energy innovation austria

IEA 2015

Current developments and examples of sustainable energy technologies

Worldwide collaboration on research for the future of our energy supply

Austria‘s contributions as part of the International Energy Agency‘s Energy Technology Network

Austria has been a member of the International Energy Agency (IEA) since it was launched in 1974, and has increasingly contributed to international collaboration on research in the IEA‘s Energy Technology Network. This issue of “energy innovation austria” surveys Austria‘s involvement and presents selected technological initiatives and both international and national research projects.

Source: Jumpeestudio, fotolia.com

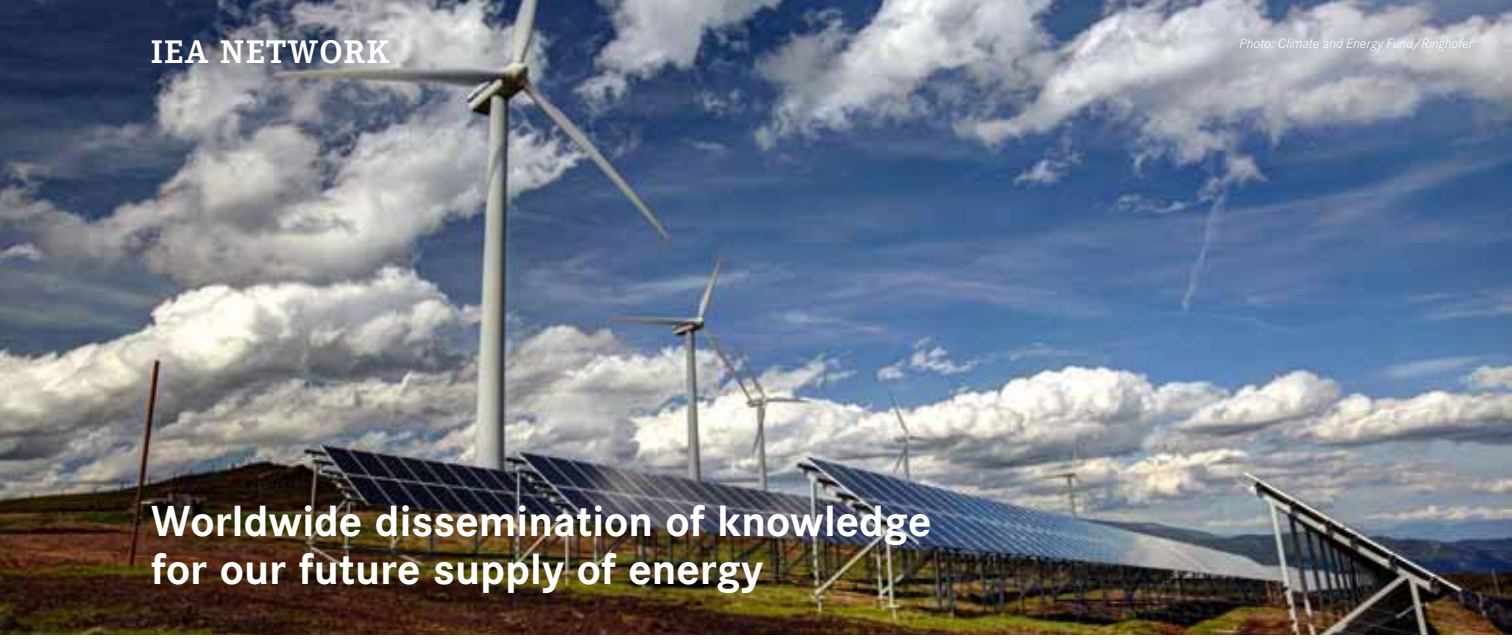


Photo: Climate and Energy Fund/Ringhofer

Worldwide dissemination of knowledge for our future supply of energy

Until the mid 1970's energy supply policy was a side issue for the industrialized nations: all the energy services needed could be provided with the fossil sources of energy available in the market. The oil crisis in October 1973 was a turning-point in national and international energy policies – for the first time the extent of dependence on the oil-exporting countries was revealed, and the security of the supply of energy in future seemed to be in jeopardy.

As a reaction to the crisis, the International Energy Agency (IEA) was set up in 1974 as an autonomous entity within the Organisation for Economic Co-operation and Development (OECD), with headquarters in Paris. Austria is one of 16 founding members; today the IEA has 29 members (Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, Turkey, USA, UK). The IEA is committed to advising on and coordinating national energy policy in the member states.

The IEA's main concerns

- Energy security: promoting diversity, efficiency and flexibility within all energy sectors
- Economic development: ensuring the stable supply of energy to IEA member countries and promoting free markets to foster economic growth and eliminate energy poverty
- Environmental awareness: enhancing international knowledge of energy options for tackling climate change
- Commitment worldwide: working closely with non-member countries, especially major producers and consumers, to find solutions to shared energy and environmental concerns

The IEA provides a forum for exchanging know-how and new insights from energy research worldwide. This makes it possible to take international developments into account early on when setting strategic priorities in Austria's research and technology policy. The IEA's energy technology initiatives are the basis for collaboration outside Europe, for example with Japan, the USA or Australia – but also with non-members such as China, India, South Africa, Brazil or Mexico, with their dynamic economies. Austrian firms and research organizations both benefit from this collaboration, since it is frequently the starting-point for follow-up projects and/or business deals. And the results often lead to further steps in standardization and quality assurance for energy technologies both within the EU and worldwide.

As an IEA member state Austria is required to document public-sector expenditure on energy research and report it to the IEA every year for central registration. As a result, developments and trends can be detected over the years, and lessons can be learnt for guiding research policy appropriately in future. The uniform survey method also makes it possible to make comparisons with other countries.

Every four years the IEA carries out a detailed audit of each member state's energy policy and energy research activities. The most recent IEA country report on Austria, in 2014, gave Austrian energy research good marks: expenditure on energy research has quadrupled since 2007, to 120 million Euro annually, putting Austria in sixth place in the IEA member state ranking. The IEA recommends that Austria ensures continuity in its energy research and increases the funds available long-term, provides even more encouragement for firms to invest in energy research, makes access to research findings as open as possible and encourages students to take subjects relevant to energy research. ◘

Photo: Nick Waldhör

Michael Paula
Head of the Department for Energy and Environmental Technology in bmvit, Austria's representative in CERT and responsible for setting priorities and for funding in Austria for research collaboration within the IEA

The IEA's Energy Technology Network
Organizing energy research internationally

In the IEA all decisions are taken by the member states. The highest level of decision is the Governing Board, which meets regularly to set strategic priorities for the IEA's activities.

Strategies and activities for energy research

Committee on Energy Research and Technology (CERT)

In the field of energy technology R&D the most important body is the Committee on Energy Research and Technology (CERT), in which the IEA's energy research strategies are formulated and supervised. The Federal Ministry for Transport, Innovation and Technology (bmvit) is represented on this committee, which initiates IEA research activities and directs the work in the Implementing Agreements. Accompanying measures are developed, too.

Source: Marcel Schauer, fotolia.com

Expertise and guidance

Experts Group on R&D Priority Setting and Evaluation (EGRD)

The Experts' Group acts as an advisory body for the CERT; its job is to develop analytical approaches to setting R&D priorities, to strategies for implementation and to evaluating research programmes. Twice a year workshops are held on a key issue such as energy technology roadmaps; discussions take place with experts, and the proceedings are documented in a comprehensive report.

>>>

What positive effects has participating in the IEA research network had on Austria's research landscape to date, in your view?

Austrian researchers have been involved in the International Energy Agency for several decades, and Austria has benefited from this in several ways. This forum, in which experts not just from Europe but from all over the world play a part, provides excellent opportunities to recognize international trends and to find out which research topics Austria can advantageously tackle. The network helps us to spotlight our own strengths in the international context. Disseminating Austrian developments around the world is significantly facilitated by the exchange of information within the IEA. This field of collaboration turns out to be an excellent starting-point for defining and submitting European projects.

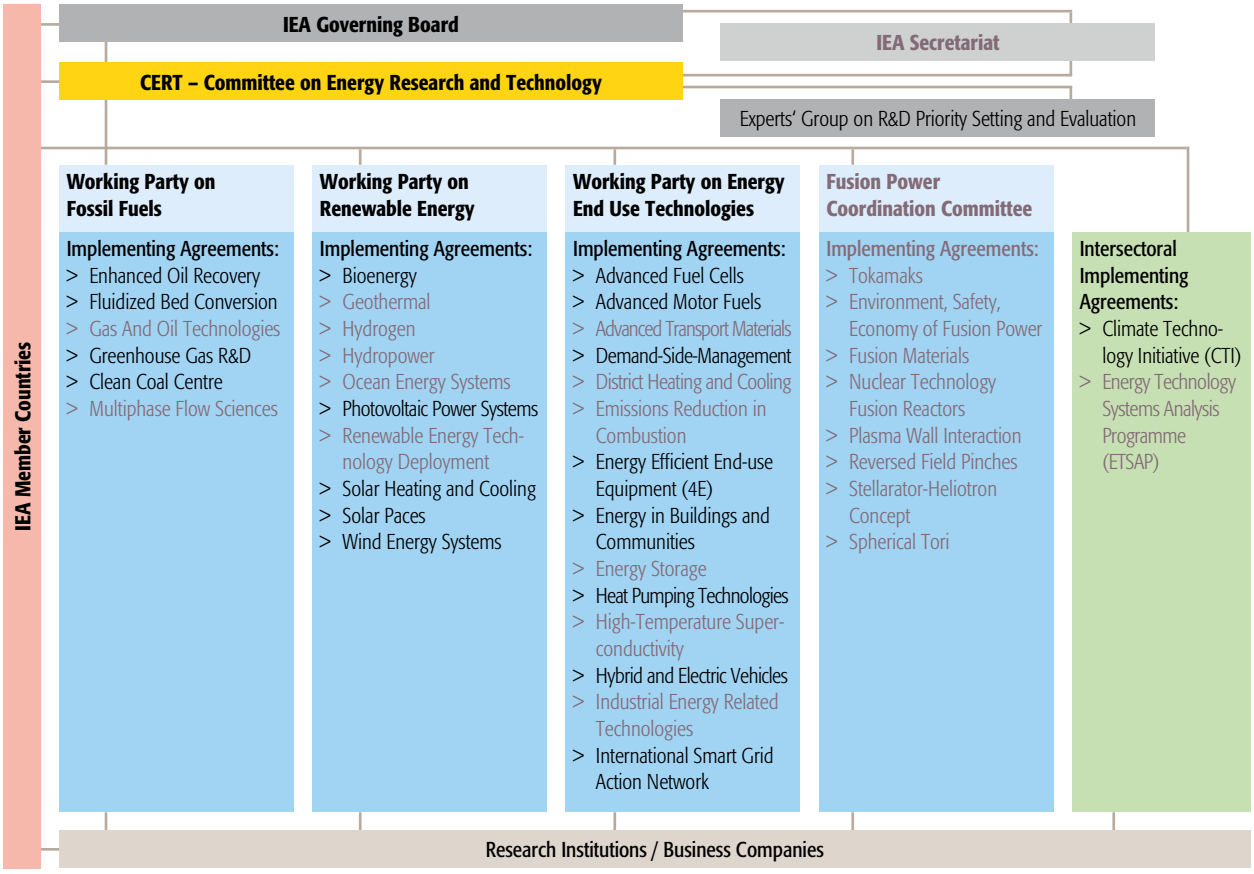
Which technological fields have major successes been achieved in as part of these networking activities?

Austria is very much focused on renewable sources of energy, side by side with issues of energy efficiency. In the IEA's bioenergy network, which is concerned with solid, liquid and gaseous fuels from renewable resources, the exchange of experience has definitely helped to stimulate innovative developments in Austria. In the field of solar heating Austrian R&D has played a considerable part for many years. In the photovoltaic sector there have been sensational developments in recent years as regards technology, market growth and price reduction. The most relevant sector for end-use technologies is buildings; so communication with experts from other countries via the IEA networks has been very valuable for the Austrian research programme "Building of Tomorrow". This concern continues today in the shape of the "Smart City" strategy, in which the focus is not just on individual buildings, but on districts, communities and whole cities.

Has this collaboration improved the chances for technological developments from Austria in international markets?

Right from the start it mattered to us that not only research, but also Austrian firms benefit. Various large-scale projects of worldwide interest that are directly linked to these expert networks have been implemented. Examples are the solar facility in Riad (Saudi Arabia), the world's largest at the time (2011), or more recently the Desert Learning Center in Al Ain (UAE), where several innovative technologies from Austria were applied for the first time in the Arab world.

Austria's involvement in the IEA's energy technology initiatives



Bold type >> Austria's involvement

Tackling energy issues

Working Parties

The various topics are grouped and assigned to four Working Parties, on Renewable Energy Technologies, Energy End-use Technologies, Fossil Fuels and Fusion Power. The experts both support the work of the topic-related energy technology initiatives (Implementing Agreements) and initiate new activities. They analyse and evaluate the work of the Implementing Agreements, and generate recommendations for CERT. Austria is represented in three of the four Working Parties (the exception is fusion).

The Working Party on Renewable Energy Technologies currently oversees technology initiatives in the fields of bioenergy, geothermal energy, ocean energy, concentrating solar power, photovoltaics, solar heating and cooling, hydrogen, wind power, and activities to disseminate the new technologies. In the field of Energy End-use Eechnologies 14 technology initiatives are currently being implemented in the areas of buildings, transport, industry and electricity. In so-called Coordination Group Workshops the relevant Implementing Agreements of the Working Party on Energy End-use Technologies, the Working Party on Renewable Energy Technologies and the IEA Secretariat are lined up side by side and cross-programme issues and strategies worked out. The Working Party on Fossil Fuels currently oversees technology initiatives for multiphase flow science, enhanced oil recovery, clean coal, fluidized bed conversion and greenhouse gas R&D.

Involvement in energy technology initiatives

Implementing Agreements

The principal mechanism for putting IEA research collaboration to work are the "Implementing Agreements". In these multilateral energy technology initiatives the countries participating set goals and research priorities. Which Implementing Agreements the member states take part in depends on their various energy technology policy priorities. The legal framework of these agreements also permits non-IEA member states to take part, which considerably enhances the options for collaboration. The activities of a technology initiative can extend from pure research all the

Load balancing room in control centre, Salzburg AG; photo: Andreas Hechenberger

way to launching a new technology commercially, e.g. by way of joint performance testing. The term of Implementing Agreements is limited to five years, but can be extended for a further five years.

Each government participating in the Implementing Agreement nominates a Contracting Party, i.e. the signatory organization (the state, a ministry or an organization specified by the state). Representatives of private enterprise can participate as sponsors. Each Implementing Agreement is managed by an Executive Committee (ExCo), in which each Contracting Party is represented by a delegate and an alternate. The chairperson is selected by ballot. The Implementing Agreements are powered by the partner states either contributing services ("task shared") or paying into a common fund ("cost shared"), in which case services can be outsourced.

Research collaboration in projects

Tasks & Annexes

Actual R&D activities take place at project level in the Tasks or Annexes. In line with the partner states' interests and financing option they can decide which projects they wish to take part in; this makes great flexibility possible. One partner manages the Task or Annex as Operating Agent. The Implementing Agreements frequently consist of up to ten current Tasks. In Austria bmvit engages national experts, research institutions and firms, so that these can contribute to the individual projects, and also initiate new Tasks under Austrian lead-management. The insights gained from the projects are constantly passed on to relevant national stakeholders. In Austria these projects are funded by way of the bmvit technology programme "IEA research collaboration". ◘

The firm of S.O.L.I.D. Gesellschaft für Solarinstallation und Design mbH in Styria has for many years participated in international collaboration within the framework of the IEA technology initiatives.

"As SME (Small and Medium sized Enterprise), S.O.L.I.D. constructs large solar facilities and runs an inhouse R&D department. For many years we have been an active partner in IEA research programmes involving Austria, and greatly appreciate the communication with industry and science in other countries.

I myself had the privilege of managing Austrian participation in a project, and regard this experience as a particularly valuable part of my professional career to date, since various joint ventures got off the ground then and got the attention they deserved."

Photo S.O.L.I.D.

Sabine Putz,
Head of R&D, S.O.L.I.D. Gesellschaft für Solarinstallation und Design mbH

The firm of Bartenbach GmbH in the Tyrol lead-manages Austria's participation in IEA SHC Task 50: Advanced Lighting Solutions for Retrofitting Buildings.

Photo © Die Fotografen

"A large proportion of the existing lighting equipment in buildings is more than 20 years old. Retrofitting with energy-efficient combinations of daylight and artificial lighting can cut end-use consumption of electricity dramatically. The savings take immediate effect and require only modest investment, which generally pays off in a short time. Such measures yield the further benefit that the quality of lighting, and thus quality of life, improve significantly. Within the framework of IEA SHC Task 50 we are generating web-based recommendations and tools for this, with which preliminary rough estimates of the potential savings can be made."

Wilfried Pohl
Bartenbach GmbH, Director Research

Photo: Climate and Energy Fund/Ringhofer

More electricity from the sun – integrating photovoltaic equipment in power networks in the best possible way

Enlarging the share of electricity generated from renewable sources of energy is central to achieving international goals in energy and environmental policy. Photovoltaics (PV) are a key element in a pioneering, sustainable power scenario. In Europe PV is intended to meet 12 % of demand for power by 2020. In Austria installed PV capacity has continually increased in recent years; as 2013 the total rating of all PV facilities connected to the electricity network came to 612.9 MWpeak.

Since 1993 the IEA's Photovoltaic Power Systems Programme (PVPS) has provided a platform for applied research activities and commercial launch strategies in the field of photovoltaics. This technology initiative is concerned with all aspects of PV systems. With 26 countries and associations currently participating, a broad international exchange of experience is possible. The strategy for 2013-2017 focuses on increased market relevance, new business models and eliminating non-technical obstacles to disseminating this technology. Integrating PV facilities in existing networks, PV integrated in building façades and so-called "solar communities" are important research issues here.

Integrating large numbers of local PV facilities in electricity networks presents new challenges to network management. In some regions capacity is already at its limit, so more local producers could be accommodated only if the networks were upgraded. Here the main issue is maintaining a stable voltage level. Smart Grid strategies offer a tentative solution; the aim here is two-directional communication between producers, consumers and storage facilities, to make sustainable energy management possible. Intelligent control arrangements are intended to provide the technical basis for tying more PV facilities into distribution networks.

As part of IEA PVPS Task 14, which is lead-managed by Austria as Operating Agent, experts from 15 countries analyse the implications of extensive PV supply for the networks, and work out best-practice scenarios for tying local suppliers in. Starting from the existing network infrastructure, the aim is to achieve the greatest possible density of local renewable supply by means of decentralized network management procedures, additional services by PV power inverters, and innovative methods of planning and operation. ◘

morePV2grid

Symo power inverter, source: Fronius International GmbH

For 70 years the Austrian firm of Fronius International GmbH has been researching new technologies to transform electricity. The Solar Energy division has worked on electronic control systems for PV since 1992, and is developing (inter alia) innovative power inverter systems which convert direct current – as generated in the solar modules – into serviceable alternating current.

In the research project "morePV2grid" (funded by the Climate and Energy Fund) Fronius collaborated with Netz Oberösterreich, AIT Austrian Institute of Technology und MEA solar to develop a strategy for voltage control by means of power inverters, and tried it out. The question was how many local PV facilities can contribute to maintaining a stable voltage in the absence of higher-level system/communication engineering, by autonomously adjusting their individual active and reactive power locally.

These approaches were verified in practice in a field trial lasting several months in a real-world low-voltage network with an above-average density of PV facilities. In this test network the electrical conditions for voltage control on the basis of reactive power were fairly disadvantageous, in line with the then state of the art. In the course of the project local reactive-power adjustment actually made good roughly a third of the rise in voltage due to supply factors; the network's capacity to accommodate local suppliers thus improved by a third. It was also established that if active power is optimized as a function of voltage, the rise in voltage due to supply factors can be reliably kept below a defined ceiling.

The project's results show that integrating numerous local PV facilities in a distribution network is feasible and works in practice, if innovative power inverters are used to provide local, autonomous, intelligent control – entirely without communications infrastructure.

Photo: Climate and Energy Fund/Ringhofer

Wind power
in cold climates

Wind power is growing into a significant economic factor in Austria. In 2013 suppliers in this field notched up a turnover of more than 600 million Euro, and 1,684 MW_{el} of new wind power capacity were installed. The Implementing Agreement "Wind Energy Systems" was launched already 1977; today 20 countries, the European Commission and the European and Chinese wind power associations collaborate on it. The experts involved exchange information on planning and implementing national wind power projects, and initiate R&D projects concerned with developing technology, commercial launches and legal frameworks. The focus is on wind power facilities of all sizes and locations (onshore and offshore), LiDAR measurements and the special conditions applying to wind power in cold climates.

In wintry weather (temperatures below 0 °C, snowfall or freezing rain) layers of ice can form on wind turbine rotor blades. Wind turbines affected by ice deliver less power, and the rotors may get out of balance, which shortens the turbine's service life. Ice throw can also pose a serious hazard. Accordingly, modern wind turbines are equipped with an ice detection system, and must be shut down or de-iced if they ice up. Roughly 15 % of the wind farms now operating in Austria can be classified as so-called cold-climate sites, where icing is frequent. But at sites in other areas, too, icing occurs several times a year.

Since 2002, within the framework of IEA Wind Task 19, researchers have confronted the special challenges presented by wind power where icing is an issue. Austria, Canada, China, Denmark, Finland, Germany, Norway, Sweden, Switzerland and the USA are partners in this Task. The aims are to gather new insights by exchanging experience, and to build up a global network. Workshops at which national research projects are presented and discussed are held twice a year. ◘

BOOSTING PRODUCTIVITY
with rotor blade icing management

Iced-up rotor, photo: LKR Ranshofen

LKR Leichtmetallkompetenzzentrum Ranshofen GmbH are pursuing a project aimed at deploying active and passive measures to minimize the negative effects of icing on wind turbines.

Innovative technologies are to reduce the risk of icing and increase wind farms' energy yield in winter. In the course of the project methods and technologies have been developed with which icing can be avoided or lessened, or ice can be removed fast and hazard-free. The approaches adopted were:

> anti-ice coatings which delay the formation of ice on rotor blades and reduce ice adhesion
> active heating by means of electricity-conductive paint on the critical portions of the rotor blades
> Fine-tuning equipment operation to reduce shutdown times

Overall the project provides a number of insights on how practicable the approaches adopted are with respect both to use in existing equipment and to standardized fabrication of new turbines; these can now be followed up and implemented.

36,300 m² PV facility in Riad, Saudi Arabia, photo: Millennium Energy Industries

Heating and cooling with solar energy

According to the IEA Technology Roadmap "Solar Heating and Cooling", the energy required for heat in buildings and industry accounts for nearly 50 % of global end-use energy consumption. Most of the applications in question involve temperatures below 250°C. In particular, the so-called low-temperature segment, with operating temperatures up to about 90°C, has special potential for deploying thermal solar facilities. In Austria technologies to use the sun's warmth have been successfully developed and implemented for decades. Today Austria is among the technological front-runners in almost all sectors of solar heating. The Austrian solar heating sector's turnover in 2013 is estimated at 293 million Euro, corresponding to roughly 2,900 full-time jobs.

Austria is a founding member of the IEA Solar Heating and Cooling Programme (SHC) and has played an active part in designing and carrying out numerous research projects in the field of solar heating since 1977. On Austria's initiative research has been carried out into using solar energy for space heating (combined solar systems) and for industrial process heat (in the low-temperature segment), pilot projects have been developed and new technologies launched commercially in collaboration with industry.

Polymers for solar heating applications

Linking research into plastics and into solar energy has tremendous potential for developing solar technology further. In the course of SHC Task 39 experts on solar energy and plastics research from various countries investigated how to employ advanced polymer technologies for solar heating systems of innovative design.

Making systematic use of plastics technologies is intended to yield reductions in cost and thus open up new ways of developing markets. Austrian researchers lead-managed Subtask C Materials, which emphasized working out market scenarios for solar heating based on state-of-the-art regenerative-only energy scenarios (national, regional and global) and identifying the opportunities these would provide for plastics technologies. ◘

SolPol-1/2

Design study for a new generation of solar collectors made of plastic (source: SCIONIC Industrial Design Education Austria Linz)

Launched at the end of 2009, the large-scale research project SolPol-1/2 (solar heating systems based on polymeric materials) is an initiative due to the Institute for Polymeric Materials and Testing at the Johannes Kepler University (JKU) in Linz. The main aim here was to develop innovative pumped thermal collectors made of plastics, using improved polymeric materials and fabrication technologies specially adapted to these. In this project experts from the scientific and business communities collaborate along the entire value-creation chain. Today solar collectors and collector systems are put together from any number of different materials in complicated and expensive fabrication processes; plastics play little part here. The bulk of the solar collectors installed around the world are either evacuated tube collectors (62.3 %) or glazed flat-plate collectors (27.9 %).

Quite apart from the prospect that particular raw materials, such as copper for absorbers, will be in short supply in the future, employing a growing share of polymeric materials in solar heating systems offers considerable potential for further innovative developments with respect to collector functionality and design. At the same time there are positive effects on cost-benefit ratios and market penetration. The results of SolPol-1/2 are real milestones on the way to establishing systematically improved, plastic-based solar heating systems and penetrating markets with these. Currently development work is continuing on pioneering materials and systems, and using polymers in PV modules, in follow-up projects.

Photos: Nick Waldhör

Professor Gerhard Faninger
Interuniversity Institute for Interdisciplinary Research and Further Education at Klagenfurt, Vienna, Innsbruck and Graz Universities, founding member of the IEA's SHC Solar Heating and Cooling Programme and pioneer in the field of Renewable Energy in Austria

What were the motives for setting the IEA research network up in the 1970's?
With the first oil (price) shock in the mid 1970's it dawned on the industrialized countries how dependent they were on supplies of energy from elsewhere. In 1974 the International Energy Agency was set up as an autonomous organization within the framework of the OECD, with the aim of planning and implementing joint measures to ensure a reliable supply of energy in the countries belonging to the OECD. Austria was one of the founding members.

How has international R&D in the field of renewables developed over the last 40 years?
International R&D in this field, together with demonstration projects, have made a decisive contribution to the successful development of the market for renewable sources of energy, such as solar heating, solar electricity, facilities to generate heat, electricity and biofuels from biomass, and wind power. Since 2005 we have seen two-digit mean annual growth rates both around the world and in Europe. The market in the renewables sector has become an economic factor: it now employs roughly 6.5 million people around the world. In Austria about 31,600 full-time jobs are currently involved. In 2013 turnover in Austria in this sector was roughly 4.4 billion Euro.

In 1980 you were nominated as the Austrian deputy on the Executive Committee for the technology initiative SHC Solar Heating and Cooling. What were the goals of this Implementing Agreement?
The initial emphasis was on developing, testing and standardizing collectors. Research then moved on to attractive applications for solar heating equipment, first in buildings, later in industry; pilot plants were tested and products launched commercially. The IEA SHC Programme also had considerable influence on how Austria developed an energy research strategy, and quite a number of research projects were initiated and carried out as part of IEA SHC.

Where did Austrian R&D develop special strengths and achieve internationally recognized successes in this field?
At Austria's instigation research was done on expanding the range of applications for solar heating equipment. Technologies for using solar energy in space heating and for process heat at low and medium temperatures were developed with great success, often in combination with biomass (wood chips and pellets). Employing solar energy to air-condition and cool buildings in high-insolation countries was another important topic. Today Austrian firms are world market leaders in the fields of flat-plate collectors and biomass combustion equipment, with an export share of up to 80 %. In order to hold on to or increase their international lead, many Austrian firms are in process of expanding their production capacities and continuing to automate them.

How is this research collaboration likely to develop from now on, and what strategies are necessary for a sustainable energy future?
The goal of the current IEA research programmes is to make the switch from fossil to renewable sources of energy possible. This switch ought to be complete by the year 2050; the energy supply industry should have ceased climate-changing carbon dioxide emissions by 2100 at the latest (according to the UNO 2015 climate report).

Today establishing regional energy systems in a circular economy – coupled with maximum efficiency in generation and use – is given preference over a globally organized energy system. In such regional energy strategies the most promising approach is to combine local systems with a transregional system: the local energy system is supported by a central electricity network (some of the electricity comes from PV equipment and wind farms), and surplus electricity from the local energy units is fed into the central network.

Using biomass sustainably
Paths to the "BioEconomy"

In recent years there has been a growing trend around the world toward using renewable raw materials. In particular, using solid, liquid or gaseous biomass to generate heat, electricity and fuels has continued to develop further. In Austria, too, bioenergy has turned into a mainstay of energy supply in the last few years. Just looking at the period from 2005 to 2012, gross domestic consumption of bioenergy (including organic household waste) went up by 64 % (from 159 PJ to 275 PJ).

Growth rates for use as materials were more modest, in spite of the fact that utilizing renewable raw materials in this way has plenty of innovative potential as regards new technologies and products. One example of a pioneering approach to using biomass sustainably is the so-called biorefinery. In a biorefinery a wide variety of organic raw materials (e.g. wood, organic waste or grain) can be converted into bio-based material products (such as biomaterials, basic chemicals etc.) and into fuels, electricity and heat with great efficiency.

Since 1978 Austria has been a member of the IEA Bioenergy Implementing Agreement, which is intended to push developing and marketing ecologically sound, efficient, cost-effective bioenergy technologies.

In Task 42 Biorefining research is carried out into new, integrated ways to use biomass as a source of energy and material, as core elements of an organically based economy, and methods of processing biomass into a wide range of marketable organically based products and bioenergy are investigated. Strategically relevant information about biorefinery value creation chains are analysed and disseminated. Austria participates in investigating the following aspects:

> Evaluating the significant aspects of market development for integrated biorefineries
> Supporting industry in making its mark in a future "BioEconomy"
> Analysing fully sustainable methods of digesting biomass in the food and non-food areas
> Working out policy recommendations
> Organizing knowledge dissemination and training activities. ◘

Biorefinery in Utzenaich, photo: ÖGUT

GREEN SAFER SOLVENT
Innovative process to make ethyl lactate from lactic acid

Extract, photo: Kornberg Institut

The "Safer Solvent" ethyl lactate (lactic acid ethyl ester) is in demand around the world, and sales are steadily increasing. This biologically degradable, non-toxic chemical is now taking the place of fossil-derived solvents, some of them toxic, all over the world. The lactic acid ester can be made from various organic raw materials; among other applications, it is used as a solvent in microelectronics, and actually satisfies the semiconductor industry's quality requirements.

As part of the project "Green Safer Solvent" researchers at JOANNEUM RESEARCH Forschungsgesellschaft mbH are developing a pioneering, ultra-efficient process to make ethyl lactate by reactive separation. This will make it possible to esterize lactic acid and ethanol, and separate off the target product ethyl lactate, simultaneously in a single facility, which has significant advantages for process efficiency; capital investment and running costs are expected to be lower, too. The development process is accompanied by ecological process evaluation, so as to take into account possible environmental impact hazards in development. The process follows up existing demonstration projects in which lactic acid is made from non-food raw materials (grass and straw) and so does not compete with food production.

Biomass power plant in Güssing, photo: EEE European Centre for Renewable Energy

IEA Greenhouse Gas R&D programme

Diminishing greenhouse gas emissions is essential if using fossil sources of energy is to be harmonized with national and international climate protection goals. In the IEA Greenhouse Gas R&D Programme (GHG), which has operated since 1991, ways of reducing such emissions where fossil sources of energy are used are developed and demonstrated.

Activities in this technology initiative include writing studies and factsheets in preparation for research, development and demonstration projects, and disseminating information. Current IEA research focuses include carbon capture and storage in power stations, storing carbon dioxide in geological formations , recycling carbon dioxide and modelling carbon dioxide storage in the ocean. Austria has participated in this collaboration since 2007. ◘

IEA Fluidized Bed Conversion

An overview of the state of fluidized bed conversion R&D around the world, and of ways of applying it in energy engineering, is provided by the IEA Fluidized Bed Conversion (FBC) Implementing Agreement. Austria (a member since 1999) has already chaired this programme twice (2000-2002 and 2011-2013). Fluidized bed conversion offers a path to utilizing various different fuels at low cost and with no ill effects on the environment, and generating heat and electricity from biomass, residues and waste. In the course of collaboration current insights are exchanged, facilities toured and future trends analysed. In 2011 a total of 27 fluidized bed units were operating in Austria, with individual ratings between 1 and 133 MW_{th} and a total capacity of more than 1,000 MW_{th}; 50 % of these units are in the paper and cellulose industry, with the next largest group used to incinerate residues, biomass and sewage sludge. ◘

ERBA
Obtaining a product gas from biomass reforming with selective carbon sequestration

Pilot plant at Vienna University of Technology

The fluidized-bed steam gasification process for ligneous biomass developed at Vienna University of Technology (Institute for Chemical Engineering) has set new standards.

This technology, currently in full-scale demonstration in two plants in Austria (Güssing and Oberwart, rated at 8 and 10 MW_{th} respectively) among others, opens up new perspectives for making use of biomass apart from straightforward heat. As solid fuel is converted into a high-grade syngas, a variety of interesting options (apart from generating electricity, heat and synthetic biofuels) are available, particularly in industry.

As part of the ERBA research project using biomass in an integrated steelmaking facility at voestalpine AG is being investigated: in particular, the possibility of using a gas produced from ligneous biomass in a "Sorption-Enhanced Reforming Process". For a product gas to be usable as an alternative reducing agent in a blast furnace, it must have considerable reductive potential; the gas generated from biomass must be rich in hydrogen, carbon monoxide and methane. To achieve this, limestone was used as bed material in the fluidized twin-bed steam gasification process. Using limestone for generating the product gas makes it possible to capture carbon dioxide selectively at the same time.

In the course of the project several ways of improving the process engineering starting-point were developed and tried out in a pilot plant. In the light of the data and insights obtained, this pioneering approach will be developed further as part of ERBA II.

The new Lehen, source: Photohof © Andrew Phelps

Sustainable energy strategies for buildings and communities

There is plenty of potential for saving energy in the building sector. Roughly 40 % of overall primary energy consumption is accounted for by space heating and cooling, lighting and other uses of electricity in accommodation, offices, hospitals and schools. So new, sustainable technologies and strategies for energy supply in buildings are highly relevant if the places where we live are to develop in a climate-compatible way.

The Implementing Agreement "Energy in Buildings and Communities" (EBC) is focused on international R&D projects concerned with integrating energy-efficient, sustainable technologies in buildings and communities. 25 countries are currently taking part in the EBC programme; Austria has been represented by bmvit in this Implementing Agreement since 2006.

From single buildings to sustainable settlements

Whereas R&D in the building sector was concentrated on technological innovations for individual buildings in recent years, the focus has now shifted to comprehensive energy strategies and cross-system solutions for sustainable cities and settlements.

More than half the world's population and two-thirds of Europeans now live in cities or urban regions; for Austria the proportion is 64 %. Investigations by the OECD reveal that cities' energy consumption accounts for a large proportion of carbon dioxide emissions around the world. To be successful, improved solutions for settlements and urban districts must be embedded in city-wide strategies and targets. Within the framework of EBC Annex 63 experts are working out recommendations for integrating energy issues into urban planning processes, and are thus helping to implement integrated energy strategies in cities, communities and regions.

Experience so far shows that the integrated planning approach can provide opportunities and benefits for all stakeholders, particularly for owners and residents. Apart from synergies in the overall system perspective on production, storage and consumption, non-technical aspects such as improved residential surroundings, local value creation or buildings' gaining in market value when settlements are upgraded are very worthwhile. ◘

FLAGSHIP PROJECT STADTUMBAU LEHEN

The new Lehen, photo: Photohof © Andrew Phelps, source: SIR

With the flagship project "Stadtumbau Lehen" construction projects and ancillary measures have been coordinated and implemented since 2007, as part of renovating the Lehen district in Salzburg. The comprehensive energy strategy for the district emphasizes boosting energy efficiency by putting up ultra-efficient new buildings and renovating the existing buildings to make them sustainable, while aiming to integrate a maximum of renewables by exploiting solar energy (via collectors and PV) systematically.

Four promoters and ten teams of architects, two scientific institutes, the City of Salzburg and two departments within the Provincial administration are collaborating on this flagship project. To ensure uniform, defined quality standards, a subproject gives SIR – the Salzburger Institut für Raumordnung und Wohnen – responsibility for project management and coordinating the numerous partners and projects. These activities are harmonized with other flagship projects in the bmvit programme "Building of Tomorrow" (such as urban district projects in Graz and Vienna Aspern), and the results are documented systematically.

Photo: Kzenon, fotolia.com

Energy-Efficient End-use Equipment

The technology initiative "Energy Efficient End-use Equipment" (4E) was launched in 2008 with the aim of encouraging the spread of ultra-efficient electric end-use equipment in the IEA member states. Household appliances, electric motors, electronic equipment, household lighting and air-conditioning systems are being evaluated in comparative studies. In the meantime the scope of the Implementing Agreement has been widened to cover energy-efficient end-use equipment in general, so that (say) appliances that run on gas can be analysed too. Austria is currently participating in the "Mapping and Benchmarking" activities and in the Annexes "Energy-efficient Electric Motor Systems" and "Electronic Devices and Networks", and is lead-managing Task 1, "Smart Metering and Energy Monitoring Systems", in the latter.

As part of the Mapping & Benchmarking activities, factsheets and benchmarking reports are produced that offer policymakers product performance comparisons; the analyses can serve as a basis for evaluating national regulations on product energy consumption and efficiency values. For instance, when electric laundry dryers in private households were compared in Australia, Austria, Canada, Denmark, France, Spain, Switzerland, the UK and the USA (plus information from CECED for the European Union as a whole), it turned out that Austria, along with Australia, Denmark and Switzerland, does very well in terms of national energy consumption (< 1TWh/year), but also notches up a higher annual growth rate than other countries (> 10 %). Increasingly Austrians are buying heat pump dryers, which cost up to 30 % more but operate very efficiently, consuming less than half the energy that condensing and vented dryers need.

Inefficient products continue to sell where Minimum Energy Performance Standards (MEPS) are feeble or nonexistent. If a strict MEPS regime, as for instance in Switzerland, took effect in other markets, this could reduce consumption worldwide by 60 %. ◘

Heat pumps in smart energy networks

Heat pumps take ambient heat from the air outdoors, the water table or the soil and raise its temperature with the aid of advanced technology, so that it can be used for heating purposes. In Austria 208,727 heat pumps were in use in 2013. Currently the main application area for heat pumps is space heating with low inflow temperatures (< 35 °C). As regards interaction with other technologies (solar collectors, PV) and power networks (Smart Grids) we can expect further developments, such that highly integrated energy systems emerge from what are as yet isolated devices operating side by side.

In the IEA's Heat Pump Programme (HPP) information about heat pumps, refrigeration engineering and air-conditioning is put together and disseminated, in order for these technologies' environmentally relevant and energy-saving potential to be used more widely in the member states. Joint research projects and workshops, plus an information service, the so-called IEA Heat Pump Centre, are key collaborative concerns.

HPP Annex 42 targets using heat pumps in Smart Grids. Austria's contribution involves analysing the technical possibilities and the economic and regulatory framework for electric heat pumps to help balance loads in Smart Grids, and investigating the effects on heat consumers and the possible options. On this basis economic incentive models for rescheduling loads are worked out and the benefits for utility companies and end users investigated. ◘

iWPP-Flex

Heat pump, source: Junkers

In the exploratory project iWPP-Flex AIT Austrian Institute of Technology is researching the flexible handling of heat pump pooling to make the use of electricity in Smart Grids more flexible. In the course of the project an overall technical strategy and a platform for evaluating heat pump pooling in terms of providing and using energy are to be put together. The results serve as preparation for specifying, implementing and analysing a subsequent demonstration project.

The various stakeholders (owners of heat pumps, pooling operators, utility companies) will be brought together in the context of the technical strategy and linked up with the aid of information and communication technology. This provides the basis for innovative services for household customers, who can make their flexibility available to various players, such as energy traders or network operators. The tools required for classifying this flexibility and for evaluating it in terms of providing and using energy with a view to marketing it will also be developed.

Smart Grid technologies
for an intelligent energy system

With PV and wind power in more and more widespread use, electricity generation is being decentralized to some extent, while the amount of electricity on offer fluctuates in line with the weather. As the energy policy turnaround continues, more and more local producers will feed electricity into the network at varying rates. This is a real challenge to distribution network operators, because of the risk that the grid voltage may fluctuate too.

New technologies will be needed to ensure that our future energy system operates reliably and securely to make it possible to tie renewable sources of energy in to a greater extent. With the aid of information and communication technologies and flexible components, Smart Grid technologies provide the technical basis for intelligent energy networks that link all the actors in the energy system (producers, storage facilities and consumers) together and enable them to function harmoniously.

International collaboration to disseminate Smart Grids

The International Smart Grid Action Network (ISGAN, set up in 2010) is a multilateral network aimed at promoting the development and use of Smart Grids. 25 IEA member states participate in joint activities. The central concerns of this technology initiative are developing legal standards and regulations, funding and business models, developing technologies and systems, coordinating vocational and other training measures and communicating with users.

In line with Austria's strategic orientation and research priorities, the national focus is on new approaches to planning and operating electrical networks with a substantial proportion of local producers from renewable sources of energy, and on tying active customers in. With this focus Austria has in recent years secured a prominent place for itself both in and outside Europe.

In the past there was a sharp divide, in research into new approaches in planning and operating networks, between transmission and distribution networks. There were no international activities of any importance to do with interaction between active distribution grids and the transmission network.

This is where IEA Annex 6, Power Transmission and Distribution Systems (ISGAN), comes in. Austria's participation is intended to generate the knowledge required to develop an intelligent, integrated complete power supply system embracing all voltage levels (transmission and distribution networks). The new insights gained in this Annex should be incorporated in current and planned Austrian projects and in the future strategic development of the topic "Operating active distribution networks". ◘

Hybrid VPP4DSO
Virtual power plants
for the European electricity market

Photo: Vorarlberger Kraftwerke AG

Researchers at AIT Austrian Institute of Technology are currently developing a concept for a virtual power plant that combines both grid-driven and market-driven approaches. The hybridVPP merges the advantages of economic and technical VPP solutions into a comprehensive concept. The aim is both to ensure the secure distribution network operation even during massive demand-response activity and to improve the economic viability of technical demand-response solutions for distribution network operation.

After a technical proof-of-concept laboratory test run, the approach is to be tested in actual grid sectors in Slovenia (ELEKTRO LJUBLJANA) and Austria (Stromnetz Steiermark GmbH). The test is coordinated by AIT Austrian Institute of Technology. STEWEAG-STEG GmbH, Elektro energija (Slovenia), Vienna University of Technology – Energy Economics Group, Institute for Energy Systems and Electrical Drives, Jan W. Bleyl, cyberGRID and the Graz Energy Agency are also partners in this project.

Photo: Salzburg AG

Calibrating meters at AMIS-Labor, photo: Energie AG Oberösterreich

Photo: Climate and Energy Fund/Ringhofer

Photo: Vorarlberger Kraftwerke AG

electrodrive, Salzburg AG, photo: Andreas Hechenberger

Photo: Climate and Energy Fund/Ringhofer

Pioneering power supply system with Demand Side Management

In power supply systems generation and consumption must be kept in equilibrium at every time. Up till now power supply has as a general rule tracked demand, so as to ensure a reliable supply at all times. However, in systems with a significant proportion of local generators and renewable sources of energy this can lead to problems, as generation levels fluctuate.

The idea of demand-side management (DSM) is to treat the consumers as an active part of the power supply system. Flexible load management makes it possible to influence the level of demand in households, industry or small-scale manufacturing systematically, i.e. to steer the rate or the timing of power consumption and thus to improve the performance of the system as a whole. Larger industrial customers for electricity have already implemented DSM; in the case of private households it may well be possible to take advantage of new potential for shifting loads, by tying heat pumps and electric vehicles in.

With the aid of the Implementing Agreement "Demand Side Management" (DSM), innovative technologies, applications and methods, plus business models for consumer-related measures are being developed and their deployment in the member states promoted. The goals here are positive effects on the reliability and security of the power supply systems, on reducing carbon dioxide and pollutant emissions and on system costs.

The DSM programme is focused on the issues of load management, energy efficiency, smart power networks and energy services, and also on the individual's role in electricity consumption and on activities connected with this.

Altering energy consumption patterns permanently

Alongside innovations in technology and systems engineering, the human factor is decisive for success in establishing a sustainable, climate-friendly energy system. It is reasonable to assume that roughly 20 % of households' and other small-scale consumers' energy consumption can be saved by means of changes in energy consumption patterns. In IEA DSM Task 24 the prerequisites for sustainable consumption patterns are being investigated scientifically, with a focus on transport, energy savings in buildings, SMEs (Small and Medium size Enterprises) and smart meters.

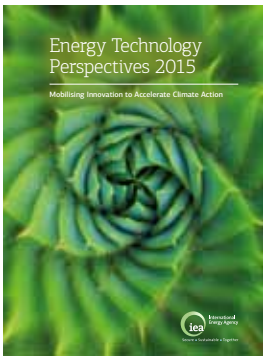
The main aim of Austria's participation is to develop promising, evaluable DSM policies (further). The investigations are concerned with purchasing, using and disposing of energy technologies and with the psychological processes triggered by changes in consumption patterns. The researchers look at new models and theories of behaviour, analyse successful case studies and put together models for evaluating and monitoring DSM policies. ◘

Information and contacts in IEA research collaboration

Austria's contributions to the IEA's energy technology network are funded within the framework of the technology programme "IEA Research Collaboration".

Further details about Austrian participation in the Implementing Agreements, Tasks and Annexes are to be found at:
www.nachhaltigwirtschaften.at/iea

Federal Ministry for Transport, Innovation and Technology
Department for Energy and Environmental Technologies
Head of Department: DI Michael Paula
Contact: Mag. Sabine Mitter
E-Mail: sabine.mitter@bmvit.gv.at



Literature and information on the IEA

Energy Technology Perspectives 2015

Published annually by the International Energy Agency, this brochure regularly gives policymakers an overview of current trends in the energy sector around the world. The analyses and scenarios offer perspectives on how a secure, climate-friendly, competitive energy supply system can look in future. The 2015 issue "Mobilising Innovation to Accelerate Climate Action" presents the technologically possible ways to achieve climate-related goals; it is a contribution to the COP21 climate negotiations in Paris in December 2015.
www.iea.org/etp/etp2015

Further information on the International Energy Agency:
www.iea.org

energy innovation austria presents current Austrian developments and results from research work in the field of foward-looking energy technologies. The content is based on research projects funded by the Austrian Federal Ministry for Transport, Innovation and Technology and the Climate and Energy Fund. **www.energy-innovation-austria.at** **www.nachhaltigwirtschaften.at** **www.klimafonds.gv.at**

Information on Austria's R&D projects:

Green Safer Solvent
JOANNEUM RESEARCH Forschungsgesellschaft mbH
Energie- und Bioressourcen
Ralf Knauss
ralf.knauss@joanneum.at
www.joanneum.at/resources

morePV2grid
FRONIUS INTERNATIONAL GmbH
Martin Heidl
heidl.martin@fronius.com
www.fronius.com

SolPol-1/2
Johannes Kepler University (JKU) Linz
Institute of Polymeric Materials and Testing
Reinhold W. Lang
solpol@ jku.at
www.solpol.at

Improving productivity by managing icing on rotor blades
LKR Leichtmetallkompetenzzentrum Ranshofen GmbH
Rudolf Gradinger
rudolf.gradinger@arcs.ac.at
www.lkr.at

Stadtumbau Lehen
SIR - Salzburger Institut für Raumordnung und Wohnen
Hemut Strasser
helmut.strasser@salzburg.gv.at
www.smartcitysalzburg.at, www.sir.at

hybrid-VPP4DSO
AIT Austrian Institute of Technology GmbH
Helfried Brunner
helfried.brunner@ait.ac.at
www.ait.ac.at

iWPP-Flex
AIT Austrian Institute of Technology GmbH
Tara Esterl
tara.esterl@ait.ac.at
www.ait.ac.at

ERBA
voestalpine Steel Division, Linz
Nina Kieberger
nina.kieberger@voestalpine.com

IMPRINT
Published by Austrian Federal Ministry for Transport, Innovation and Technology, (Radetzkystraße 2, 1030 Vienna, Austria) in cooperation with the Climate and Energy Fund (Gumpendorferstr. 5/22, 1060 Vienna, Austria)
Edited and designed by Projektfabrik Waldhör KG, 1010 Vienna, Am Hof 13/7, www.projektfabrik.at
For change of your shipping address contact: versand@projektfabrik.at