energy innovation austria

1/2021

Current developments
and examples
of sustainable energy
technologies

klima+ energie fonds

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Smart Energy Systems

Multilateral collaboration on innovation for the energy supply of the future

Transforming the energy system to 100% renewable energy requires not only intelligent technologies and solutions, but also new business models, using sector coupling or setting up integrated regional and local energy systems. Austria is an active player in transnational research partnerships, networking to share knowledge and experience, and working with international partners to drive innovation forward for the energy system of the future.

Photo: stock.adobe.com

Transnational collaboration

for a sustainable energy system

Converting our energy system to a climate-neutral supply structure based on renewable sources is a huge challenge. New technologies and systems are needed to allow increased integration of renewable sources in the energy system, and to guarantee security of supply at all times despite fluctuating levels of wind and sunlight.

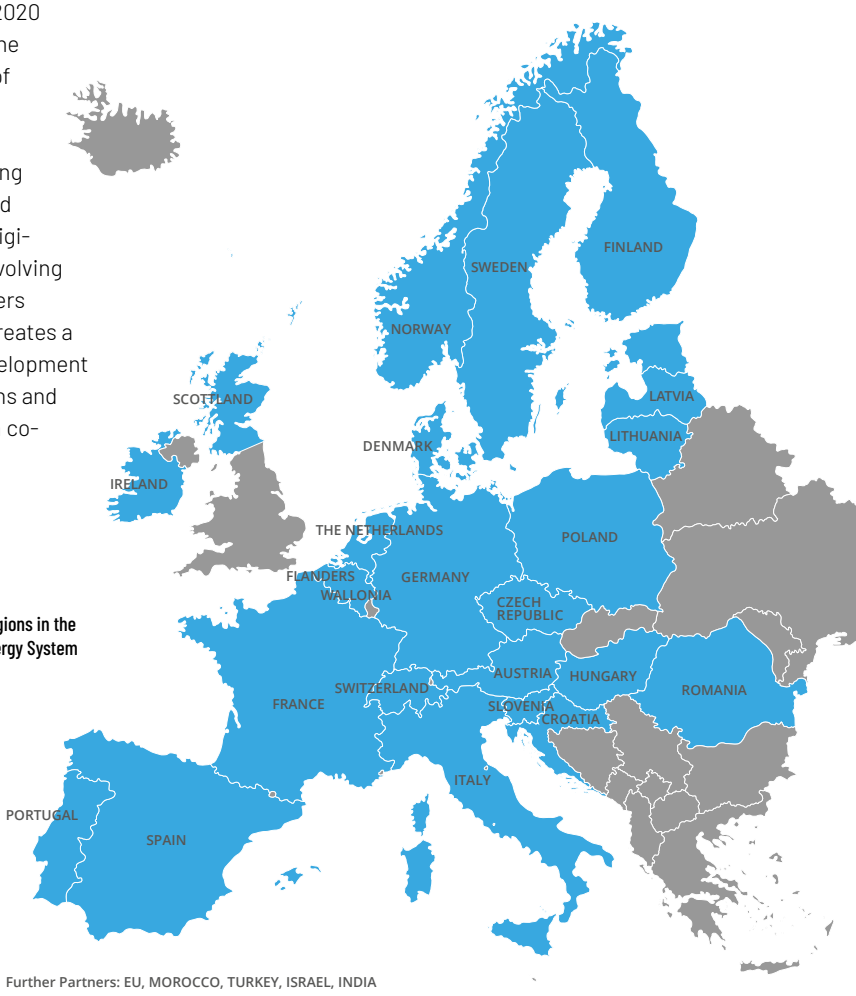
The objective of the multilateral Joint Programming Platform Smart Energy Systems (JPP SES) is to support transnational RDI projects for the development of intelligent, integrated energy systems to facilitate the supply of energy using up to 100% renewable sources. These research initiatives are supported by 32 national and regional public funding partners and partly co-funded by the European Union within the Horizon 2020 programme. Together, these partners aim to further the research, technical development and demonstration of innovative solutions.

The platform organises annual calls for research funding on themes such as smart grids, integrated regional and local energy systems, heating and cooling networks, digitalisation of the energy system and smart services. Involving relevant innovation stakeholders, technology developers and users in the participating countries and regions creates a transnational knowledge pool. This helps with the development and dissemination of new technologies, market designs and business models. Early involvement of stakeholders in co-creation processes is a vital part of this.

REALISING EUROPEAN OBJECTIVES

The Joint Programming Platform Smart Energy Systems is making a significant contribution to the transformation of the European energy system and the implementation of the European SET-Plan. The platform functions as an umbrella for ERA-Net Cofund actions in the area of SET-Plan Action 4, focusing on the integration of energy systems, sector coupling and digitalisation[1]. The various different JPP SES Focus Initiatives in the period from 2015 to 2025 complement each other, allowing synergies to be exploited and enabling links to be made between projects from different ERA-Net calls.

[1] nachhaltigwirtschaften.at/en/news/2018/implementation-plan-of-set-plan-action-4.php



Partner countries and regions in the Joint Programming Platform Smart Energy System

Further Partners: EU, MOROCCO, TURKEY, ISRAEL, INDIA

Joint Programming Platform Smart Energy Systems

32 funding partners
22 associated partners

75 projects in total
26 with Austrian participation

5 Calls*

EUR ~ 100 million
funding in total*

* 2015-2019

PRIORITIES AND ACTIVITIES

Between 2015 and 2019, JPP SES organised five transnational joint calls with public funding of just under EUR 100 million. Beginning with the focus on smart grids (calls 2015/16/17), in 2018 an initiative was launched on the theme of "Integrated regional energy systems". The 2019 joint call concentrated on storage system solutions and was also targeted towards external funding partners from the Mission Innovation countries ("MICall19")[2]. In 2020, a call for proposals was launched focusing on "Digitalisation of the energy systems". 2021, a call is planned on integrated regional energy systems with an emphasis on heating and cooling solutions. Three of the joint calls were co-financed by the European Commission through the ERA-Net Cofund instrument (ERA-Net Smart Grids Plus, ERA-Net RegSys, ERA-Net EnerDigit).

Since 2015 the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) is coordinating the JPP SES initiatives. During this period, Aus-trian stakeholders have been involved in 26 transnational proj-ects, helping to advance the international exchange of research and knowledge.

DEVELOPING PIONEERING SOLUTIONS

Research, technological development and demonstration play a central role on the path to a sustainable energy system. Transformation of the energy supply to 100% renewable energy sources requires a fully integrated system, in which power, heating/cooling and mobility are linked and many different components function together in an intelligent system. Integrated regional and local energy systems will play an important part in future.

In this edition we present some pioneering solutions and components for smart energy systems which are being developed in Austria, in collaboration with European partners, under the scope of the Joint Programming Platform SES, and some trailblazing national RDI projects from the programmes of the BMK and the Climate and Energy Fund. ●

www.eranet-smartenergysystems.eu

[2] Mission Innovation is a global initiative of 24 countries and the European Union, working to combat climate change and accelerate the development of clean energy technologies. At the 2019 Mission Innovation Ministerial conference in Vancouver a side event was organised by JPP SES where a group of MI countries declared their willingness to participate in the pioneering "MICall19", the first mulitlateral funding call for RDI projects within Mission Innovation, hosted by JPP SES.

CLEAN ENERGY TRANSITION PARTNERSHIP

Building on the findings and experiences of the ERA-Net initiatives the new European "Clean Energy Transition Partnership" (CETP) is now emerging. Austria is actively involved in the conception and development of the programme through BMK. Twenty-seven countries have already declared their interest to collaborate in this partnership. BMK together with a core group of countries facilitated the development of an initial Strategic Research and Innovation Agenda that was finally launched in November 2020. CETP is a pan-European research programme with the aim of accelerating all aspects of the energy transition. The initiative supports activities on regional, national and European levels, as well as collaborations between research, public organisations, industry and citizen organisations. Its purpose is to work together to drive forward the transformation of the energy system and to make Europe a pioneer of energy innovations and their implementation. CETP is helping to implement the European Green Deal and make the European vision of a climate-neutral Europe by 2050 a reality.

The innovation laboratory region Oberwart-Stegersbach, photo: act4.energy

CLUE

Pilot regions for local energy communities in four EU countries

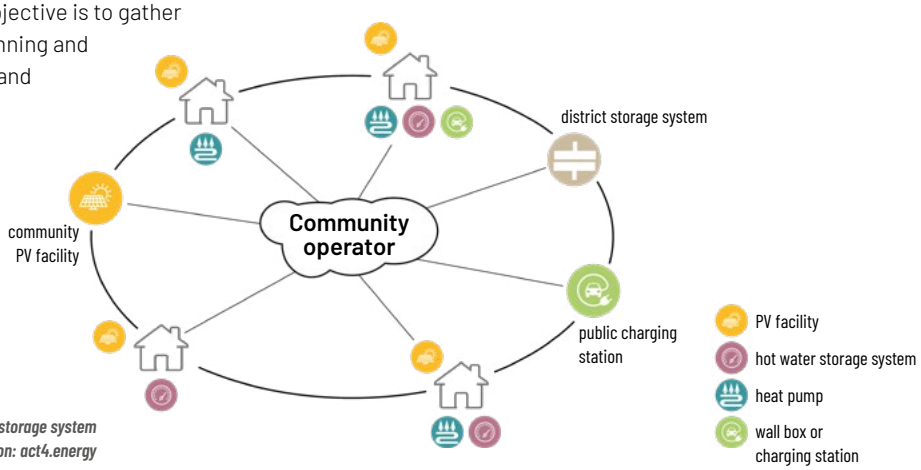
Energy communities provide a framework for implementing new solutions in the energy sector, by enabling citizens, municipal institutions and local businesses to share and exchange renewable energy resources amongst themselves. The idea is for energy to be locally generated, stored and used, so as to increase the proportion of e.g. photovoltaic power that can be used within the local community. Participants in local energy communities have lower energy costs, network charges, taxes and emissions. This creates incentives to invest in local, renewable energy systems and further increase the use of renewables.

TRANSNATIONAL COOPERATION

The CLUE research project is part of ERA-Net Smart Energy Systems and is focused on the implementation of local energy communities (LECs) in four European countries (Sweden, Scotland, Germany and Austria)[1]. The objective is to gather knowledge about optimised design, planning and operation of such energy communities and to develop a toolkit for the planning and operation of LECs.

The focus is on new technologies which allow flexibilities to be pooled and facilitate sector coupling within energy communities. The research partners also want to devise appropriate services and business models, with involvement from "prosumers" and stakeholders.

CLUE is run by leading European research institutions, industry and local partners, working together on five trial locations in the participating countries. By implementing and demonstrating various technological and market solutions, and carrying out transnational analyses, CLUE can develop optimised LEC solutions, tailored to country-specific and location-specific conditions.



Energy community with households, district storage system and e-charging infrastructure, illustration: act4.energy

> **ERA-Net is an instrument that allows us to pool transnational research activities that embody collaborative proposals in a certain way, e.g. by using shared strategies, work programmes, calls for proposals, evaluation processes or publications. This means that national research funding from different member states can be combined for greater effectiveness. The ERA-Net SES also facilitates the systematic sharing of information and best practices, with the aim of promoting communication between European partners.**
>
> RALF EICKHOFF
> FORSCHUNGSZENTRUM JÜLICH GMBH / FUNDING PARTNER GERMANY

AUSTRIAN TEST REGIONS

Austria is involved with two demonstration regions for local energy communities – the Almenland in Styria and the Oberwart-Stegersbach region in South Burgenland, which is the act4.energy innovation laboratory[2].

In South Burgenland the focus is on the integration of mobility options. To explore this, a local energy community is being set up in the demonstration region, with the aim of generating flexibility in the charging of e-vehicles, in combination with automated charging and payment processes. The automated payment system within the energy community is based on blockchain technology, which allows the use of a regional "energy token" (similar to a cryptocurrency such as Ethereum). The act4.energy innovation laboratory is providing expertise in open innovation and co-creation processes and will concentrate on user-friendliness and the end user experience for the project solutions being demonstrated.

In the Styrian trial region the emphasis is on investigating energy communities with regard to their potential contribution to network stability and security of supply. Energienetze Steiermark is investigating an energy community in the Almenland region that offers its customers short- and long-term storage of locally produced renewable energy. Day-to-day storage is to be provided using a battery system, while seasonal storage will rely on a hydrogen-based system. The two technologies are being used at both customer level and network level. The project is also testing how customers can use smart home devices ("homee") to adjust their usage by switching interruptible devices on and off, depending on the availability of surplus energy. ●

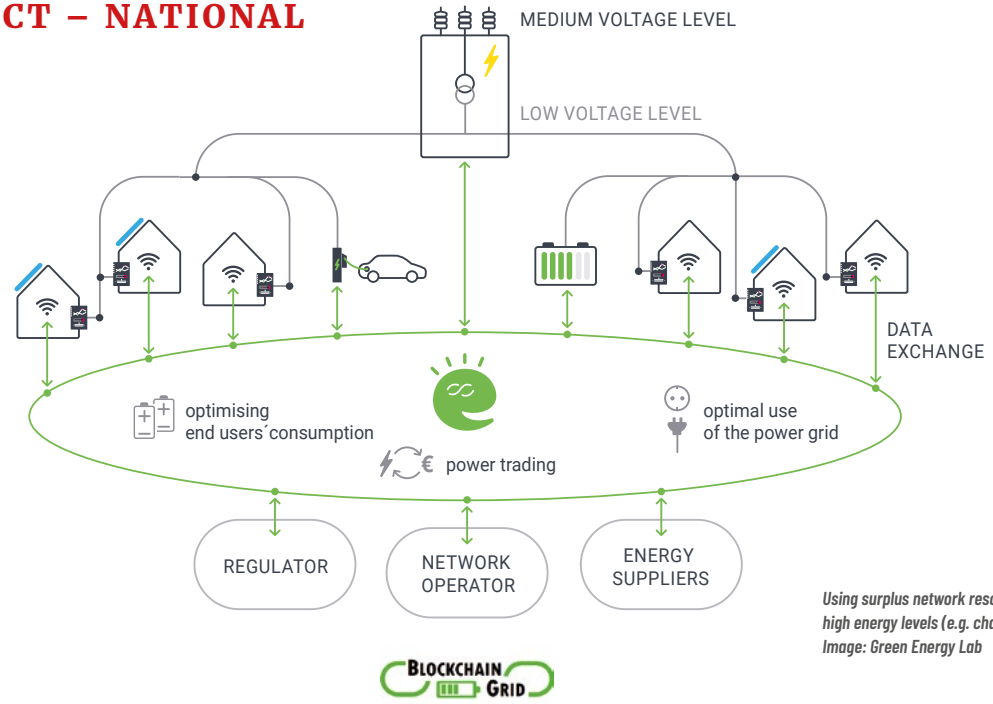
www.project-clue.eu

[1] **PROJECT PARTNERS**:
Austria: AIT Austrian Institute of Technology GmbH (project management), Energienetze Steiermark, Siemens AG Österreich, Climate and Energy Model Region, the municipality of Gasen, TU Wien/Department Computer Science, University of Applied Sciences Technikum Wien, lab10 collective eG, Energie Steiermark Kunden GmbH, Nature Park Almenland
Germany: Fraunhofer Institute for Solar Energy Systems ISE, E.ON Energy Solutions GmbH, Fakt AG
Sweden: Malmö stad, E.ON Energidistribution Aktiebolag, E.ON Energilösningar Aktiebolag, RISE Research Institutes of Sweden AB, Lunds universitet, Malmö kommuns parkeringsbolag, Vasakronan AB, Serneke Group AB
Scotland: ORE Catapult Development Services Limited, University of Strathclyde, Smarter Grid Solutions Limited

[2] www.act4.energy

This project has been funded by partners of the ERA-Net SES 2018 joint call RegSys. As such, this project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 775970.
www.eranet-smartenergysystems.eu

Photovoltaic and charging infrastructure in the innovation laboratory region, Photos: act4.energy



Using surplus network resources for applications with high energy levels (e.g. charging electric vehicles), Image: Green Energy Lab

Blockchain grid

Testing local management of energy, storage systems and networks

The growing number of decentralised sources feeding renewable energy into the grid, as well as new consumers such as electric vehicles, heat pumps and air conditioning systems, is increasing the load on medium- and low-voltage networks. New energy concepts are needed to enable more locally produced energy to also be consumed locally. Local energy communities are an innovative concept that was also included in the EU's climate and energy package, "Clean energy for all Europeans" [1]. They allow citizens and local authorities to participate actively in the energy system as "prosumers" (i.e. energy producers and consumers).

TEST OPERATION IN SOUTHERN STYRIA

Since autumn 2017, the community of Heimschuh in southern Styria has been the location of a pilot project for local energy communities. As part of the research project "LEAFS" [2], a central community storage system for photovoltaic power was installed. Residents can feed the solar power they produce into this storage system and then retrieve it when needed. This increases the utilisation rate of PV facilities from 30% to over 70%, and reduces household energy costs. It also relieves loading on the local power grid and creates additional capacity for connecting further renewable energy sources.

"With this project at Energienetze Steiermark, together with project partners Siemens, Energie Burgenland and the Austrian Institute of Technology (AIT), we are acting as trailblazers for the whole of Europe. We are already analysing specific strategies directly in the field, long before this is needed. In this way, we are gaining valuable knowledge and will have an immense starting advantage."

CHRISTIAN PURRER UND MARTIN GRAF
MANAGING BOARD OF ENERGIE STEIERMARK

Photo: Energie Steiermark

This "urban box" houses the community storage system, photo: Energie Steiermark/icon

Monitoring the power grid in the network control room, photo: Energie Steiermark/Werner Krug

BUILDING BLOCKS FOR LOCAL ENERGY COMMUNITIES

>> Community storage system
At times when locally produced electricity is not matched by demand, this surplus energy from households can be stored locally in a community storage system and consumed locally when required at a later point in time.

>> P2P trading
This approach allows surplus energy to be shared locally between customers, so that locally produced power can increasingly be marketed locally. Previously, any surplus power was bought by the major energy suppliers at low prices, without considering local needs.

>> Dynamic allocation of network capacity
This concept offers incentives for the optimal use of unused network capacities, which fluctuate over time, for producers and consumers. It allows households to allocate unused network capacities amongst themselves within a single section of the network. The network operator acts as market facilitator for the platform.

USING BLOCKCHAIN TECHNOLOGY

Since 2019, another field trial has been under way in the test network at Heimschuh, with around 200 passive and 13 active participants. In the Blockchain Grid project[3], Energienetze Steiermark, in cooperation with Energie Burgenland, Siemens and the Austrian Institute of Technology (AIT), is developing and testing a new application that allows users to sell their surplus solar power directly to neighbours and to allocate unused network resources autonomously amongst themselves. The key to this is blockchain technology, which is being tested here in real operating conditions for the innovative management of energy, storage systems and networks. There are 13 households participating actively as prosumers: they can share their unused resources via a blockchain-based platform to provide flexibility.

This project makes Heimschuh one of the first pilot "renewable energy communities" in Europe. The purpose of "energy islands" like this is to enable locally produced energy to also be stored and used locally, making it possible to become largely independent of external power sources. In addition, unused network capacity is allocated in real time to customers, allowing for instance faster charging of e-vehicles. ●

[1] https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en

[2] LEAFS - Integration of Loads and Electric Storage Systems into Advanced Flexibility Schemes for LV Networks, project partners: AIT Austrian Institute of Technology (project management), FRONIUS International GmbH, Siemens AG Österreich, Salzburg Netz GmbH, Netz Oberösterreich GmbH, Energienetze Steiermark GmbH, TU Wien – Energy Economics Group, Energy Institute at Johannes Kepler University Linz, MOOSMOAR Energies OG

[3] **PROJECT PARTNERS:** Energie Netze Steiermark (project management), Energie Burgenland, Siemens AG Österreich, AIT Austrian Institute of Technology

This project is part of the "Green Energy Lab" innovation laboratory. www.greenenergylab.at

LarGo!

Secure roll-out of smart grid applications in distribution networks

The onward march of digitalisation in power grids is changing the role that information and communication technologies play in distribution networks. Rather than just installing new hardware and network technologies, various software applications are also being deployed that process field data and perform control functions in real time. These applications are becoming increasingly necessary in order to guarantee power grid stability. The new systems and their software have to be maintained continuously and kept up to date. Updates are used, for example, to activate new functions or to adjust the configuration of existing functions, as well as to ensure system security.

Distribution networks are critical parts of the infrastructure, where outages cause substantial costs. Errors in the roll-out of new software solutions or updates in the network can have serious consequences, ranging from reduced power quality to power outages. Another effect can be a reduced efficiency of the new technologies. This could negate the potential environmental and financial advantages of smart grid technologies.

MAKING SMART GRIDS FUTURE-PROOF

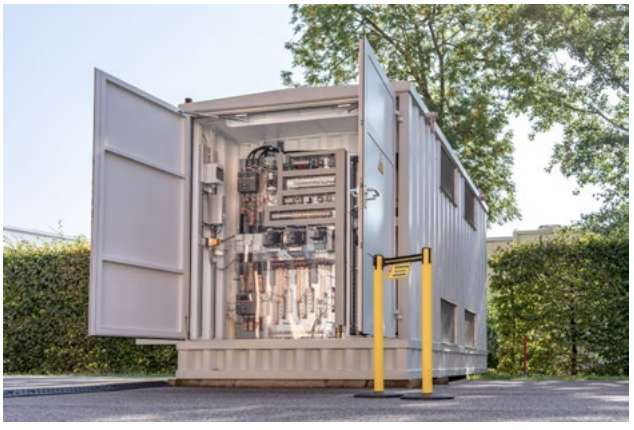
As part of the LarGo! project, a consortium[1] led by the Center for Energy at the AIT Austrian Institute of Technology is coming up with key solutions to the operational challenges in the grid management of today and tomorrow. LarGo! enables smart grid applications to be rolled out securely and resiliently by developing a seamless, application-specific deployment process[2]. Two domains were considered in particular detail in the project: the roll-out of software to control intelligent secondary substations, and of software for energy management systems in buildings. Comprehensive system simulations, hardware-in-the-loop experiments and field tests were used to develop the solutions for a secure smart grid roll-out.

For example, in order to facilitate the introduction of new software applications in distribution network operations, a framework was developed that generates an optimal roll-out schedule for all devices in a distribution network and also takes the specific situation in the network into account. This ensures that a roll-out can be carried out as quickly as possible, yet without jeopardising the security of the network.

In addition, the project demonstrated how a poorly planned roll-out of the software could lead to critical outages in the power grid. In order to prevent this from happening, part of the project was to work out a number of guidelines. The developments from LarGo! help to increase the efficiency and safety of future smart grid roll-outs and thus improve the acceptance of new smart grid solutions. ●

www.largo-project.eu

Control units in a smart local substation, photo: AIT/Oleksandr Melnyk



The intelligent local network station of the AIT SmartEST laboratory, photo: AIT/Oleksandr Melnyk

[1] **PROJECT PARTNERS:** AIT Austrian Institute of Technology GmbH (project management), Siemens AG Austria, Wiener Netze GmbH, OFFIS e.V. (Germany), Fraunhofer Institute for Solar Energy Systems ISE (Germany), KTH Royal Institute of Technology (Sweden)

[2] Deployment processes are semi- or fully automated processes to install and configure software on PCs and servers.

This project has received funding in the framework of the joint programming initiative ERA-Net Smart Grids Plus, with support from the European Union's Horizon 2020 research and innovation programme.
www.eranet-smartenergysystems.eu

Photo: European Commission, DG RTD-Research & Innovation

Patrick Child

Deputy Director-General
Directorate-General Research and Innovation (DG RTD)
European Commission

How does the Joint Programming Platform Smart Energy Systems contribute to the efforts of transforming the European energy system and the European Green Deal?

Smart energy systems are vitally important to provide the flexibility and resilience needed to accelerate electrification based on renewable energy sources, as a key dimension of our action on climate change. The Joint Programming Platform Smart Energy Systems is a focus for cooperation and joint programming of research and innovation between EU, national and regional funding partners. It will make major contributions to our shared goals under the European Green Deal including with active participation of communities and regions. We strongly welcome the enthusiastic support of Austrian participants in this important initiative.

As part of the international research and innovation cooperation on clean energy transition, how do you see the role of Mission Innovation and the ongoing renewal of it?

Mission Innovation (MI) is one of the key international cooperation platforms through which the EU promotes the ambitions of the European Green Deal globally. Building on the success of current initiatives, MI is preparing to launch an ambitious second phase at the next Ministerial meeting, hosted by Chile in May this year. The future MI cooperation will include missions that will inspire and lead members and partners to commit to actions, which can reach tipping points and deliver climate impacts within the next decade. A new MI platform will allow continuation of sharing information, best practices and results of existing initiatives.

Achieving these ambitious goals requires strengthened cooperation with members, including we hope new partner countries as well as investors and innovators in the private sector and the research and innovation community in Europe and beyond.

Austria is very active in MI, with a leading role on preparing the future missions and a sustained contribution to the secretariat. As current chair of the Steering Board of Mission Innovation, I look forward to continuing this close cooperation with Austria and other partners as we prepare Ministers' decisions on the future direction of MI and its contribution to the wider debate on Climate change among leaders at the COP26 meeting in November in Glasgow.

During the Pioneer Call 2019, non-European partners from Mission Innovation countries contributed as well. Which opportunities could arise from expanding the network of membership of Mission Innovation?

Climate change and the clean energy transition are global challenges that require global solutions. International cooperation in research and innovation is needed to mobilise countries around the world on commonly agreed objectives. Our EU experience of international collaboration through the SET-Plan and ERA-Nets is something that we can share with other MI partners as inspiration for future effective multilateral international cooperation in joint projects. Moreover, expanding the collaboration of ERA-Nets with Mission Innovation countries provides opportunities to align the R&I activities under the SET-Plan with Mission Innovation priorities.

How would you define the main goals and key challenges of the new Clean Energy Transition Partnership (CETP) initiative?

Achieving a climate neutral society by 2050 is one of Europe's most important challenges and the raison-d'être of the European Green Deal.

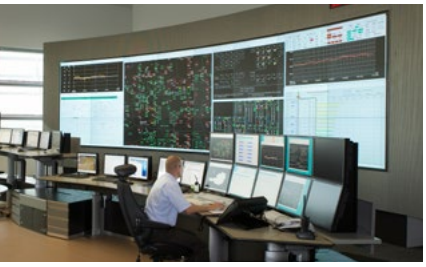
The transformation of the energy sector is at the heart of this agenda. Achieving a clean and integrated energy system requires a sustainable and socially fair transition, encompassing technological, social, economic and political dimensions. Research and innovation (R&I) is vitally needed to support this transition with new technologies, strategies and business models. The EU's upcoming Horizon Europe framework programme will generate a wave of multidisciplinary impact-driven R&I actions to support the transition, including the Clean Energy Transition Partnership (CETP).

For the next 10 years, the CETP will be a cornerstone for multilateral R&I collaboration in Europe and beyond, supporting national and regional research programmes in finding and implementing a shared vision. The CETP's transformative research and innovation programme will be reflected in a challenge-driven and transdisciplinary Strategic Research and Innovation Agenda (SRIA). Implementation will be through the CETP joint programming activities. We also need to find synergies with other initiatives and partnerships to ensure that the CETP adds value and is coherently embedded in the overall SET-Plan landscape.

ABS4TSO

High-dynamic services for the power grid

The growing number of renewable energy sources and the increased decentralisation of energy generation mean that our energy networks need to be transformed. The fluctuating power supply from renewable energy sources, such as wind and solar energy, is changing the situation in the transmission and distribution networks fundamentally. In order for the electricity system to function reliably, electricity consumption and generation must be balanced at all times. When the mains frequency is constant at 50 Hertz, this balance is guaranteed and the energy supply is stable.



APG control centre, photo: APG/Lukas Dostal

Transmission and distribution grids per se are practically unable to store energy. Up until now, fluctuations between power generation and consumption as well as minor grid faults and frequency deviations have been compensated in conventional hydraulic and thermal power plants by the large rotating flywheel masses of the turbines. This is called system inertia. In contrast, wind power and photovoltaic power plants are usually connected to the grid through inverters, which means that they do not provide their own natural inertia mass with today's common control methods, and therefore do not have a frequency-stabilising effect on the system. Due to the conversion of the energy system to renewable energy, more and more conventional power plants are going off the grid and as a result there is less natural inertia mass in the overall system. This is increasingly posing a challenge to the power system.

INTELLIGENT STORAGE CAPACITIES AS A SOLUTION

As part of the ABS4TSO (ABS for Transmisson System Operators) research project, the transmission system operator APG (Austrian Power Grid AG), in cooperation with several project partners[1], is investigating innovative approaches to stabilising the power system, ensuring a secure power supply and integrating renewable energy sources. The focus is on the concept of using intelligent battery storage units as well as other fast controllable technologies in order to be able to react very quickly to frequency deviations in the transmission grid, thus keeping the high-voltage system stable. The inertia mass, which has so far been supplied by the rotating generators, could in future be provided virtually by means of battery storage and inverters. ABS stands here for "Advanced Balancing Services". Like the ABS system in a car, these storage systems could in future take on the task of keeping the system on track in difficult situations.

TEST SYSTEM IN VIENNA

In order to test this forward-looking concept, a test system was installed at APG's Vienna Southeast substation in 2019. The heart of the system is a battery storage unit with a capacity of 1 MW and an energy content of 500 kWh. Here, the characteristics of high-dynamic system services, which will be necessary to en-

"We need new grid elements and new mechanisms in the power grid to provide the basis for integrating renewable energy sources and to maintain the current high security of supply. This is precisely where the "ABS for the power grid" project comes in. It shows the ways we could use intelligent storage systems and other fast controllable technologies to stabilise the Austrian and European power transmission grid of the future. The project represents a dynamic system in which the energy transition will succeed and and the security of the power system will be kept."

MICHAELA LEONHARDT,
PROJECT LEADER AUSTRIAN POWER GRID AG

Photo: Georg Wilke

Top: Vienna Southeast substation with ABS4TSO battery storage unit, Photo: APG/Rainer Wagenhofer
right: ABS4TSO battery storage unit interior, Photo: APG/Gerhard Wasserbauer

sure system stability and security in the future, are being investigated. Battery cell technology based on lithium-ion batteries is already a proven standard. The inverter, on the other hand, had to be specially adapted for the investigations in the high-dynamic range. While the reaction time for standard products is in the range of seconds, the ABS4TSO inverter must react high-dynamically within milliseconds in order to be able to provide virtual inertia mass. As part of this project, research was done in the laboratory on own parameterisation options as well as new additional functions for the inverter, and then simulated, programmed, and finally implemented in the system.

CONTROLLING MULTIPLE FUNCTIONS

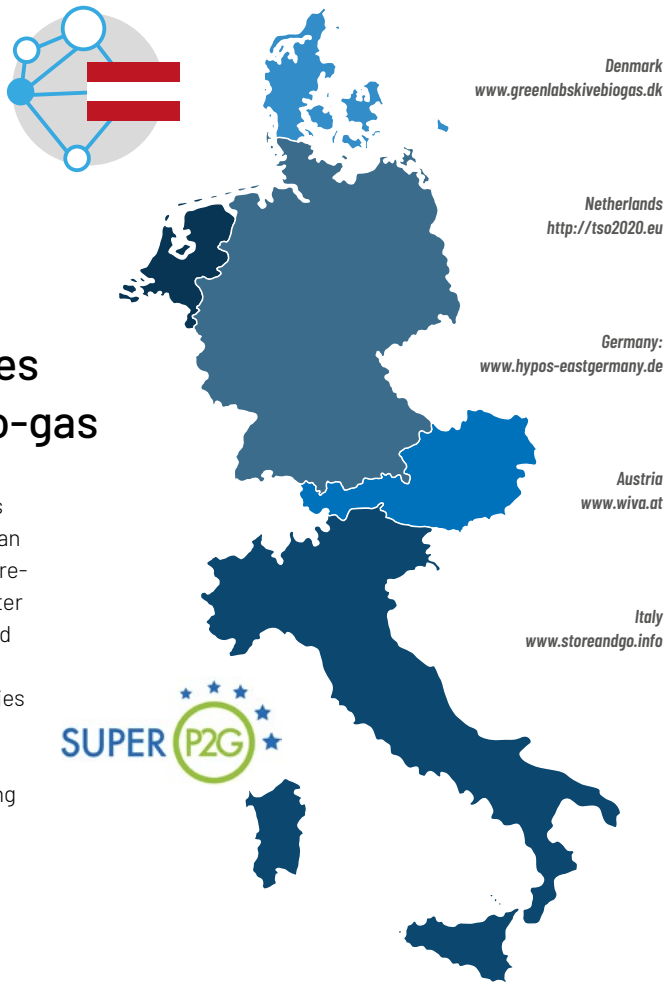
In the field test, real frequency curves and current grid events are now being used to investigate whether the battery storage unit can stabilise the power system in the same way as the rotating masses of conventional power plants do. The goal is for the storage system to perform multiple functions, thus providing high-dynamic services. These include stabilising the frequency by supplying virtual intertia mass, providing high-dynamic control power and damping low-frequency system oscillations. The system should be able to respond to each of these situations as well as to combinations of them. Extensive simulations were carried out in the laboratory beforehand from which specifications for the practical test were then derived.

Depending on the research results from the test system, it will then be evaluated which new system services are feasible in practice and can be scaled up for the European transmission grid. ●

www.energieforschung.at/projekte/1012/advanced-balancing-services-for-transmission-system-operators
www.apg.at/en/projekte/abs4tso

[1] **PROJECT PARTNERS**: Austrian Power Grid AG (project management), AIT Austrian Institute of Technology GmbH, TU Wien, VERBUND Hydro Power GmbH, VERBUND Energy4Business GmbH, VERBUND AG

A project within the framework of the energy research programme of the Climate and Energy Fund.
www.energieforschung.at



SUPER P2G

Using renewable energy sources more effectively with power-to-gas

The switch to a CO_2-neutral energy system in the future entails major challenges. Power-to-gas (P2G) technology could make an important contribution here. In this process, electri-city from renewable sources is used to produce hydrogen by means of water electrolysis and, in an optional second step, it can be combined with carbon dioxide (CO_2) to produce synthetic methane. The conversion of energy with the help of power-to-gas technologies opens up many options for future integrated energy systems and enables a coupling of the electricity, heating/cooling and mobility sectors. The technology offers solutions for developing a CO_2-neutral energy system, such as the long-term storage of fluctuating renewable power sources and providing renewable energy carriers for industrial processes and mobility.

There are now a large number of P2G pilot or test plants in Europe. However, these can usually only be implemented and operated with public funding, because commercial use is often not yet possible. Among other things, the general conditions that would reward the additional positive system benefits of P2G plants are still lacking at the moment. This is where the SuperP2G[1] project comes in. Within the framework of the ERA-Net cooperation, the plan is to develop strategies for the commercial implementation of this technology. Important topics are its technical optimisation and system integration, how to bring Power-to-Gas to the market, increase its acceptance, and develop customised solutions for companies.

CASE STUDIES IN FIVE COUNTRIES

The transnational cooperation aims to bring together the leading European power-to-gas initiatives – in Austria this is the flagship region WIVA P&G[2]. Case studies are being carried out in five countries in order to initiate joint learning processes and approaches to solutions. Each national project focuses on specific issues. New strategies and solutions are developed by researchers in close cooperation with local stakeholders.

The Austrian contribution involves analysing the future demand for renewable hydrogen and SNG (Synthetic Natural Gas) in industry. An important focus is on simulating the cost trends. For this purpose, a special methodology will be developed and validated using Austria as an example.

Among other things, the tools developed at the Energy Institute at Johannes Kepler University Linz (CoLLeCT, PResTiGE, and MOVE) will be expanded in order to be able to estimate future demand and the cost trends of renewable gases. The resulting data will then be incorporated into a cross-border SuperP2G tool.

EXCHANGE OF KNOW-HOW

The findings from the case studies will be shared by the project partners and in the ERA-Net Knowledge Community. Based on these findings, the aim is to assess how power-to-gas technology can be used to improve renewable and regional system integration. Key questions concern the possibilities for regional purchase of green gas, involving regional stakeholders, as well as the potential for scaling up power-to-gas to other EU regions. ●

www.superp2g.eu

[1] **PROJECT PARTNERS**: Technical University of Denmark (project management), Greenlab Skive (Denmark), Energy Institute at Johannes Kepler University Linz (Austria), DGI Gasttechnologisches Institut GmbH, DVGW Research Station at Engler-Bunte-Institute, Karlsruhe Institute of Technology (KIT) (Germany), National Research Council of Italy, CNR ITAE, University of Bologna/Department of Industrial Engineering (Italy), University of Groningen/Faculty of Economics and Business (Netherlands), European Research Institut for Gas and Energy Innovation (Belgium)

[2] www.wiva.at

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www.eranet-smartenergysystems.eu

Clean Energy 4 Tourism

Modern control technology for high energy efficiency in tourist regions

Photo: GettyImages-963088232 | shutterstock.com/prochasson freder

In the Austrian flagship project Clean Energy for Tourism (CE4T)[1], innovative technologies and products for decarbonising ski resorts are being developed and tested. To do this, Salzburg's ski resorts are being equipped with state-of-the-art energy control technology and specially developed optimisation algorithms are being used to coordinate different energy-intensive processes with one another and exploit areas of flexibility.

The goal of optimising and managing the various areas of energy flexibility within the ski resorts (e.g. the pumps, snow machines, PV systems, e-charging stations, etc.) is to increase energy efficiency and take some of the pressure off the power grids. By storing surplus energy in Salzburg AG's storage power plants in the off-season and getting other local industries (such as hotels and spas) involved, the expansion and integration of renewable energy sources are to be promoted.

INTEGRATED ENERGY MANAGEMENT

However, unlike in industry, for example, there is no solution for comprehensive energy management for ski resorts on the market today that integrates the many energy-intensive processes such as snowmaking, powering the ski lifts, grooming the slopes, running the restaurants, and providing mobility all in one system. The project develops and implements tried-and-tested optimisation algorithms, related interfaces, and an ICT framework to maximise energy efficiency, integrate renewable energy sources, and make use of opportunities for flexibility in the ski resorts' energy requirements.

The aim is to achieve an integrative and systemic optimisation that covers the entire winter tourism region, the energy supply system, and the electricity market. The new technologies and solutions are developed in a co-creative process with energy suppliers, grid operators, technology providers, and ski resort operators. They should help to make the most efficient use of existing infrastructures and optimise them in terms of the energy network and the electricity market. The plan is for the solutions to be transferable to other areas within Austria's tourist industry as well as to other countries and other energy-intensive industries.

CURRENT HIGHLIGHTS

- The optimisation calculation for controlling flexibilities has been implemented for the first ski resorts. In the summer of 2020, the first algorithm-based filling of a reservoir took place in the Schmittenhöhenbahn ski area.[2]
- The planning tool for integrating renewable energies and technologies was developed.[3]
- A prototype was created for the energy management system.[4]
- Using a KPI (Key Performance Indicator) system, the ski resorts can be compared in future and the effects on the CO_2 balance can be shown.[5] ●

www.nefi.at/ce4t-clean-energy-for-tourism

[1] **PROJECT PARTNERS**: Salzburg AG (project management), ski resorts: Oberpinzgauer Fremdenverkehrsförderungs- und Bergbahnen AG, Hinterglemmer Bergbahnen GmbH, Saalbacher Bergbahnen GmbH, Schmittenhöhebahn AG, Gletscherbahnen Kaprun AG, Rauriser Hochalmbahnen AG, Bergbahnen Fieberbrunn GmbH, Leoganger Bergbahnen GmbH, BBSH Bergbahnen Saalbach-Hinterglemm GmbH, sattler energie consulting GmbH
Research partners: AIT Austrian Institute of Technology GmbH, University of Leoben/ Chair of Energy Network Technology
Technology partners: World-Direct eBusiness solutions GmbH, BEST – Bioenergy and Sustainable Technologies GmbH, Faradis GmbH, sattler energie consulting GmbH

CE4T is a project of the flagship region NEFI – New Energy for Industry.
www.nefi.at

[2] AIT (algorithm), World Direct (control and data management), Salzburg AG (energy industry and energy markets)
[3] BEST (algorithm), Salzburg AG (energy industry and energy markets)
[4/5] AIT
[6] AIT, World Direct

HEATflex

Staying competitive in the district heating sector

Solar field, photo: stock.adobe.com

Heat pump for feeding waste heat into district heating networks, photo: 4ward Energy Research GmbH

In the HEATflex[1] project, experts from Austria and Denmark are developing technical and economic strategies within the framework of ERA-Net SES to increase the competitiveness of CHP plants and district heating plants. Central topics are the integration of renewable energy and the provision of heat flexibilities.

Decentralised feed-in to district heating systems will increase significantly in the future thanks to the European "Directive on the promotion of the use of energy from renewable sources"[2]. The share of renewable energy sources in the EU's final energy consumption is to increase to at least 32% by 2030. In the heating and cooling sector, the Directive stipulates an annual increase of 1.3 percentage points in the share of renewable energy sources.

[1] **PROJECT PARTNERS**: 4ward Energy Research GmbH, Güssing Energy Technologies GmbH, Reiterer & Scherling GmbH, Regelungs-Verteilerbau GmbH (Austria), PlanEnergi (project management), energy Cluster Denmark, Viborg Fjernvarme (Denmark)

[2] https://eur-lex.europa.eu/legal-content/DE/LSU/?uri=CELEX:32018L2001

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CURRENT SITUATION IN THE DISTRICT HEATING SECTOR

Competitive pressure in the district heating sector is steadily increasing, especially for biomass-based CHP plants. At present, it is hardly possible to operate such plants in Europe without subsidies. Energy-efficient building renovations are also reducing the specific heat demand in existing district heating networks, which leads to lower utilisation.

The decentralised feed-in of energy from renewable sources has a significant impact on the operation and control of grids. Operators of district heating networks are confronted, among other things, with the situation that too much heat is fed into parts of the network in the meantime (e.g. in summer in the case of district heating in Silkeborg, Denmark, where the world's largest solar power plant is located). Moreover, conventional district heating systems are not designed to distribute heat in both directions in the network. This increases the demand for flexible heat and for solutions that integrate a higher proportion of renewable energy sources.

TRANSNATIONAL RESEARCH COOPERATION

Due to the complexity and the different applications, there is a great need for research in the district heating sector. New concepts and solutions must be developed for both technical and economic issues. These include hydraulic integration, the control of decentralised pumps, the billing of prosumers (users who both feed heat into the district heating network and draw heat), flexibility on the heating market, and the optimised use of P2H (power-to-heat). New business models are needed that take advantage of the prosumer approach and reduce dependence on subsidies in the future.

This is where the transnational HEATflex project comes in. In a first step, more than 30 interviews as well as workshops with stakeholders in Austria and Denmark were carried out within the framework of the project in order to ascertain the technical, legal and economic framework conditions, as well as the need for new business and operating models. Based on this, business cases could be defined and a simulation approach for a valuation tool was developed.

HEATFLEX CALCULATION TOOL

The next step was the development of the HEATflex Calculation Tool, a simulation tool that allows the estimation of the (positive) impacts of integrating renewable energy sources into an existing district heating network. After entering a reference scenario, different heat sources, such as solar energy or a waste heat recovery plus heat pump, can be added and the analysis of the technical, commercial, and economic effects can be calculated. Work is currently underway to integrate thermal storage models into the system.

The HEATflex-Calculation Tool will be available for free download on the project homepage after completion. The project results will also be incorporated into various guidelines to help with the implementation of sustainable heat networks. Guidelines are planned for integrating prosumers in district heating networks, as well as for reducing the network temperatures. ●

www.4wardenergy.at/en/references/heatflex
www.cleancluster.dk/heatflex

District heating pipes, photo: stock.adobe.com

District heating house distributor, photo: stock.adobe.com

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