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energy innovation austria

Current developments and examples of sustainable energy technologies

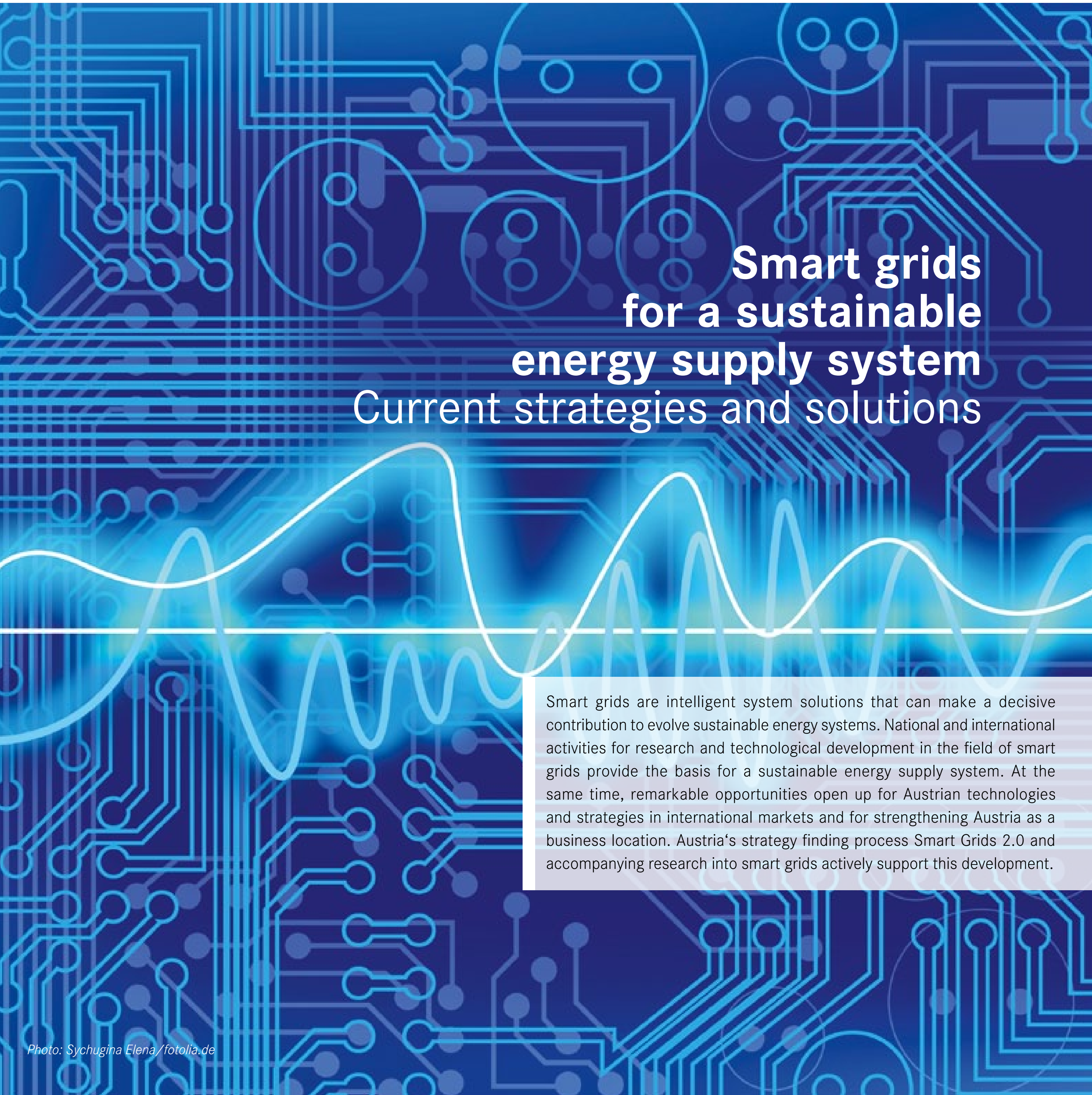

Photo: Sychugina Elena/fotolia.de

Smart grids for a sustainable energy supply system
Current strategies and solutions

Smart grids are intelligent system solutions that can make a decisive contribution to evolve sustainable energy systems. National and international activities for research and technological development in the field of smart grids provide the basis for a sustainable energy supply system. At the same time, remarkable opportunities open up for Austrian technologies and strategies in international markets and for strengthening Austria as a business location. Austria's strategy finding process Smart Grids 2.0 and accompanying research into smart grids actively support this development.

Photo: Gina Sanders/fotolia.de

SMART GRIDS 2.0
Strategy finding process for tomorrow's sustainable energy system

Smart grid technologies and approaches can play a vital part in sustainable energy systems; they help to cope with the challenges we face as the number of local providers feeding in electricity from renewables at fluctuating rates goes up, while demand for electricity-based services increases. This is carried out by communicatively linking together particular components such as local generating and storage facilities, flexible consumers and intelligent buildings. Here interesting prospects open up for decentralized and self-organized approaches.

In addition, smart grids also can help to improve energy efficiency and make the power supply more reliable throughout the power supply system. Some technologies for smart grid solutions are already available today; however, they need to be optimized and assembled into a system to be introduced into distribution networks on a larger scale.

Within Europe Austria is a pioneer in developing smart energy systems and implementing demonstration projects, with electricity suppliers, industry and researchers all playing a part. The Federal Ministry for Transport, Innovation and Technology (bmvit) actively supports this development via the strategy finding process smart grids 2.0, in which numerous stakeholders from the power supply industry, industry in general and research organizations collaborate closely, with the aim of evaluating the results obtained to date from research and demonstration and deriving medium-term strategies and concrete plans of action for Austria from these.

The strategy finding process Smart Grids 2.0 builds on three pillars: the Technology Roadmap for smart grids in and from Austria, the Strategic Research Agenda in the field of smart energy systems in and from Austria, and initial elements (worked out with the help of a wide range of contributors) of a strategy for introducing smart grids.
>> www.e2050.at/smartgrids (in German)

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Key messages from the strategy finding process Smart Grids 2.0

Decentralizing and participation need an interactive power system – smart grids must provide an arena for citizen involvement

Smart energy strategies make sense for the economy as a whole – provided that costs and benefits are assigned in the right way

Flexibility options for a dynamic energy system exist – we must tap them cost-effectively

Smart services bring the smart grid to life – we must cooperate on digging up the "buried" data

Reliability of supply, resilience and data privacy have top priority – they must be integral design parameters for smart grids

Austria is exceptionally good at developing smart grid components and system solutions; we must strengthen Austria's position as an engineering location, so as to take full advantage of international opportunities for Austrian business

Strategic Research Agenda
for developing an intelligent energy system in and from Austria

published by bmvit and AIT Austrian Institute of Technology GmbH

The extent of the long-term need for research toward a sustainable, optimized energy infrastructure has been worked out within the Strategic Research Agenda (SRA). In a participative process involving all Austrian players who are active in this research field, the relevant topics for the transition to integrated energy and ICT infrastructures have been viewed in a comprehensive perspective, and synergies identified.

With a focus on interdisciplinary and systemic issues, the extent of the necessary research has been defined in detail for the following four areas: developing spatially specific infrastructure covering all sources of energy, the governance of the energy turnaround, the electricity system and grid-bound provision of heat and cold. Information and communication technologies (ICT), storage technologies and aspects of energy efficiency, which are relevant for all energy networks and for developing new business models, have been grouped together as cross-cutting issues.

With the Strategic Research Agenda Austria intends to provide crucial support for the key aims of the European Energy Union: to make the power supply more reliable by diversifying across sources of energy and using the energy provided more efficiently, a completely integrated European market for energy, as well as climate protection and reduction of emissions to achieve the climate targets agreed in Paris in 2015.

>> www.nachhaltigwirtschaften.at/e2050/results.html/id7500 (in German)

"The energy system for 2050 is based on an infrastructure integrated across all domains of energy technologies, with an extremely large share of energy from renewables, taking social justice in a changing society into account. Many users of the energy grids do play an active part as providers of energy or of storage and flexibility services. Once pioneering solutions for designing energy-efficient, sustainable, resilient energy systems have been introduced in the Austrian market, there is a demand for them in many other countries."

Vision for tomorrow's intelligent energy system in Austria, Strategic Research Agenda

Technology Roadmap for smart grids in and from Austria
Steps to implement the transition of the power system up to 2020

published by bmvit & Technologieplattform Smart Grids Austria

The Technology Roadmap deals with the short and medium-term development steps for establishing smart grids in Austria, all the way to developing and implementing saleable products and services industrially. Here the focus is on the period up to 2020. The path to implementing smart grid solutions on a broad front should take the following course: designing the framework, applied research and further development, validating technologies that are already worked out in the system context and the implementation phase. In the Roadmap realizing and fine-tuning the individual solutions is viewed along three development axes: grid, system and final customers. A comprehensive ICT architecture provides the foundation for the various technologies and solutions. In the Roadmap the actions required from the key stakeholders, such as public institutions, network operators, technology providers and research organizations, are specified in detail.

>> www.nachhaltigwirtschaften.at/e2050/results.html/id7489 (in German)

Photo: VioNet/fotolia.de

Development of initial elements for introducing smart grids
in the strategy finding process Smart Grids 2.0

As the third pillar of the strategy finding process Smart Grids 2.0, workshops with experts are held; in these selected topics are discussed, and national research activities are evaluated and fitted into an overall picture together with international findings (Management: B.A.U.M. Consulting). The strategy finding process thus provides an open space for established and new stakeholders to design a widely acceptable framework for decisions and develop elements to implement smart grids in practice.

>> www.nachhaltigwirtschaften.at/e2050/results.html/id7512

Photo: avantsmart

Interview with Hemma Bieser, avantsmart coordinator and chair of the smart service activities within the strategy finding process Smart Grids 2.0

Why are new services and business models so important for disseminating smart grids?

We are currently going through a major transformation process: digitalizing all areas of work and life. Companies such as Google, Apple or Amazon develop digital technologies and launch them in the market with innovative business models – with the focus on the customer. This people-centred approach is exactly what we need for designing the energy systems of the future, too. A number of technologies are already sufficiently mature; now we must get them to market with new business models.

Which business models might be of particular interest to customers?

Business models which offer customers monetary benefits have obvious attractions. Packages aimed at households with high energy consumption and at commercial customers are already available in the market. By means of consumption monitoring and specific tips on economizing one can benefit financially, even allowing for the cost of this energy service. Looking further ahead into the future, we are discussing business models that build on current trends. Take the idea of a sharing economy: there is no need for each of us to own one of everything – instead people share a solar facility, say, which can be crowd-funded. The shareholders receive electricity, can trade with it in a peer group, or even donate it to third parties if they like. These ideas for business models are based on data on provision and consumption and on appropriate software facilities.

Which target groups will be addressed?

Every business model is aimed at very specific target groups - ranging from private households to companies or electricity suppliers. In developing new business models and services one must be aware of the needs of the various categories of customer. The tenants of flats in towns are e. g. interested in "renewables first" models, because they have no property and may still wish to join in the energy turnaround. On the other hand, financially independent houseowners on the outskirts have money to invest in solar facilities, household power storage or electric cars. For each group of customers the right business model must be developed; data analysis can be employed to get a clearer picture of behaviour and motives.

>> www.avantsmart.at

Smart Services
for tomorrow's energy system

More and more people are investing in renewables and energy efficiency, and will become active participants in the energy system. The digital transformation of the systems provides the basis for new business models and smart services. In tomorrow's energy system data from various sources will be available on a large scale; this will open up new market opportunities for ICT-related services that go far beyond indicating and invoicing electricity consumption transparently. As part of the strategy finding process Smart Grids 2.0, the technical and organizational prerequisites for smart energy services are being discussed, and impulses for developing pioneering services and business models placed.

The **Vienna start-up Grid Singularity – GSy GmbH** is currently collaborating with worldwide leading IT-specialists (www.ethcore.io) on developing a decentral web-based platform for energy data management and exchange, using blockchain technology. With this pioneering technology key data can be recorded in real time and protected against subsequent changing; it should become a valuable tool for all participants in the energy market (providers, network operators, investors, traders and consumers). The platform has the great advantage of being interoperable, which results in significant savings in infrastructure costs.

>> www.gridsingularity.com

Photo: private

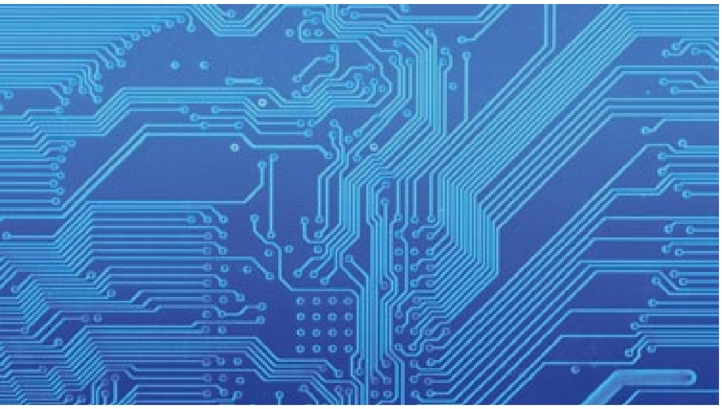
"Our main goals are to simplify the energy market to the complexity level of downloading an app on a smartphone and reduce the enormous entry fee cost into the energy market. The decentralised and interoperable character of the platform is further enhanced by the auditable fact that every user keeps exclusive access and control over his data. Think of Google without Google in the middle."

Ewald Hesse, CEO Grid Singularity - GSy GmbH

Smart grids
for reducing backup capacities

With the increasing share of renewable energy in power generation, it may be necessary in future to provide backup capacity in the form of rapid-response power stations, so as to tide over supply shortfalls. In today's electricity market only the amount of electricity actually supplied is paid for, not providing generating capacity; hence the expression "energy-only market". As the share of power from renewables grows, while bulk prices for electricity go down, many conventional power stations become unprofitable to operate; a shortage of assured generating capacity might result.

The idea of introducing so-called "capacity markets" for electricity, where assured generating capacity is traded, rather than electricity consumed, is currently being discussed. Smart grids could be an alternative or a supplement to these. If flexibility from demand side and generation in a smart grid were encouraged (e. g. by means of load management and storage facilities), there would be much less need to invest in additional backup capacities.



Simulating the energy system of 2050

Researchers at the Institute of Energy Systems and Electrical Drives at TU Wien (Vienna University of Technology) investigated whether more load flexibility would make it possible to reduce backup capacities. To do this, an energy system for Germany and Austria in 2050 was simulated, in which carbon dioxide emissions from the electricity and heat sectors were 88 % lower than in 2011. The HiREPS simulation model developed at TU Wien was employed to determine how much more load flexibility would be required for this. The model identifies the necessary mix of power station capacities (renewables and fossil fuels) on the basis of detailed profiles for power generation, consumption and storage, plus future technology costs and targets for reducing carbon dioxide emissions.

Photo: shooting star

"In connection with smart grids the potential for exploiting flexibility – whether by rescheduling electrical loads or by cogenerating power and heat – is frequently presented as the solution to implement the energy policy change. However, the project "Smart Grid Backup" has shown that existing restrictions e. g. of production processes severely limit this potential. So flexibility must count only as one component of several important elements, such as efficiency, storage facilities and/or backup generating capacity."

Wolfgang Prüggler,
MOOSMOAR Energies OG, previously project manager at TU Wien (Vienna University of Technology)

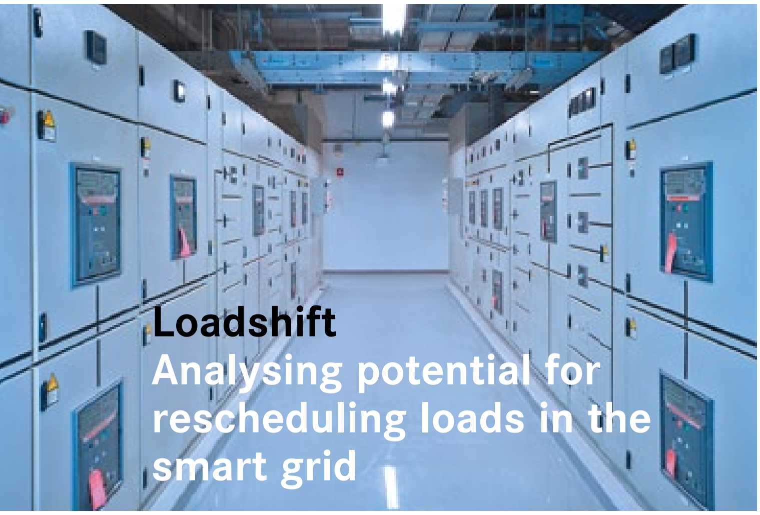
Load flexibility in a smart grid

Analysis reveals that if the existing potential in the field of industrial load management is tapped and the electricity and heat sectors (power-to-heat) are coupled together flexibly, roughly 7 GW of electricity generating capacity could be saved in Germany and Austria. To achieve this, increased load flexibility of 5.8 GW in industry and 58 GW in the power-to-heat sector would be necessary. According to the calculations the backup capacities required could be reduced by roughly 5 %. The largest potential for capacity savings from industrial load management was found in chlorine and steel plants.

Cost-effectiveness

In the simulated energy system for 2050 the savings in fossil-fuel power-station capacity would contribute roughly 3.8 billion Euros to gross earnings. This could be used to implement the new technologies for more system flexibility. In the case of industrial applications and large power-to-heat facilities the cost of ICT infrastructure is not very significant; the main cost factor is compensation for the variable costs of rescheduling or shedding loads. However, ICT infrastructure costs have a considerable impact on profitability in the case of small-scale facilities (e. g. heat pumps in households). Here overall system efficiency could be improved if the ICT technologies were used synergetically for additional services (e. g. information or automation facilities). ◘

>> www.nachhaltigwirtschaften.at/e2050/publikationen/view.html/id1323 (in German)



Loadshift
Analysing potential for rescheduling loads in the smart grid

Photo: vorclub/fotolia.de

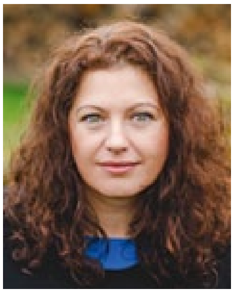


Photo: private

"The twin projects Loadshift and Flex-Tarif have made it clear that in tomorrow's energy system there will be no "one size fits all" solution. Different groups of customers in industry, commerce and households have individual wishes, demands and goals. In the years to come the challenge will be to achieve a clearer grasp of how to cope with this individuality while ensuring that the supply of energy stays reliable and efficient."

Andrea Kollmann
Project Manager, Department of Energy Supply and Use
Energy Institute at Johannes Kepler University Linz

Strategies for rescheduling loads in the grid – alongside network expansion, pioneering storage technologies and implementing new measuring, information and communication technologies – can help to ensure that our power supply facilities are secure and the system is efficient in future, too.

As part of the **Loadshift project**, experts of the Energy Institute at Johannes Kepler University (JKU) Linz identified the potential for rescheduling loads in Austria, and analysed the relevant economic, technical and legal aspects. The researchers differentiated the sectors households, industry, commerce and communal infrastructure, estimated the costs incurred with differing levels of potential exploitation, and derived cost curves for Austria.

Rescheduling loads in industry & commerce

In the literature the maximum technical potential for reducing load at the consumer end in Austria's industry is estimated at 664 MW; this includes also the service sector and public administration.
(Source: Abschätzung des maximalen technischen Potenzials für verbraucherseitige Lastreduktion in Österreich, Gutschi and Stigler, 2008 (in German))

Starting from this assessment, the Loadshift project examined six different industrial and commercial sectors. Analysis revealed that firms in the cement industry, certain chemicals firms and the paper industry have the largest rescheduling potential. Here the cement industry does best costwise, at less than 100 Euro/MWh. The largest potential is in the paper industry, which is one of the biggest power consumers in production, at 4,614 GWh per annum. For the paper industry, taking the timber yard, processing waste paper and making wood pulp into account, the analysis assessed load rescheduling potential at roughly 215 to 265 MW, at a cost of around 200 Euro/MWh.

In the commercial sector refrigerating food and air-conditioning service buildings are candidates, since (thermal) storage facilities are on hand in both cases. There is significant potential here for load rescheduling with a duration of at most 60 minutes.

Potential in households & electric-powered vehicles

In households the largest load-scheduling potential is available in connection with space heating and supplying hot water. In general tying in instrumentation, information and communication technologies at the household level is seen as a prime mover for implementing smart grids. At the moment private electric vehicles play little part in Austria as regards load rescheduling; one of the inhibiting factors is that frequent charging and running down shortens accumulators' service life. With an increasing number of electric cars and a more developed accumulator technology, this sector might reach a size large enough to be relevant for load rescheduling.

Strategies for communities

As part of the project the possibilities offered by plant and process engineering of rescheduling electrical loads in the field of community sewage disposal were investigated, and a case study was carried out in the Lower Austrian community of Großschönau to show how a local community can implement load rescheduling measures in practice. To date there is no visible economic incentive to invest in more load flexibility for sewage treatment plants and water supply systems. It might be of interest to take advantage of the degree of flexibility detected when new business models, such as pooling several communities' facilities, start to play a part. ◘

>> www.nachhaltigwirtschaften.at/e2050/publikationen/view.html/id1335 (in German)

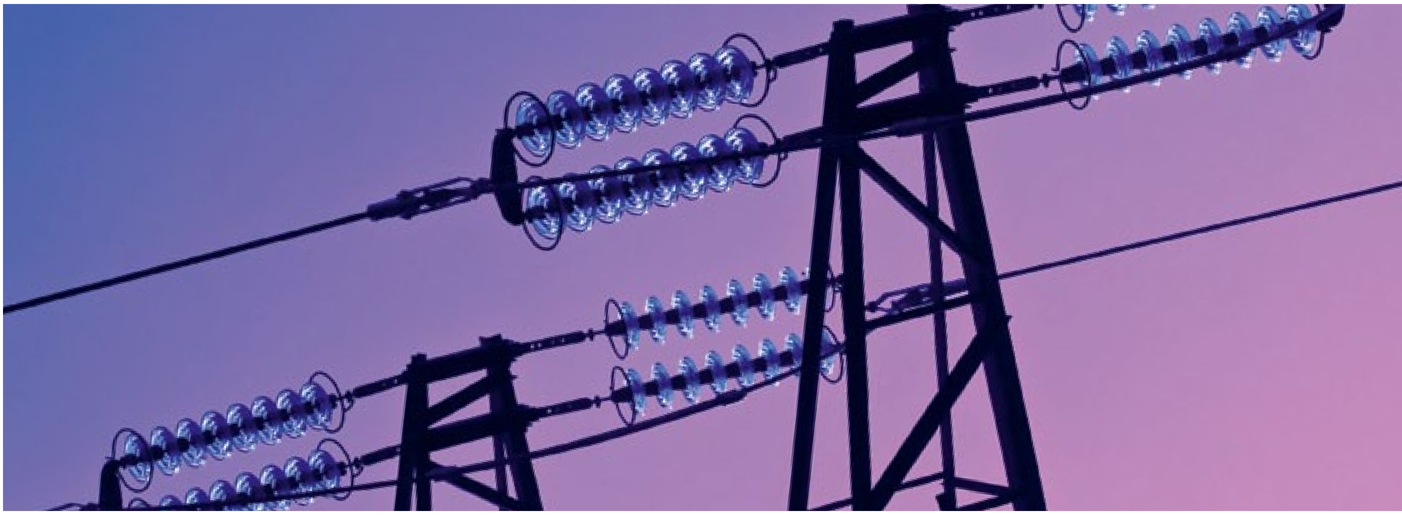


Photo: Gina Sanders/fotolia.de

Flexible tariffs
to direct load flows in the power supply system

Intelligent grids, smart meters and equipping buildings with modern devices that can be actuated by means of information and communication technology (smart homes/smart buildings) are an excellent basis for load rescheduling (to some extent automated) at low cost. Within the **"Flex-Tarif"** project researchers at Johannes Kepler University (JKU) Linz investigated flexible electricity prices and charges in the context of opportunities to reschedule loads in households and companies.

Households, commerce and industry as addressees and providers of load rescheduling, as well as network operators and power suppliers as customers, make up the participants in the load rescheduling market. Actually rescheduling a load and selecting a flexible tariff must have advantages for both providers and customers. Apart from technical and legal prerequisites, motivation and special interests in the various customer segments are decisive when it comes to implementing load rescheduling. Customer and market segmentation is necessary so that differentiated, flexible electricity tariffs can be developed for different groups of customers in the future. Communication between the various stakeholders plays a vital part here.

In the **small-customer sector** households and small commercial operations were examined as part of the project; these are invoiced without power factor measurement to date. It can be assumed that by 2025 smart meters will be installed everywhere, power factor measurement will be possible and flexible tariff models will gain acceptance with particular target groups.

In the long term the interests of grid and market should be harmonized intelligently by means of a so-called **traffic-light system**, in which customers can react freely to the market price during the green phase (when a reliable supply is assured), whereas no choice is possible in the red phase (critical for reliable supply) and only restricted choices are possible during the orange (transition) phase.

This approach is seen as making sense for **large consumers**, too; since some automation potential already exists here and the extent of modifiable loads/consumption levels is greater, it is easier to implement than in the small-consumer sector. ◘

>> www.nachhaltigwirtschaften.at/e2050/publikationen/view.html/id1324 (in German)

Flexible tariffs

Tariffs have two components: an electricity price and network charges. Charges are (regulated) tariff elements, either flat-rate or kW and/or kWh-dependent; prices are unregulated tariff elements for electricity. Flexible tariffs comprise all elements that influence demand, such as switchable, dynamic tariffs (real-time pricing) or time-dependent tariffs (time of use).

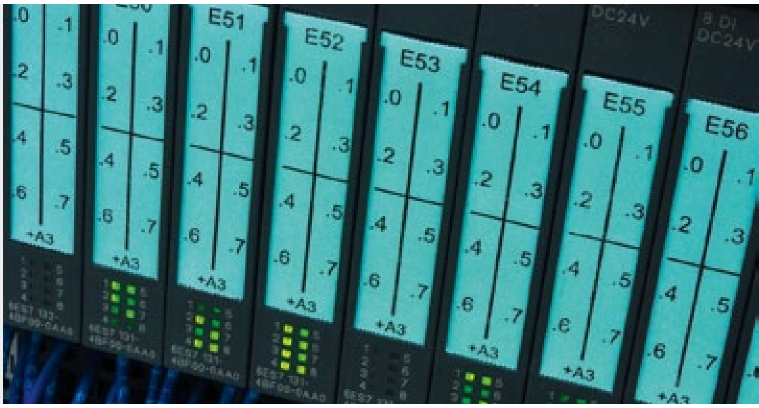


Photo: tdrechsler/fotolia.de

Photo: AIT

Helfried Brunner
AIT Austrian Institute of Technology

You are actively involved in the Austrian strategy finding process Smart Grids 2.0 and have been in charge of the work on the Strategic Research Agenda. What is your opinion on developments so far in the field of smart grid technologies in Austria?
Previous strategic work, combined with a pro-innovation aid system, has provided an excellent basis for initiatives in which industry, electricity suppliers, infrastructure operators and researchers all participate, making Austria an international pioneer – both in the development of technologies e.g. to increase distribution grids' capacity to cope with renewables, and in the development of services that underlie the process.

What will the next steps be toward implementing a sustainable energy system?
The current focus is on developing methods and strategies for the individual energy domains (power, gas and heat), with increasing attention to the interfaces between them (hybrid networks). That will be the basis for the next step: exploring tomorrow's energy system across all domains (an interdisciplinary, integrated and systemic task). And then the focus will shift to further developing the energy system (integrated in real life) using the experience gathered.

In which areas is there the most need of research?
Apart from developing individual technologies and system solutions further, one central aspect is reducing planning uncertainty when these are put to work in the highly cross-linked energy system. So we need simple methods and tools, to equip both infrastructure operators and industry for evaluating when and which solution is most suitable where.

How are Austria's activities in the field of smart grids tied in internationally?
The Austrian activities in the field of smart grids are not seen as separate from international initiatives. Tying in goes both ways: the discussions and developments in individual international initiatives, such as those of the International Energy Agency or the European Research Alliance, play a part in the Austrian developments and the international cross-linking of our own activities, such as the participation of Austrian pilot projects in international research programmes, ensures that the strategies developed here find their way into international initiatives.

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INFORMATION

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