

energy innovation austria

3/2020

Current developments
and examples
of sustainable energy
technologies



Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Integrated energy systems

Citizens take an active role
in the energy transition

The "Green Energy Lab" is Austria's largest living lab to research and test exciting new concepts and solutions for an energy system of the future that runs on 100% renewable energy. A key part of these efforts is bringing stakeholders and users on board at an early stage and developing innovative business models.

Photo: stock.adobe.com



Photos: Projektfabrik Waldhör KG

Shaping the future of energy

Involving users in the innovation process

To meet the challenges posed by climate change and the destruction of the environment, the European Union launched a new growth strategy in late 2019.

The European “Green Deal” is the roadmap for a sustainable and competitive EU economy and is designed to make Europe the world’s first climate-neutral continent by 2050. The ambitious package of measures ranges from making a decisive cut in greenhouse gas emissions and investing in cutting-edge research and innovation through to preserving the natural environment. The investment plan proposed in early 2020 sets out to mobilise sustainable investments worth at least EUR 1 trillion over the next ten years for the climate transition.¹ The Green Deal initiatives include Europe’s first-ever climate law to enshrine the goal of climate neutrality by 2050 in EU legislation.

PARTICIPATION AND CO-CREATION

Major societal upheavals such as climate change, urbanisation, demographic change and digitalisation call not only for technological but also for social innovations. If Europe is to achieve the climate neutrality it is seeking for 2050, it will need to get its citizens involved from an early stage and on an ongoing basis. Two key objectives of European mission-oriented research policy are to integrate user perspectives into the innovation process and involve stakeholders and users in developing and implementing missions, including as part of co-creation processes.² The Climate Pact being proposed by the EU Commission is designed to pool all the efforts geared towards a climate-friendly future and to integrate regions, local communities, civil society, schools, industry and individuals into the transformation process.³

CUSTOMERS PLAY AN ACTIVE ROLE IN THE INTEGRATED ENERGY SYSTEM

Energy customers will take on a new role in the energy system of the future, which will be based on renewable energy sources. The fluctuating supply of energy from wind and solar power calls for a great deal of flexibility from the energy system. In the future, an increasing number of private households, public buildings, small-scale manufacturers and industrial companies will go from being simple consumers of energy to “prosumers”, who can generate their own energy on their own premises, consume it locally, store it and feed it into the grid. Digitalisation is opening the door to integrated solutions and enabling the various components, such as photovoltaic (PV) systems, storage systems and electric vehicles as well as consumption, to be controlled and coordinated with one another. By harnessing new technologies, end customers will be able to offer flexibility and thus become active players in the integrated energy system. The EU’s “Clean energy for all Europeans” climate and energy package⁴ has established a



Photo: stock.adobe.com

Green Energy Lab

Austria's largest "living lab" for green energy



The Green Energy Lab is a research initiative for sustainable energy solutions and part of the Austrian "Flagship Region Energy" innovation campaign being run by the Climate and Energy Fund. More than 200 partners from science, business and the public sector are taking part. They are working together with energy providers from four states – Wien Energie, EVN, Energie Burgenland and Energie Steiermark – to develop solutions that are geared towards customers, based on actual requirements and scalable, from the prototype phase through to market readiness. The aim is to showcase a joint demonstration of an integrated energy system running on 100% renewable energy. A total of EUR 150 million is to be invested in innovative projects as part of the Green Energy Lab by 2025.

The region involved (Vienna, Lower Austria, Burgenland and Styria) offers ideal conditions for developing and trialling new energy solutions: it is home to 5 million inhabitants, presents a

framework that strengthens the role played by individuals, SMEs, public bodies and relevant community structures in the energy sector.

ENABLING ENERGY COMMUNITIES

A recent study entitled "Renewable Energy in Austria" (by the University of Klagenfurt, Vienna University of Economics and Business, Deloitte Austria and Wien Energie) shows that many Austrians back the idea of renewable energy carriers. Across the country, 77% of respondents are in favour, while amongst young people the figure is as high as 82%. Solar power is the most popular, with some 88% stating that they would support a PV power plant in the community where they live, 74% a small-scale hydropower plant and 67% wind turbines near their community, according to the report for 2019. The idea of setting up energy communities has also met with growing interest, with nearly two thirds of Austrian respondents considering getting actively involved in a system of this kind. Energy communities allow individuals to club together to generate, consume and store electricity or heat at a local level. The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) is currently formulating a new national framework as part of its implementation of an EU Directive on energy communities. Since 2017, Austrians have been able to use a shared production facility to make the electricity generated by a building available to all its residents

marked contrast between its urban and rural areas, and already generates by far the highest percentage of Austria's renewable energy (98% of its wind power and 64% of its PV). Direct access to the energy providers' core market allows new developments to be tested out here on a large scale.

Key priorities in terms of developing and delivering innovations include getting the relevant stakeholders and users participating from an early stage, devising new business models, transferring knowledge, networking, and communicating project results to a wide audience.

<https://greenenergylab.at>

>>> In this issue, we take a look at some current projects that are being implemented in Austria as part of the Green Energy Lab research initiative.

or tenants. In the future, the new energy communities will also enable electricity to be produced, put to communal use, stored and even traded on the energy market beyond the boundaries of the building that generated it, i.e. elsewhere in the same region. This is likely to expect dynamic growth in the future.⁵ ●

¹ https://ec.europa.eu/germany/news/20200114kommission-praesentiert-plaene-zur-finanzierung-des-oekologischen-wandels_de

² https://ec.europa.eu/info/sites/info/files/research_and_innovation/contact/documents/ec_rtd_mazzucato-report-issue2_072019.pdf

³ https://ec.europa.eu/commission/presscorner/detail/de/qanda_20_336

⁴ https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en

⁵ <https://infothek.bmwit.gv.at/studie-erneuerbaren-energien-oesterreich-klimapolitik/>



Photo: Projektfabrik Waldhör KG



In net terms, the **Burgenland wind-power region** generates around 50% more electrical energy than it consumes over the course of a year. At the end of 2019, it was home to 450 wind farms producing a total output of 1,124 MW.

<https://windfakten.at/mmedia/download/2020.03.30/1585561587790868.pdf>



Hybrid DH DEMO

New business models for wind power in the Neusiedl energy hub

Photo: Projektfabrik Waldhör KG

Wind power will have an important role to play in the future energy scenario involving 100% renewable energy. The state of Burgenland has been expanding the use of wind power for many years and now generates much more energy than it consumes. However, the large surplus (around 50%) places a certain amount of strain on the power grids, meaning that the wind turbines sometimes have to be switched off. The fact that the tariff subsidies are soon to run out for many older turbines is also posing new challenges to the marketing of wind power. The Hybrid DH DEMO¹ project is therefore developing concepts and innovative business models for using wind power in a hybrid district heating system and is testing them in Neusiedl am See.

COUPLING WIND POWER AND HEAT

Neusiedl, where the central district heating power plant, the natural gas grid and the public power grid all come together, lies at the heart of the project. The location is to be developed into an “energy hub” by using heat pumps to couple the two sectors of power and heat. This will involve expanding an existing biomass heating plant connected to the district heating network by adding a power-to-heat plant. A direct line will take wind power straight from the substation to the heating plant, where it will be converted into heat and then distributed via the district heating network. The conversion process will be driven by a flue gas condensation heat pump (1 MW_{th}) and an air source heat pump

(1 MW_{th}). A buffer storage system will also be enlarged to 300 m³ and a power storage solution will be implemented to facilitate controlled operation of the heat pumps. The smart coupling of heat and power will allow some of the energy used in the district heating system to be replaced by surplus wind power.

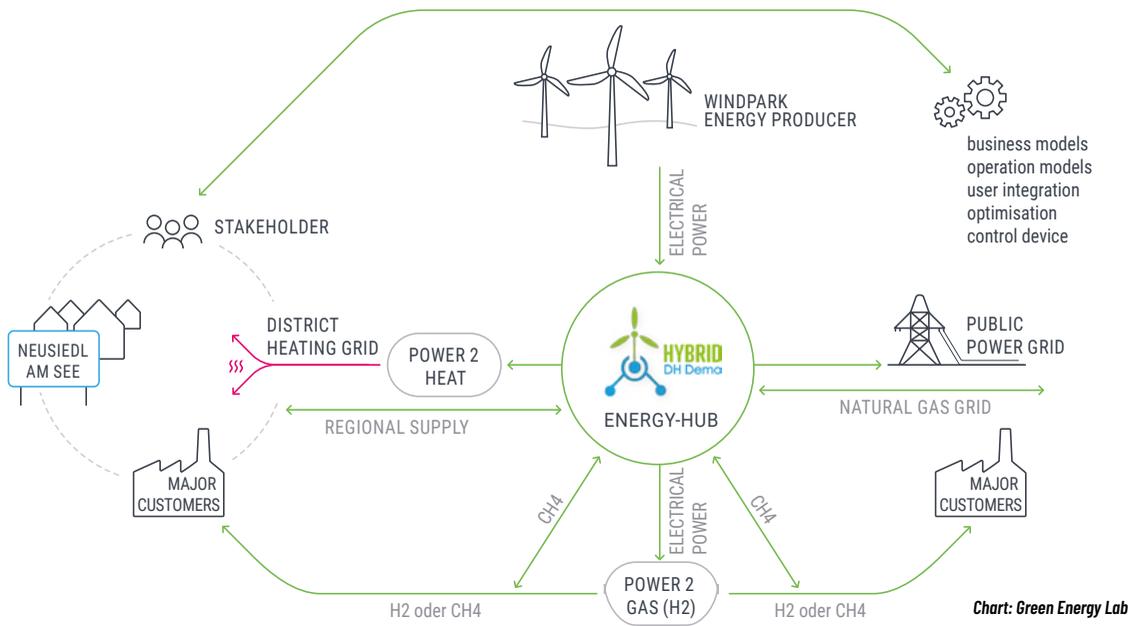
AN “OPEN INNOVATION” APPROACH

Efforts are being made to involve the town of Neusiedl and its residents in project development based on the “urban living lab” principle in order to ensure a high level of acceptance for the innovations. The new concepts and business models designed to improve the use of wind power are being devised and tested out together with locals, companies and other interested parties. The main innovative element in this is the development of a multimodal management strategy. The project also involves monitoring operations at the energy hub and continuously optimising the economic and technical aspects of operation. ●

<https://greenenergylab.at/projects/hybrid-dh-demo/>

¹ **PROJECT PARTNERS:** 4ward Energy Research GmbH (project management), Energie Burgenland AG, ENERCON Service Austria GmbH, Forschung Burgenland GmbH, TBH Ingenieur GmbH

The project has been funded by the Smart Cities Demo 2018 research programme and is an associated project of the Green Energy Lab.



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If we want to devise future measures for climate protection, we’re going to need a concerted effort. The burden of delivering complex projects has to be shared – nobody can manage it on their own. This is why Energie Burgenland joined forces with Wien Energie, EVN and Energie Steiermark to set up the Green Energy Lab innovation laboratory. In the Lab, we combine the best ideas with the best companies and get research projects ready for a large-scale market roll-out.”



Photo: Energie Burgenland AG

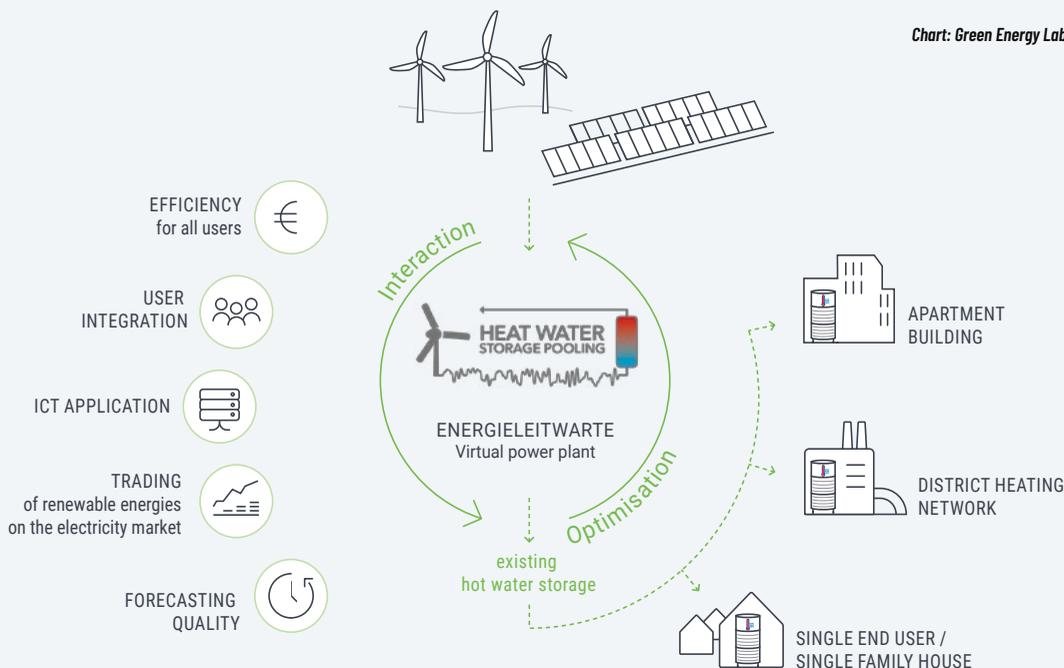
RAPHAELA REINFELD-SPADT
HEAD OF INNOVATION AND PRODUCT MANAGEMENT AT ENERGIE BURGENLAND AG,
CHAIRWOMAN AND SPOKESWOMAN OF THE GREEN ENERGY LAB ASSOCIATION



PROJECT GOALS

- > 20% fewer shutdowns for Energie Burgenland’s wind turbines
- > 5% increase in the percentage of renewables in the town of Neusiedl’s energy mix (excluding fuels)
- > Optimising the district heating network and reducing losses by 2%
- > Optimising energy flows in the “energy hub” from an economic, technical and ecological perspective
- > High level of acceptance amongst residents

Heating plant at Neusiedl am See,
Photo above: Energie Burgenland
Photo below: Projektfabrik Waldhär KG



Heat Water Storage Pooling

Heat storages for a more flexible energy system

In order to optimise local and regional energy systems with a high percentage of renewable energy, consumption has to be made flexible. One way to introduce this flexibility on the consumer side are power-to-heat plants, which generate heat by electricity from renewable sources to use it locally straight away or store it. These storage systems help to balance the fluctuations between power generation and consumption and increase grid stability.

POOLING HOT WATER STORAGE SYSTEMS

The Heat Water Storage Pooling project aims to group together existing heat storages of different sizes and uses (from boilers in single-family homes to large-scale storage systems for district heating) in order to create a pool which is characterized by a high total capacity and flexible characteristics. Existing storage units are upgraded and combined into one large virtual storage unit as part of the project, which is run by Forschung Burgenland GmbH together with Energie Burgenland AG and other partners.¹ Wind turbines, regional heating systems and storage systems are integrated into a single system inside this virtual power plant. Automated control of the thermal storage systems allows power-to-heat operation to be shifted to times when a lot of wind power is generated.

TESTING WITH THE HELP OF ENERGY CUSTOMERS

To evaluate this approach, heat storage units of at least 30 individual customers, a district heating network and five apartment buildings are connected to the so-called Energieleitwarte (i.e., a central station responsible for scheduling and operating the different system components) and the operation of the pooled

hot water storage systems is optimised. The project helps to develop and trial a pioneering concept involving economic and social aspects to enable the integrated pooling of hot water storage systems for a broad rollout.

PROJECT GOALS

- > Minimising costs for customers and suppliers by optimising storage system operation
- > Optimising grid operation by pooling heat storage vertically
- > Increasing the potential for integrating multiple renewable energy sources
- > Avoiding wind turbine shutdowns
- > Avoiding the need for regulating and balancing energy

Combining systems into a virtual storage unit harbours enormous potential for using heat storages to provide flexibility. Burgenland alone is home to several thousand small-scale thermal storage systems connected to electrical heat generation as well as several hundred units in residential buildings and the potential for up to 170 GWh in district heating per year. The concept can also be replicated in other regions, it can help to optimise the energy system and push the integration of renewable energy sources into grids and markets. ●

<https://greenenergylab.at/projects/heat-water-storage-pooling/>

¹ **PROJECT PARTNERS:** Forschung Burgenland GmbH (project management), Energie Burgenland AG, 4ward Energy Research GmbH, energy & meteo systems GmbH, Pink GmbH



Photo (left): stock.adobe.com

Photo (right): Sonnenplatz Grossschönau GmbH

BEYOND

New market designs for optimised local and regional energy systems

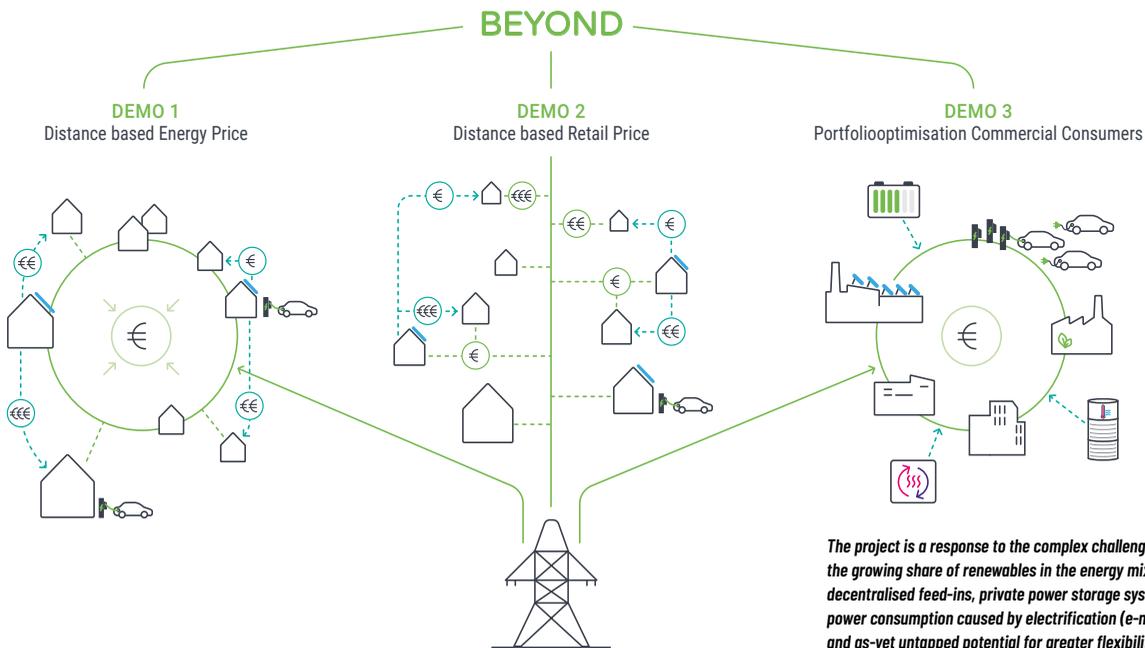
Led by TU Wien¹ this project is developing and demonstrating new market designs as well as applications for integrated local and regional energy systems that benefit grids and systems. The aim is to optimise local energy systems containing many different market participants while also enabling them to be integrated into regional and national grids. To this end, a socio-technical ecosystem is being created that is being implemented and trialled in three testbeds, each with specific characteristics.

New monitoring strategies and the use of decentralised IT technologies (including blockchain) are being studied and evaluated as part of the project, and concepts for local and regional energy markets and innovative partnership and business models are being devised.

The new concepts and digital solutions are being developed in collaboration with future users and relevant stakeholders (e.g. grid operators) to facilitate a high level of acceptance and enable the results to be replicated elsewhere. The general legal and regulatory conditions as well as European, regional and local market trends are also being taken into consideration in this process.

The feasibility of the concepts being developed will be assessed from autumn 2020 onwards based on use cases in the municipality of Großschönau and two energy-buying groups – best connect (which has members throughout Austria) and eFriends (based in Lower Austria). The plan is to link up and optimise the energy systems of up to 50 households and businesses. The trial is intended to showcase the technological advantages of the model as well as its commercial potential. ●

<https://greenenergylab.at/projects/beyond/>



PROJECT PARTNERS:

TU Wien (project management), best connect Unternehmensgemeinschaft GmbH, eFriends Energy GmbH, Forschung Burgenland GmbH, Moosmoar Energies OG, ms.gis Informationssysteme GmbH, Sonnenplatz Großschönau GmbH, University of Applied Sciences Technikum Wien, Norwegian Institute of Science and Technology, SINTEF, Svaltlamoen Boligstiftelse, FLEXIDA0 S.E.S.S.L., International Energy Research Centre/Tyndall National Institute, CITCEA-UPC

R2EC

Regional Renewable Energy Cells

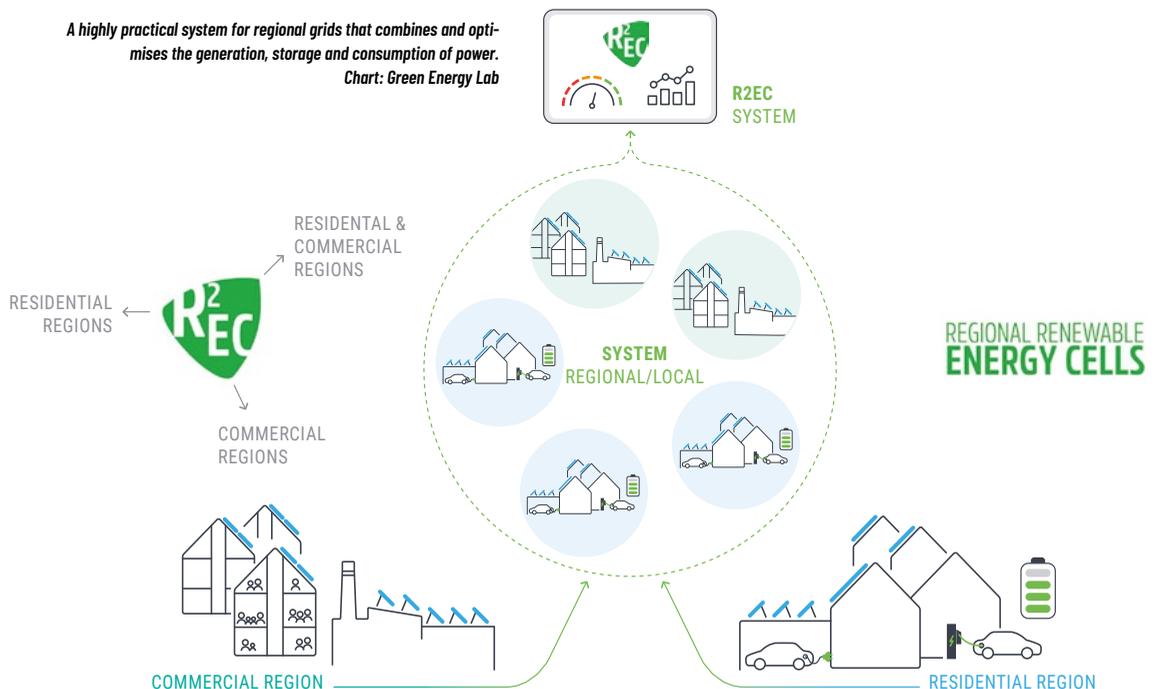
As part of the transnational research project R2EC, researchers from Austria, Norway and Belgium¹ are developing a scalable system of decentralised, interactive energy cells that use a high proportion of locally generated renewable energy. This involves simulating decentralised energy cells based on renewable energy sources and testing relevant technologies. The Austrian consortium is looking at ways to get users involved (co-creation workshops, surveys, etc.) as well as logging real data (measured load profiles) in selected testbeds.

MODEL REGIONS FOR 100% RENEWABLE ENERGY

The project aims to increase the percentage of renewable energy in local energy communities. Specifically, each region is to be supplied autonomously with locally available renewable energy and will ideally also make a contribution towards covering the consumption of other regions. In Austria, three model

energy regions have been chosen in the district of Tulln and its surrounding areas in order to collect real consumption data from households, commercial properties, and municipal buildings and consumers and study how regional energy cells are helping to make the energy transition a success.

The testbeds being observed are mainly using infrastructure components from smart meters. Combined with the findings from the accompanying socio-scientific research being undertaken, the real load profiles recorded in this process enable the energy cells to be replicated and optimised at simulation level and at laboratory scale. To achieve the goal of "100% renewable energy", more use has to be made of existing areas of flexibility, and new opportunities for integrating a high percentage of renewable energy need to be created with the help of storage systems. The plan is to maximise the use of renewable energy at local and regional level by having production, storage and con-





Photos: Projektfabrik Waldhör KG

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New technologies and business models? But what if nobody wants to use them? A successful energy transition largely hinges on whether people are willing to get on board. Only if we succeed in striking a balance between the technology, the business model and the needs of users and stakeholders we will produce strong innovations. And this is why EVN is part of the Green Energy Lab, where strong partners are working towards a sustainable energy future.”



Photo: EVN

DR ANDREA EDELMANN
HEAD OF INNOVATION, SUSTAINABILITY AND ENVIRONMENTAL PROTECTION AT EVN,
DEPUTY CHAIRWOMAN OF THE EXECUTIVE BOARD OF THE GREEN ENERGY LAB ASSOCIATION

sumption interact in a coordinated way with smart control. As well as energy-specific optimisation measures, economic and ecological aspects as well as the perspective of the users themselves will also be factored in.

ACTIVE PARTICIPATION IN THE ENERGY MARKET

Coming together to form energy communities brings many advantages for everyone involved. For one thing, sharing the use of renewable energy resources that are available locally makes stakeholders more autonomous. Existing areas of flexibility can be exploited, making systems and plants more cost-effective and boosting grid stability. New opportunities presented by lower grid charges in a renewable energy community and improved underlying conditions (e.g. direct trading within the community, joint investments, promoting energy autonomy) are currently emerging, with some already in place at regional level.

A comprehensive process to integrate all the participants into the selected testbeds is being implemented as part of the project. First of all, local stakeholders were identified that were to provide long-term cooperation in co-creation processes. Workshops to provide information and present the project’s goals as well as initial surveys have already been conducted to gauge the local mood and people’s willingness to get involved. In the next step, the experience gained with the energy monitoring system being deployed and the related changes in energy behaviour in the three project countries will be documented and presented as a country-by-country comparison. ●

<https://greenenergylab.at/projects/r2ec-regional-erneuerbare-energiezellen/>



Project presentation, stakeholder workshop,
photos: University of Applied Sciences Technikum Wien

¹ **PROJECT PARTNERS:** University of Applied Sciences Technikum Wien (project management), KEM / WYNERGY e.U., EffiCent Energieeffizienz Dienstleistungen GmbH, 4ward Energy Research GmbH, EVN AG, TPPV Austrian Photovoltaic Technology Platform, NORCE Norwegian Research Centre AS, Z Energi AS, TRIPOD HOUSE AS, Becquerel Institute (Icaeres Consulting SPRL), GreenWatch S.A.

The project is being implemented as part of the ERA-Net SES 2018 Joint Call RegSys in the EU’s Horizon 2020 research and innovation programme (www.eranet-smartenergysystems.eu).

Zukunftsquartier 2.0

Integrating positive energy districts into power grids and heating networks

Positive energy districts (PED) are areas of towns and cities that are able to meet their energy needs from renewable sources. Much of this depends on how densely packed their buildings are.¹ The concept aims to put most of the energy that is generated on site to local use, making sure that peaks in supply and demand are handled correctly. In order to be able to feed surplus energy into the grid and minimise peak loads, a smart system is required to control the production, consumption and storage of renewable energy, and buildings must be highly energy-efficient.

Initial concepts for positive energy districts were developed by UIV Urban Innovation Vienna GmbH together with the University of Applied Sciences Technikum Wien, the IBR & I Institute of Building Research and Innovation in a previous exploratory study entitled “Zukunftsquartier” (“district of the future”). This in-depth look at supply concepts and modelling of different variants laid the groundwork for flagship energy neighbourhoods to be created in Vienna. The energy concepts developed combine maximum-efficiency buildings with a substantial volume of energy generated locally by large-scale PV plants and ground source heat pump systems or thermal networks, combined with demand-side management (DSM) and thermal storage systems (thermal building activation systems, underground storage systems).

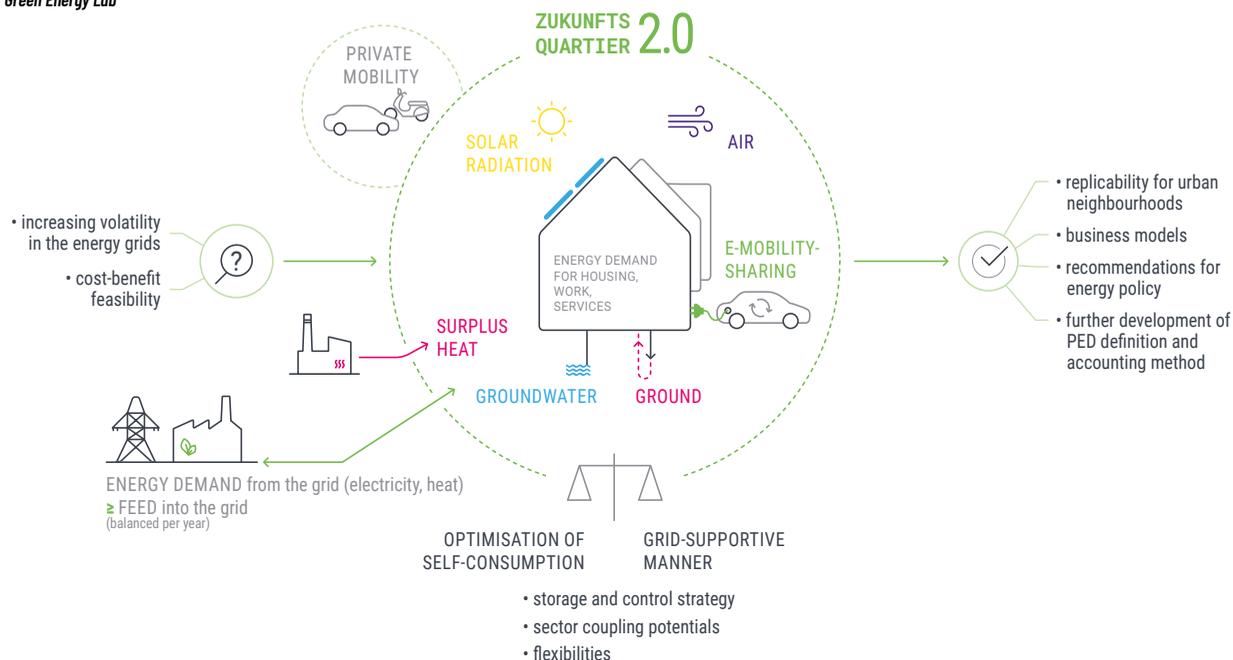
The follow-up project, “Zukunftsquartier 2.0”², is conducting research into integrating districts that generate a lot of energy locally and feed into the grid infrastructure (power and district heating) in a grid-supportive manner. The aim is to create a “win-win” situation for energy suppliers and grid operators, investors and developers and, ultimately, users as well. Both sector coupling and thermal networks offer significant potential.

Urban districts harbour potential for greater flexibility that has rarely been exploited to date in such a wide range of small-scale, decentralised units. “Zukunftsquartier 2.0” is a highly practical project that is focused on implementation. As such, it is demonstrating how smart load shifting and storage management that benefits the grid can work in innovative positive energy districts in dense built-up urban areas. Initial results show that, if the concept is to be implemented economically and sustainably, the positive energy approach has to be factored into the planning process from an early stage. A moderate building density in the urban district is needed and the district’s buildings should be mixed-use.



Positive energy districts have the potential to become key components of a sustainable, reliable and affordable energy supply in urban areas.

Chart: Green Energy Lab



HOW URBAN DISTRICTS AND GRIDS INTERACT

Technical, economic, legal and social issues are being analysed as part of the project. A method for optimum system design including storage technologies for newly planned urban districts is being devised, and a regulation strategy is being developed to enable the positive energy urban area to interact with the overall system. The intention is for daily, weekly and seasonal storage systems in the district to be able to respond flexibly and cross-sectorally to demands from the grids and prevent or at least soften demand and supply peaks. A key focus when planning the utilities management concept lies on issues of social acceptance and user-friendly load shifting measures that are also feasible in practice. Cost optimisation measures are to be analysed over the entire life cycle and suitable business and operator models proposed in order to enable cost-effective implementation.

Capacity: 1,335.6 kWp
 Module area: 6,845.5 m²
 Expected output: 1,307,558 kWh

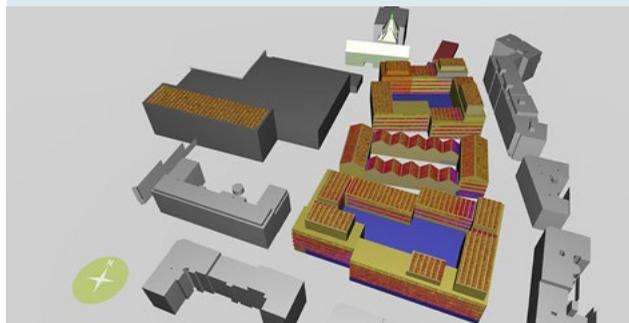


Illustration of the PV potential of the "Ottakringer_Leben" neighbourhood, source: Technikum Wien

HELPING TO PLAN A NEIGHBOURHOOD IN VIENNA

The project team is currently supporting the planning of an area of Floridsdorf (Pilzgasse), Vienna, which has been designed as a positive energy district. If innovative energy concepts are to be implemented cost-effectively, specific requirements have to be embedded right from the first stage of the planning process. Energy-related specifications regarding the structural shells of buildings and their floor plans were therefore included in the architectural competition. This ensures that PV modules will be integrated on a large scale and in an architecturally attractive way while also allowing cost optimization during implementation.

Participants and stakeholders in other potential positive energy neighbourhoods (e.g. the Ottakring site and parts of Seestadt Aspern) are also to be involved as part of the project. Close coordination between researchers, property developers and planners will produce solutions that can be replicated elsewhere. The results will be made available in the form of instructions and tools for conducting and supporting future planning processes of urban district developments. ●

<https://greenenergylab.at/projects/zukunftsquartier-2-0/>

¹https://nachhaltigwirtschaften.at/resources/sdz_pdf/schriftenreihe-2020-11-zukunftsquartier.pdf

²PROJECT PARTNERS:

UIV Urban Innovation Vienna GmbH (project management), University of Applied Sciences Technikum Wien, IBR & I Institute of Building Research & Innovation ZT GmbH, SÜBA AG, Böhm Stadtbaumeister und Gebäudetechnik GmbH, hacon GmbH

The project is being funded as part of the City of Tomorrow research programme and is an associated project of the Green Energy Lab.

INFORMATION

Green Energy Lab innovation laboratory

<https://greenenergylab.at>

Hybrid DH DEMO

4ward Energy Research GmbH

Contact:

Alois Kraußler

alois.kraussler@4wardenergy.at

www.4wardenergy.at/

Heat Water Storage Pooling

Forschung Burgenland GmbH

Contact:

Markus Puchegger

markus.puchegger@forschung-burgenland.at

www.forschung-burgenland.at

Beyond

TU Wien

Energy Economics Group (EEG)

Contact:

Georg Lettner

lettner@eeg.tuwien.ac.at

<https://eeg.tuwien.ac.at>

R2EC – Regional Renewable Energy Cells

University of Applied Sciences Technikum Wien

Contact:

Peter Illich

illich@technikum-wien.at

www.technikum-wien.at

Zukunftsquartier 2.0

UIV Urban Innovation Vienna GmbH

Contact:

Petra Schöfmann

schoefmann@urbaninnovation.at

www.urbaninnovation.at



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