to start with.

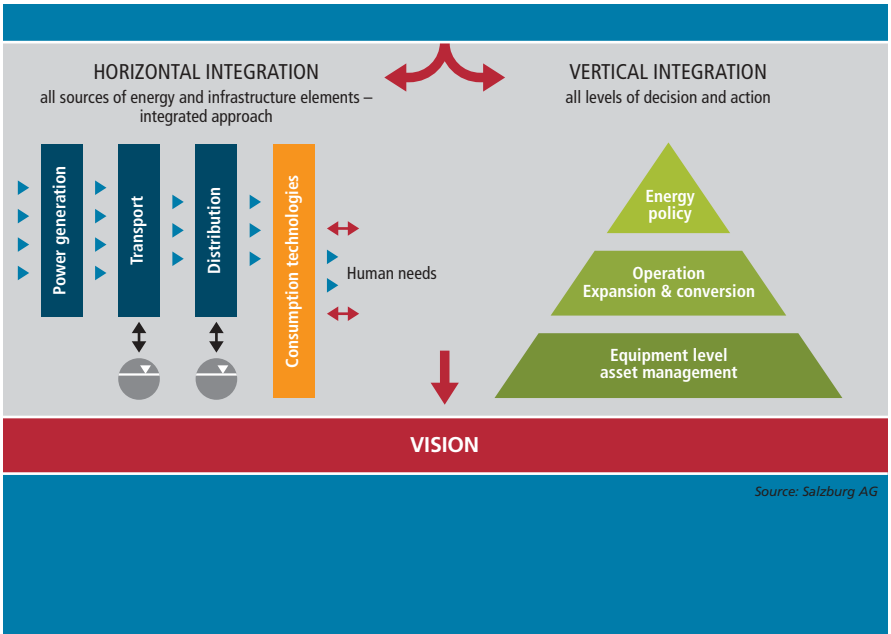
THE SALZBURG APPROACH – AN INTEGRATED PROGRAM



■ Salzburg has based its overall program for smart infrastructure on a number of preliminary scientific studies in which the physical foundations, the technical feasibility and the economic and ecological impacts of smart grids were analysed. The program encompasses a wide range of new activities, to be implemented within the framework of "Neue Energien 2020", the Austrian Climate and Energy Fund's third call for proposals. Here Salzburg AG is collaborating with an interdisciplinary team of scientists and partners in industry.

Salzburg AG, the energy supplier for the province of Salzburg, is a multi-utility firm covering the fields of electricity supply, natural gas, district heating, water, telecommunications and transport. The vision of smart infrastructure for the showcase region of Salzburg requires convenient, intelligent, resource-conserving and integrated infrastructure, i.e. all subsystems, technologies and domains are integrated into a comprehensive system. The program links together and clusters all aspects that contribute to providing the energy service in demand. Alongside the technical issues, this approach includes the process of reaching decisions, planning, streamlining operation, defining the framework for action, asset management and analysing consumer behaviour. Here benefits to customers, and designing and managing the customer interfaces, are regarded as vital assets for the future. Integrated planning makes it possible to exploit synergies and to coordinate plans to expand or contract individual sectors better. Integrated planning is intended to link up the various fields of activity, from climate and energy policy via strategic network expansion planning right through to operating and maintaining equipment.

The program is being implemented on three levels. First, new (tentative) customer-oriented solutions for current headaches in real grid sectors are tried out in practice. Next, the findings from the various subprojects in the showcase region are to be amalgamated. Synergies, dependences and reciprocal relationships can be revealed when individual effects are overlapped; they should be viewed in terms of horizontal and vertical integration (see diagram below). Finally, it is intended to set up lighthouse facilities to demonstrate the integrated approach visibly and comprehensibly.



Source: Salzburg AG

Implementing the various lines of development is intended to achieve the following results:

- Convenient, flexible, efficient infrastructure matched to customer interests
- Large-scale use of renewable sources of energy
- Reduced peak loads
- Accumulating solid field experience, resulting in leadership in innovation for Austria and thus improved export opportunities
- Reduced CO_2 emissions and resource consumption

The core team in the project initiative is coordinated by Salzburg AG; it also includes the research institutes of Vienna Engineering University, plus the Energy Economics Group and the Institute of Computer Technology, the Austrian Institute of Technology and CURE (the Center for Usability Research & Engineering), with Siemens, Salzburg Wohnbau and Fichtner as partners from industry. With their excellent connexions within the Austrian research network, Salzburg AG utilize a variety of platforms for cooperation and exchanging know-how: these include national platforms such as Smart Grids Austria, for technology, or eConnected, and international cooperative link-ups such as Smart Grids D-A-CH, the multilateral European program network ERA-Net Smart Grids, and the International Energy Agency's Research Agreement.

MODULES FOR IMPLEMENTING THE SHOWCASE REGION OF SALZBURG

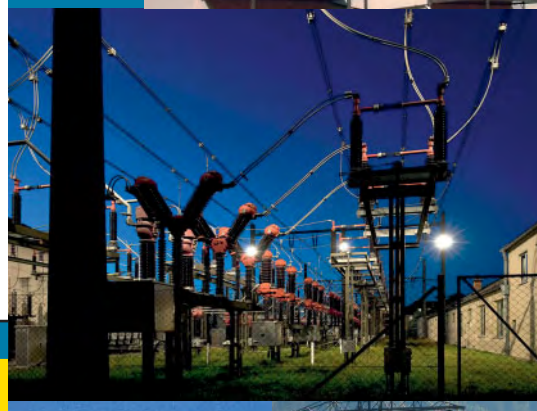
■ The research, development and demonstration projects for the "Smart Grids Showcase Region Salzburg" are mainly focussed on the topics active distribution grids, new technologies and intelligent strategic approaches (e.g. in district heating), electric-powered mobility and load and demand-side management. The results can be transferred to other showcase regions, and are synergetically coordinated with international activities in the smart-grid context. Scientific exchange with the D-A-CH countries is particularly close.

ACTIVE DISTRIBUTION GRIDS IN MEDIUM AND LOW-VOLTAGE GRIDS

Smart grids are designed to accomodate both conventional large-scale power plants and a variety of decentralized suppliers using renewable sources of energy, especially small-scale hydropower, but also wind power, photovoltaics and biomass. To take full advantage of such decentralized suppliers, distribution grids need new and improved control and optimization philosophies. In individual sections of the grid, e.g. in Lungau (part of the province of Salzburg), bottlenecks are already developing today as decentralized suppliers feed more power in. The two projects ZUQDE (central voltage(U) and power factor(Q) control with local feeds in) and DG Demo-Network Validation (an AIT "Austrian Institute of Technology" project, with Salzburg Netz GmbH as project partner) implement a centralized and a regional approach to intelligent control of a medium-voltage grid, respectively; these are tested in practice and the results compared. A further step will be a project to develop approaches to smart-grid system integration in low-voltage grids.

In the **ZUQDE project** the existing grid management system being enhanced with new online applications. Central control of voltage and power factor is to be implemented in two phases: in open-loop mode the operators check the setpoints worked out by the voltage and power factor control system for plausibility, before passing them to the controllers by hand, in closed-loop mode the setpoints are passed to the controllers by the grid management system directly, making fully automated operation possible. Implementing this intelligent centralized control setup for local suppliers makes it possible to take full advantage of spare capacity in the existing grid infrastructure, and thus for the grid to accommodate additional local suppliers more easily.

The approaches to voltage control developed in the two projects "DG Demo-Network" and BAVIS (cf. FF 5/2006) are to be implemented for real in selected sections of the grid in Vorarlberg und Salzburg, within the framework of **DG Demo-Network Validation**; the approaches in question will thus be subjected to a field test. The main aim of the project is to make it possible to integrate the maximum density of local suppliers using renewable sources of energy in the power distribution grid, without power lines needing to be made thicker. And with the new approaches to voltage control in use local power suppliers can, apart from generating electricity, provide grid services in the field of voltage stability that had been left to large power stations up till now.







CONSUMER2GRID AND BUILDING2GRID – LOAD AND DEMAND-SIDE MANAGEMENT

Smart Grids connect people and technology together intelligently. Two projects investigate the role of consumers as active participants ("Human in the Loop") and that of buildings as active, load-optimizing components in an intelligent energy system. The main aims are to find out how information for consumers should be presented (energy feedback) and what technologies can be employed in buildings to permit consumers to play an active part in an intelligent energy system and make the most efficient use of energy. In addition, the potential and benefits of smart metering are to be analysed.

Consumer2Grids analyses the role and behaviour of electricity consumers as active participants in a smart-grid environment. Various methods of feedback (established and experimental), combined with smart metering, provide the basis for this project, which is intended to identify practical ways of encouraging consumers to use energy more efficiently without any loss in convenience.

Building2Grids has as its starting-point buildings involving a substantial electrical load that have until now been managed so as to achieve an optimum from the perspective of the building in question (regardless of the current state of the power supply system). Here the aim is to take advantage of degrees of freedom that were previously unused in these buildings (such as retiming loads, load shedding or turndown), so as to optimize grid functioning. For instance, a building's thermal inertia can be utilized by cooling the building in advance when the grid is not operating at capacity, so that less power is needed at times of peak demand (e.g. at midday, when all air-conditioning systems are running). In this way, with the aid of intelligent, communicative building control systems, buildings are tied into the smart grid interactively and grid optimization coupled to building optimization. In actual fact selected buildings are concentrated into a load aggregate by means of building control systems and cooperative telecontrol. Load models to be developed for these load aggregates' specific local characteristics are intended to make it possible to anticipate future needs for control purposes, and to exploit potential that has been ignored until now. Results expected from this project include: generic load models, a tested and verified IT representation of the buildings compatible with smart grids, and well-founded statements (backed up by experiments) about the potential and usefulness of "active" buildings in a smart grid.

PEOPLE BUILDINGS

V2G (VEHICLE TO GRID) STRATEGIES AND INTERFACES

As more electric-powered vehicles come into use, there will be considerable opportunities to improve energy efficiency and reduce CO_2 emissions in the transport sector. Electric-powered mobility involves tough challenges for grid operators, but also opens up new perspectives. If a large number of electric-powered vehicles are simply connected to the grid and recharged without any form of coordination, this can lead to more extreme spikes in demand and to excessive grid loading. Smart-grid technologies could be employed for managing charging (by retiming loads) and to use the batteries for storage (with reverse flow to the grid), though, which would open up new optimization options. Here the aim is to integrate electric-powered mobility into the overall system intelligently and in a grid-oriented way, while accommodating mobility customers' future requirements and making the best possible use of the existing grid infrastructure. Starting from the experience gained in Salzburg AG's ElectroDrive program (which began providing complete electric-powered mobility packages in April 2009), the project **Vehicle to Grid (V2G) Interfaces** is to develop interactive portals for electric-powered mobility customers in the showcase region of Salzburg. Here the first step is to identify the data flows required and suitable business models within Salzburg AG. The communications systems already in use will be enhanced by means of new facilities (e.g. for administering and charging for energy services for electric-powered mobility customers). Together with the ElectroDrive program an implementation plan will be drawn up, to form the basis for a demonstration project planned in the showcase region of Salzburg. In the study **Studie Vehicle to Grid (V2G) Strategies**, to be carried out by the Institute for Electrical Equipment and Power Management at Vienna Engineering University and by Salzburg Netz GmbH, technological, economic and ecological consequences of massive penetration of the Austrian electricity system by electric-powered mobility (up to 2050) are to be investigated and strategies for actively integrating it in the grid developed. The following outputs are anticipated:

- Scenarios for developing electric-powered mobility in selected urban (Salzburg) and rural regions (Salzburg, Vorarlberg, Upper Austria) and throughout Austria up to 2050
- Customized strategies for charging and decharging, taking patterns of mobility, the grid characteristics of the charging infrastructure provided and the mix of generating sources into account
- Technology impact assessments for urban and rural distribution grids, employing new strategies of active integration in grids for G2V (Grid to Vehicle) and V2G (Vehicle to Grid)
- Cost/benefit analysis of several different nationwide business models

MOBILITY

MORE MODULES TO TURN SALZBURG INTO A SHOWCASE REGION

SMARTSYNERGY – POTENTIAL FOR ICT SYNERGIES

For smart-grid and electric-powered mobility applications many different forms of data and information must be collected over a wide area and distributed to the right addresses. Every single application involves its own special technical requirements, e.g. as regards the volume of data, real-time capability, data security, etc. These requirements have a considerable effect on the details technical implementation and thus on the cost of the requisite ICT infrastructure. The Smart Synergy project is concerned with working out ways of installing the ICT infrastructure for several applications cost-effectively and utilizing it for synergies, and with validating the potential actually available for synergies. The ICT requirements of the smart-grid and electric-powered mobility applications will be derived from the results of projects which Salzburg AG have completed or are now carrying out in various areas of relevance (geographical distribution, and qualitative and quantitative technical requirements). The next step will be to aggregate the various requirements and compare them with the existing telecommunications infrastructure in the showcase region. Then the potential for synergies between individual applications, and the extent to which the existing ICT infrastructure can be used, will be evaluated. The aim is to derive strategies for the expansion of ICT infrastructure needed in the showcase region of Salzburg.

COMMUNICATION

SMART HEAT NETWORKS

Until now smart-grids have been analysed and developed mainly in connexion with electrical grids. This project is intended to evaluate the potential of this approach for large and small-scale district heating grids as exemplified in the showcase region of Salzburg.
To reduce peak loads, an intelligent grid management system for large-scale district heating grids will be developed, using a selected small-scale district heating grid operated by Salzburg AG in the province of Salzburg as a test case. Various operating and control strategies can be tested by means of hydraulic and thermodynamic grid simulation tools, so as to narrow down the choice of measures that may help to improve ecological and economic performance. The next step will be to evaluate how well these strategies can be applied to the district heating grid in the city of Salzburg.
As output, guidelines for implementing optimized operating strategies will be developed, approaches that make economic and ecological sense worked out and the simulation results verified point by point.

HEAT

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(CURE)

FIGURES/DATA/FACTS

INFORMATION PUBLICATIONS

Final reports on the projects have been published by bmvit (in German) in the series "Berichte aus Energie- und Umweltforschung".

These reports can be downloaded from
www.NachhaltigWirtschaften.at

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