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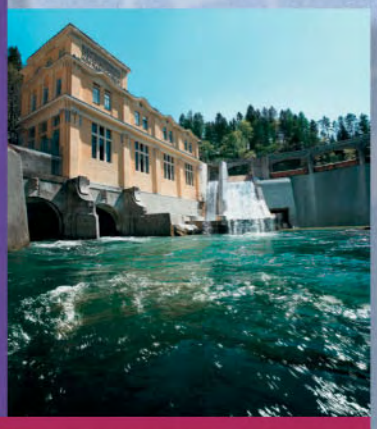
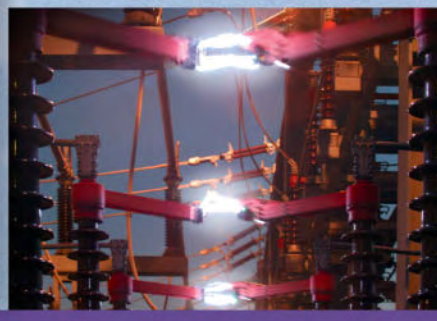




SMART GRIDS
PIONIER REGION UPPER AUSTRIA

STRATEGIES FOR A SUSTAINABLE ENERGY SYSTEM USING RENEWABLES TO THE FULL

bmvit
Austrian Federal Ministry of Transport,
Innovation and Technology

T O P I C

SUSTAINABLE ENERGY SUPPLY IN UPPER AUSTRIA – AIMS AND POTENTIAL

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.

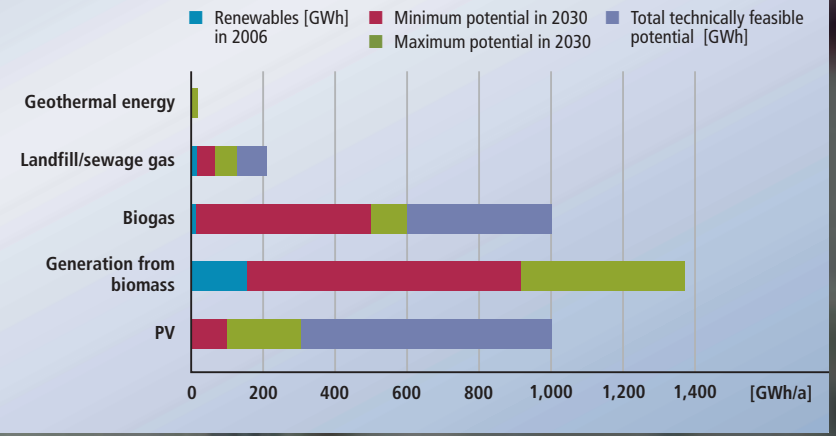
All over the world our energy systems are undergoing major restructuring. Energy policy aims such as improving energy efficiency, increasing the share of renewable sources of energy and reducing CO_2 emissions have long since found their way into legislation and regulations at the EU level (20-20-20 targets) and in the EU member states. As increasing use is made of renewable resources, the number of regional, peripheral energy suppliers grows – a real challenge for utility grids. Intelligent (smart) electricity grids capable of merging renewable sources of energy with established facilities by means of new technologies and ICT solutions are seen as the key to an efficient, sustainable energy supply system. At the same time energy efficiency in distribution and consumption should be improved and service quality for the customers boosted. As part of research initiatives backed by the Federal Ministry of Transport, Innovation and Technology (BMVIT) and the Austrian Climate and Energy Fund (Klima- und Energiefonds), a constant stream of R&D and demonstration projects are being implemented, helping to get pionier regions into shape for intelligent, sustainable energy systems.

The smart-grid activities in Upper Austria are based on the Provincial Government's energy strategy "Energy Future 2030", aimed at switching to renewables step by step in the case of space heating and electricity, while reducing CO_2 emissions and energy imports. That is what the "Energy Turnaround" scenario is meant to do. The strategy is based on a comprehensive assessment of the potential of renewables in Upper Austria.

The diagram below provides an overview of the extent to which renewables are already being used, of the potential that can be tapped by 2030, and of the technically feasible scope for using renewables (excluding hydroelectricity).

Electricity supply in Upper Austria is mainly in the hands of Energie AG Oberösterreich and LINZ AG. In 2005 both companies launched grid subsidiaries of their own: Energie AG Oberösterreich Netz GmbH and LINZ STROM Netz GmbH. Energie AG Oberösterreich Netz GmbH operates a grid supplying electricity to the bulk of Upper Austrian consumers (plus some in Salzburg, Styria and Lower Austria), whereas LINZ STROM Netz GmbH concentrates on the city of Linz and 82 neighbouring communities. Building on the findings from numerous research projects, both companies are developing stable business models with which Upper Austria's energy policy targets can be met step by step. Forthcoming research will increasingly be aimed at developing comprehensive, intelligent strategies for "smart cities" and "smart urban regions".

Potential for generating electricity in Upper Austria



Source: Energiezukunft 2030

In Upper Austria's energy policy large-scale expansion of photovoltaic generation plays a central part. New energy systems with a variety of different suppliers are intended to make it possible to utilize the potential of PV. Electricity supply structures of this kind mainly rely on renewable sources of energy, while taking full advantage of control and conservation options at the consumer's end and utilizing all components' potential for optimization, particularly at the low-voltage level.

P R O J E C T S

MODULES FOR REALIZING THE SMART GRIDS PIONIER REGION UPPER AUSTRIA

SMART METERING
NEW SERVICES FOR ELECTRICITY CONSUMERS

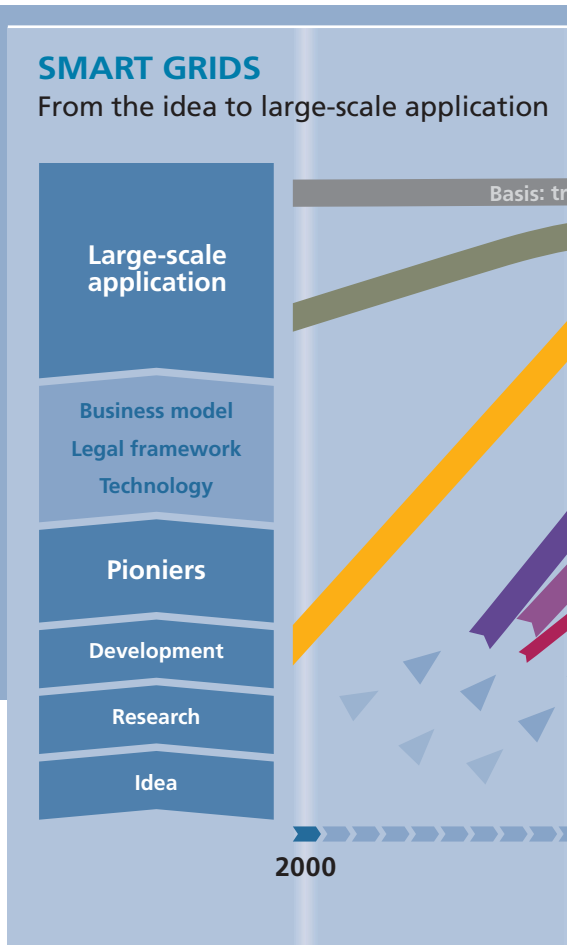
Both Energie AG Oberösterreich and LINZ AG started early on implementing and testing smart functions in real life. Experience from the first rollout of smart meters, involving a variety of technologies and manufacturers, is currently being analysed. This will benefit both grid operators at the stage of large-scale implementation, as each can take advantage of the other's experience. The facilities provided make it possible not only to automate metering for billing purposes and for registering, deregistering and reregistering, but also to optimize internal processes at the customer's end. With the introduction of smart metering, new services, such as detailed information about consumption patterns, tips on energy conservation or offers based on new tariff models, are provided to customers. By means of smart metering systems it is also possible to obtain data on voltage levels in the distribution grid, as a basis for operating the grid more efficiently. In addition, two-way data transfer becomes possible, making switching and other smart functions feasible. Meanwhile the confidentiality of the individual customer's data is ensured. Data transfer is by DLC (Distribution Line Communication) via the power line. The data obtained are passed to data concentrators at the sub-transformers, then packaged and transmitted to the grid operator via optical cables, radio data transmission or GPRS links.

Energie AG Oberösterreich employ the Siemens AMIS package to collect the data on the customers' electricity consumption, plus data from the grid infrastructure. Arrangements to tie in meters for other utilities (such as gas, district heating, water) are already in place. Work is in progress on demand-side management, additional service options and integrating electric vehicles. By mid 2012 roughly 100,000 and by 2020 about 500,000 customers will be equipped with the new meter technology. Since 2007 LINZ AG have, together with their partner ubitronix system solutions GmbH, equipped around 50,000 households with Echelon electronic electricity meters. The data are transmitted to headquarters in Linz on the basis of individual agreements. The system is used to read electricity and gas meters and to transmit grid data; it is planned to extend it to cover other utilities (gas, district heating, water etc.). Within the next ten years 240,000 meters throughout the service area are to be upgraded to smart meters.

S T R A T E G Y

MAXIRES – Maximum Renewable Energy Sources for Upper Austria

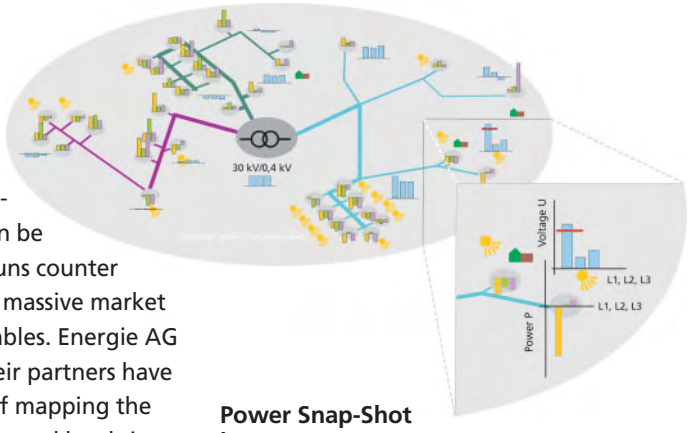
Both electricity suppliers in Upper Austria are carrying out several research, development and demonstration projects in the smart-grid field, and are working out innovative solutions for smart technologies and applications and new services for their customers. This provides a firm footing for restructuring the electricity supply system step by step, and for integrating peripheral contributions from renewable resources. Both companies take advantage of opportunities to collaborate. The long-term strategy for Smart Grid activities in Upper Austria is shown in the diagram on the right. The strategic starting-point is summed up in the acronym MaxIRES (Maximum Renewable Energy Sources). Further development and implementation are to be pushed ahead in close cooperation between the two key players, Energie AG Oberösterreich and LINZ AG, with support from the Federal Ministry of Transport, Innovation and Technology (BMVIT) and the Austrian Climate and Energy Fund (Klima- und Energiefonds) in the context of research initiatives.



As renewable sources of energy are tapped more widely, electricity generation becomes increasingly decentralized – and this imposes entirely new demands on grids. Building on preliminary scientific work and on the rollout of smart meters, the long-term aim is to develop innovative ways of integrating peripheral generating facilities such as photovoltaic systems or wind farms, in both medium-voltage and low-voltage grids. With conventional technology in place, coping with distributed generation on a large scale involves a great deal of expenditure. Innovative planning strategies, appropriate technologies and stable business models for smart planning, smart monitoring and smart control make solutions with much better cost/benefit ratios possible.

Eyes in the grid – ISOLVES: PSSA-M (Power Snap-Shot Analysis by Meters)

The existing low-voltage grid is not designed to accommodate feeding in significant amounts of electricity from peripheral generating facilities such as photovoltaic systems. As things stand, the operative decisions this requires still have to be based on individual calculations and on estimating load peaks in individual segments of the grid. To ensure that the voltage stays within defined limits, ample safety margins are added – severely restricting the number of additional distributed generating facilities that can be accomodated, which runs counter to the political goal of massive market penetration by renewables. Energie AG Oberösterreich and their partners have developed a method of mapping the actual voltages and demand levels in low-voltage grids in town and country: "Power Snap-Shot Analysis by Meters". Smart meters provide the necessary data. Data gathered in roughly 100 representative local grids are used to characterize the state of the grid and construct appropriate grid models; this makes it possible to improve grid planning and grid operation significantly, and to develop support tools for operation.



Power Snap-Shot by Meters

Source: Energie AG Oberösterreich

Information flows in electrical energy system – IRON Concept

To date there is little or no communication with consumers or small suppliers in the power grid. Project IRON (LINZ AG and partners) explored market-oriented ways of utilizing efficiency-boosting potential that has not yet been tapped. The focus was largely on load management, in which the main concern is with rescheduling loads over time. Both consumers and suppliers can be influenced only if a communications infrastructure based on smart metering is in place. The technical models looked into will be evaluated in follow-up projects, mainly in terms of their economic aspects.

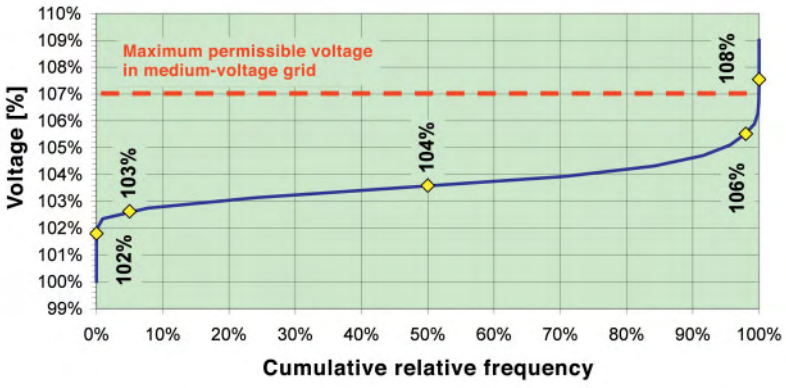
Smart network planning – Probabilistic assessment

In the Smart Planning project, which builds on the IRON Concept, LINZ AG are working on new planning methods for connecting additional peripheral suppliers to the grid. In a demonstration project the economic advantages of switching from conventional planning to a new assessment approach, probabilistic planning, are being established.

The benefits from this method have already been demonstrated in two scenarios: feeding power from several PV units into a low-voltage grid, and from a planned wind farm into a medium-voltage grid. In conventional assessment the assumption is "Maximum load under the least favourable operating conditions"; evaluation is carried out for peak load and off-peak load (in each case with and without power fed in). The result obtained is that with power fed in the voltage exceeds the permissible ceiling, i.e. it would be necessary to reduce the feed-in rate.

The new assessment method relies on statistical assumptions about the behaviour of the factors influencing the system. The aim is to compute the probable voltage at the connection point, taking the stochastic behaviour of all consumers and suppliers into account. Examples reveal that the voltage at the connection point only occasionally exceeds the permissible ceiling. If the grid operator can cap suppliers briefly as soon as the voltage reaches this ceiling, a much higher rating can be connected to the grid (without investment in conventional technologies).

Results of probabilistic assessment



DG DEMONET – Active distribution grid operation in medium-voltage grid

Together with scientific institutes and other grid operators, Energie AG Oberösterreich have developed four innovative control strategies with which to stay within voltage limits and ensure a reliable power supply even with increased peripheral feed-in (e.g. from wind farms or hydro generators). In the current validation phase these strategies are being implemented under real-life conditions in the form of test platforms in two grid sections, in collaboration with VKW Vorarlberger Kraftwerke AG and Salzburg AG. In the future scenario the assumption is that in Energie AG Oberösterreich's service area mainly PV units will be added. Energie AG Oberösterreich are making their know-how available during validation, and investigating how widely the solutions are applicable; as part of this the time series data from years of measuring voltages in medium-voltage grid branches are evaluated, and potential assessed.

SMART LV GRID – Integrating peripheral electricity suppliers in low-voltage grids

With the spread of PV units on a large scale, more and more consumers (households) will become electricity suppliers too in future. Both these small-scale suppliers and other new grid participants, such as electric vehicles, present major challenges to low-voltage grids. It will thus be necessary to monitor grid operation throughout, and to intervene actively to ensure that the system constraints are complied with. The project DG Demonet Smart LV Grid, which Energie AG Oberösterreich, LINZ STROM Netz GmbH and Salzburg Netz GmbH are implementing together with partners in science and industry, is focussed on developing and evaluating intelligent planning, monitoring, management and control approaches to integrating peripheral electricity suppliers and flexible loads (such as heat storage or electric vehicles) in low-voltage grids systematically. Here existing infrastructure and new technologies, such as the smart metering communications systems, are to be utilized efficiently as regards energy and costs. As part of the project PV capacities in selected locations will be massively expanded, such that in the absence of adaptive measures the grid would be unable to cope. Suitable solutions will be developed by means of co-simulation in communications and power grids. These approaches are to be evaluated as a basis for developing future technologies, standards, connection criteria and models for feeding in.

P R O J E C T I N F O

R&D – PROJECTS AND PROJECT PARTNERS

■ **Smart Metering – Energie AG Oberösterreich**
Project partners: Siemens Energy Automation GmbH & Co. KG (AMIS),
SAP AG (process automation)
Status: completed

■ **Smart Energy Management – LINZ AG**
Project partners: ubitronix system solutions GmbH (software), Echelon GmbH (electricity meters), Pilot project to integrate multiple utilities – gas meters (Flonidan), district heat meters (Kamstrup), water meters (EWT), street lighting (Siteco), home automation (Moeller)
Status: completed

■ **DG (Distributed Generation) Demonet Strategy – BAVIS – DG Demonet Validation**
Active operation of electricity distribution grids with a large share of peripheral suppliers – designing and testing demonstration grids
Project partners: AIT Austrian Institute of Technology, Energie AG Oberösterreich, Salzburg AG, VKW Vorarlberger Kraftwerke AG, ICT Institute of Computer Technology / Vienna University of Technology, Energy Economics Group / Vienna University of Technology
As part of the programs:
"Energiesysteme der Zukunft", BMVIT / „Neue Energien 2020", Klima- und Energiefonds
Status: in progress

■ **ISOLVES: PSSA-M**
Innovative Solutions to Optimise Low Voltage Electricity Systems:
Power Snap-Shot Analysis by Meters
Project partners: AIT Austrian Institute of Technology, Siemens AG Österreich, Energie AG Oberösterreich Netz GmbH, Salzburg Netz GmbH, Wien Energie Stromnetz GmbH
As part of the programs:
"Energiesysteme der Zukunft", BMVIT / „Neue Energien 2020", Klima- und Energiefonds
Status: in progress

■ **DG Demonet smart LV Grid**
Control concepts for active low voltage network operation
with a high share of distributed energy resources
Project partners: AIT Austrian Institute of Technology, Energie AG Oberösterreich Netz GmbH, LINZ STROM Netz GmbH, Salzburg Netz GmbH, BEWAG Netz GmbH, Siemens AG Österreich, ICT Institute of Computer Technology / Vienna University of Technology, Energy Economics Group / Vienna University of Technology, Fronius International GmbH
As part of the programs:
"Energiesysteme der Zukunft", BMVIT / „Neue Energien 2020", Klima- und Energiefonds
Status: in progress since 03/2011

■ **IRON Concept**
Project partners: LINZ STROM GmbH, Sonnenplatz Großschönau GmbH,
Envidatec GmbH, ICT Institute of Computer Technology / Vienna University of Technology,
Lawrence Berkeley National Laboratory, USA
As part of the programs:
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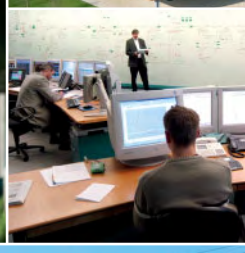

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INFORMATION PUBLICATIONS

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

A full list of these reports, and facilities for downloading them, are to be found on the website:
www.NachhaltigWirtschaften.at

Further informations:
www.ENERGIESYSTEMEderZukunft.at/highlights/smartgrids

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