

energy innovation austria

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Current developments
and examples
of sustainable energy
technologies



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

Testing the energy transition in practice

Living laboratories
for a climate-neutral energy supply

This special issue explores the idea of a living laboratory for a regional energy supply drawn 100% from renewable sources. Concepts from nine different areas in Austria showcase how the interaction between technologies, components and stakeholders in an integrated, renewable energy system can be illustrated in a true-to-life way and trialled under real-world conditions.

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100% renewable energy supply

How can the energy transition work in practice?

Austria has set some ambitious targets for its climate policy, aiming to become climate-neutral by 2040 and generate all its electricity from renewable sources even sooner, by 2030. As well as significantly ramping up wind and solar power capacity, this will also mean transforming energy infrastructure and its control processes in such a way that large quantities of renewable energy can be fed into power grids and heating networks and guarantee a sustainable, safe and secure supply of energy. Decentralisation, digitalisation and the democratisation of the energy system are all key terms within this process.

Developing integrated regional energy systems will play a central role to the energy transition. The transformation that will lead to a 100% renewable energy supply will be effected decentralized at local level in the various regions. The success of this process hinges on citizens and regional stakeholders playing an active role in helping to shape the shift and benefiting from the added value created by the energy system of the future. We already have some of the technologies and individual solutions required for this energy system available on the market. Now it is a question of trialling the complex interaction between the various components and stakeholders in integrated energy systems under real-life conditions.

THE “LIVING LABORATORIES FOR 100% RENEWABLE ENERGY” FLAGSHIP INITIATIVE

As part of its RTDI efforts focusing on the energy transition, the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) has launched a flagship initiative to set up living laboratories for 100% renewable energy, where prototypical system solutions for integrated regional energy systems are to be developed and trialled. The aim is to establish and support up to five living laboratories for different types of Austrian regions by 2025 and thus promote initial validation runs and model solutions for an energy supply drawn exclusively from renewable sources.

The project began with an expert debate entitled “Die Energiewende proben – (wie) geht das?” (“Trialling the energy transition – can it be done (and, if so, how)?”), where key players from industry came together with scientists and researchers to set out the guiding principles and objectives of the flagship initiative.

The aim is to gain insights on several levels:

- >> **Technologies and solutions for integrated regional energy systems**
What technologies, components and technical system solutions are needed, and how can we make these available?
- >> **Structuring energy systems**
How should we structure the interaction between various stakeholders and system elements (including market and business models and the underlying legal and regulatory environment)?
- >> **Transitioning between energy systems**
How can the new solutions become part of everyday life for the public, local communities, regions, companies and infrastructure operators?



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WHAT IS A

“LIVING LABORATORY FOR 100% RENEWABLE ENERGY”?

If new technologies and individual solutions are to be scaled up and made part of integrated regional energy systems, they must first be tested out in practice. Innovative technologies need to be brought together in a true-to-life environment and subjected to full-scale trials, and their interactions within the system need to be monitored and analysed. Within a transformation process, a living laboratory is the final step, so to speak, before new solutions are rolled out across the board. It involves various stakeholders from research and practice collaborating across discipline boundaries.

The living laboratories for 100% renewable energy are designed to illustrate in a true-to-life way some of the key aspects of an energy supply drawn exclusively from renewable sources. This will allow (at least some) future scenarios for the energy system to be pre-empted, including a high concentration of PV systems combined with local storage systems, ways to increase flexibility for local and regional companies, and low-temperature district heating networks coupled with waste heat use by local businesses.

A living laboratory covers the entire value chain, from the generation and storage of energy through to its transport and use. Trials under real-life conditions are designed to show how the various elements of a regional energy system work together on a technical, organisational, economic and social level. One key question is how the interplay between individual components and system elements (generating plants, buildings and neighbourhoods, commercial enterprises, energy communities, grids and networks, infrastructure, storage systems, etc.) can open up new possibilities in terms of the efficiency, flexibility and resilience of the energy system, for instance. Incorporating all the energy sectors (electricity, heating/cooling and mobility) has a key role to play in this regard, as does sector integration.

A living laboratory needs corresponding “equipment” (i.e. plants, infrastructure, buildings, etc.) and “test subjects” (the system and its elements) in order to conduct its real-world experiments. It also makes use of targeted research and development methods such as piloting and trialling, co-simulations and digital twins.

SOLUTIONS WITH SCOPE FOR REPRODUCIBILITY

In Austria, the prerequisites for switching to a 100% renewable energy supply vary from region to region, in some cases significantly. Amongst other things, agricultural parts of the country, Alpine regions, cities and industrial heartlands differ in terms of their consumer structure, the resources available locally and their infrastructure (from power grids through to buildings). Using system integration, the aim of the living laboratories is to show how as much of the renewable energy generated as possible can be used locally in each region and how surplus production, for example, is to be managed within the system.

Getting all the relevant regional partners on board is crucial. “Regional” in this context means that, in order to set up the living laboratory, consumers that share links in terms of their geographical location and the context of the integrated energy system in question come together to form a consortium. The key players involved in the living laboratory should have a genuine need for the new solutions and actually intend to implement them once developed. Full-scale validation will both stimulate further development in the specific region and help to build up knowledge at national level. The aim is to identify the (core) components missing from integrated energy systems and develop them further in order to find solutions that offer scope for reproducibility.



Photos: stock.adobe.com

The living laboratory is a place for developing systems that facilitate system operation and the use of energy from 100% renewable sources by increasing efficiency, synergy effects, flexibility and sector integration. This is designed to create regional added value and get regional stakeholders actively involved in their energy system.

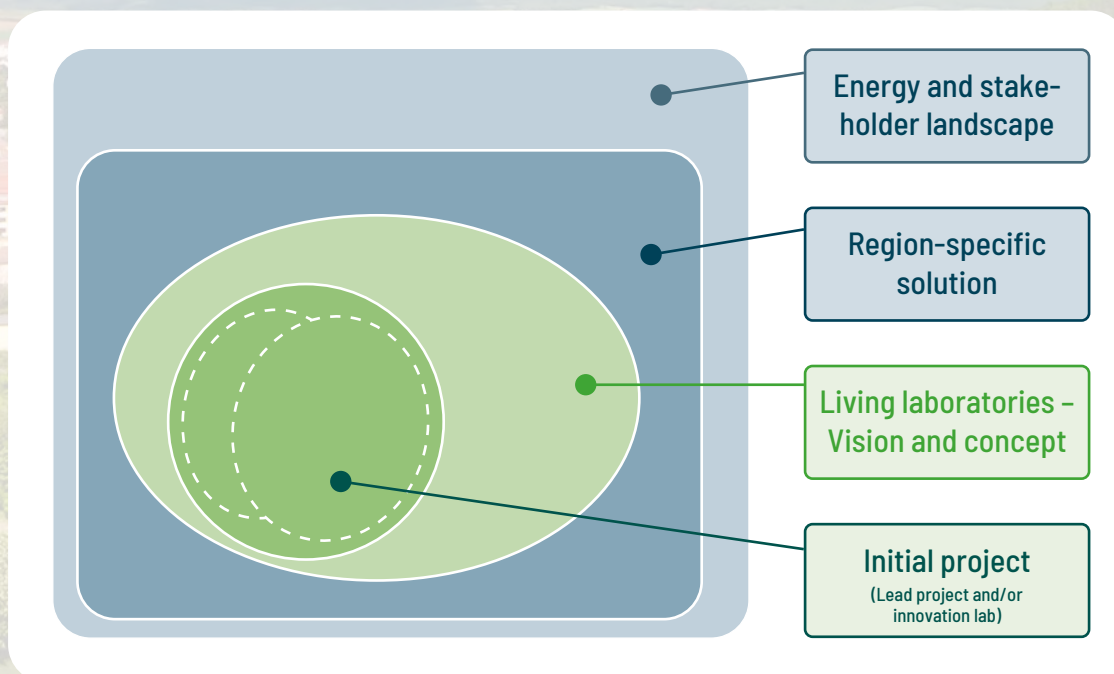
The next step: initial projects for living laboratories for 100% renewable energy

The current call for the flagship initiative will see a number of initial projects given funding over the next few years to set up five living laboratories in Austria. These are to cover a wide range of different regions and the elements of the solution required in each case. Comprising an overall concept, a lead project and/or an innovation laboratory, the initial projects will lay the foundations for the living laboratories.

On the next few pages, we present nine exploratory studies from the previous round of bids that were geared towards identifying initial approaches and concept ideas for establishing living laboratories in various parts of Austria.

ELEMENTS OF THE OVERALL CONCEPT

Within the energy and stakeholder landscape, the current conditions in the region are to be illustrated alongside the potential that it offers in relation to the targets for 2030 and 2040. The intention here is to devise region-specific solutions that can be applied to other regions of the same type and/or scaled up. The living laboratory is to create a space for experimentation in which system solutions can be trialled and RTDI-related questions answered. As a basic principle, all the BMK's support services can be drawn on to make the living laboratory vision and the comprehensive living laboratory concept a reality.



INNERGY

Die Transformation beschleunigen



INNERGY – a living laboratory for climate-neutral semi-urban areas

The area between Wattens and Zirl along the Inn valley in Tyrol is home to clusters of mainly small settlements and towns. It is a patchwork of neighbourhoods made up of buildings from different eras, commercial and industrial estates, and agricultural areas – all put to a variety of uses on a small scale. A district heating line runs through part of the region. The area presents some attractive possibilities for trialling prototype solutions for the energy transition.

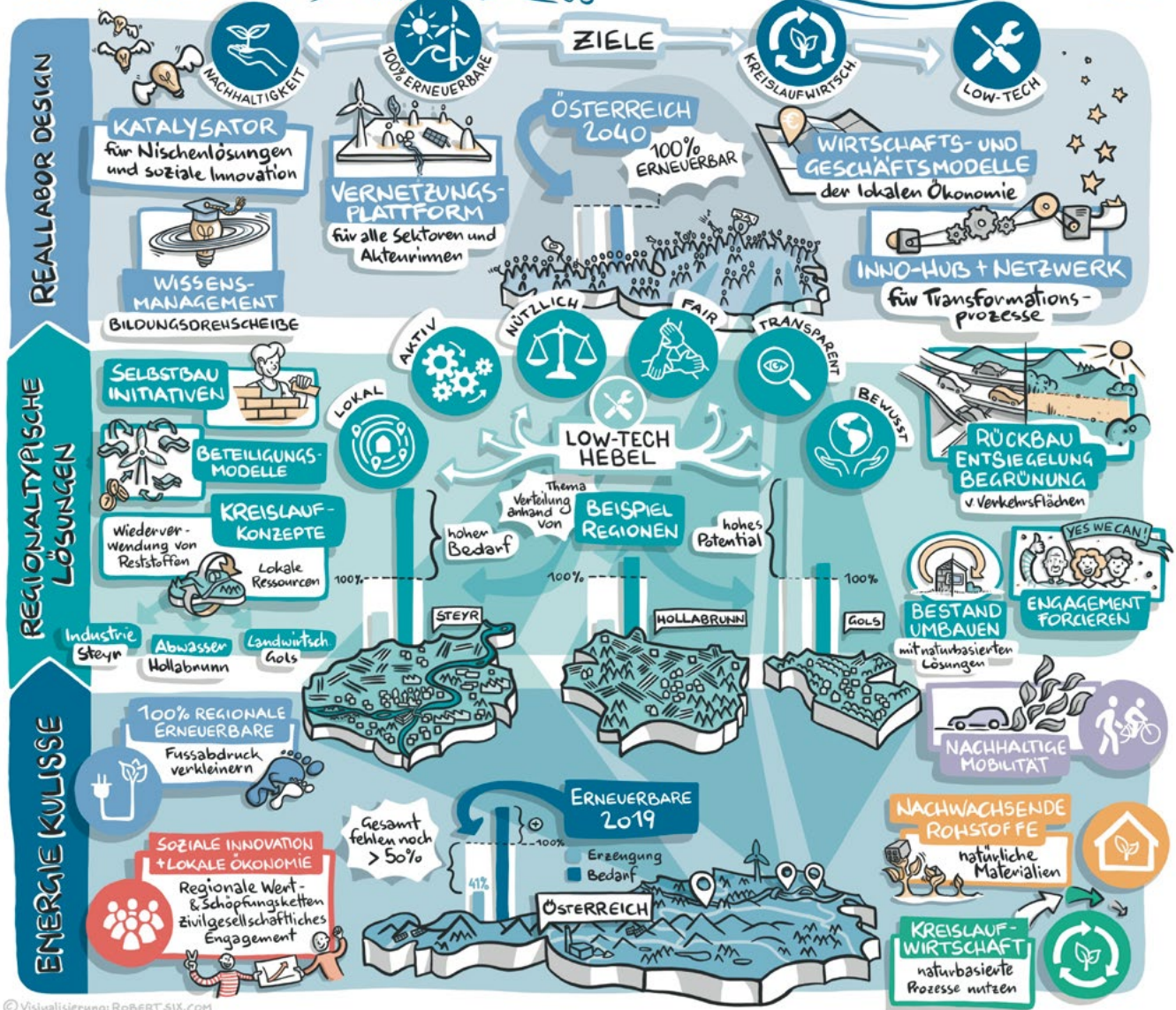
The exploratory phase saw specific projects from the region selected and organisational and substantive concepts for running a living laboratory developed. The supply of heating and cooling and

the use of waste heat were identified as key issues. An initial lead project in the living laboratory is to focus on increasing flexibility on the consumer site and integrating volatile feed-in streams.

INNERGY will accelerate the development of innovative energy solutions and embed them in an overall spatial energy system and the local innovation ecosystem.

LOW-TECH INNOVATION-LAB

ZEIT FÜR NEUE WEGE & ROBUSTE LÖSUNGEN



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LOW TECH innovation lab – robust solutions for the energy system of tomorrow

This exploratory study is devoted to finding low-tech solutions for climate-friendly and resource-efficient energy systems. As well as requiring the involvement of the energy, transport, agriculture, industry and commercial sectors, trialling reproducible model solutions for 100% renewable energy also relies just as much on participation by locals. Easy-to-understand low-tech solutions are vital if the citizens are to make an active contribution to the energy transition.

The study investigated some fundamental aspects of low-tech model solutions and prepared the ground for their use in three specific pilot regions as part of an overall concept. The model regions – Hollabrunn/Retzer Land (Lower Austria), Traunviertel/

Ennstal-Steyr (Upper Austria) and Bruck an der Leitha/Gols (Burgenland) – differ significantly in terms of their geographical location, climate, economic structure, mobility and transport infrastructure, and potential for supplying energy. Comprehensive analyses were conducted of the current situation in all three regions, and packages of measures focusing on low-tech solutions and saving resources were put together.

The results of the analyses fed into the “LOW-TECH Innovation Lab TOOLKIT”, which also contains specific guidance on energy, construction, mobility, the circular economy and nature-based solutions.

#MURAU

REALLABOR DER ENERGIEWENDE FÜR INNERALPINE REGIONEN

Integrierte Lösungen für ein 100% erneuerbares Energiesystem



Murau – a regional “system power plant” for an inner-Alpine region

Inner-Alpine regions are rich in natural resources such as water, sunlight, wind and biomass. The Murau region is aiming to become 100% climate-neutral while also safeguarding energy supply to its main conurbations by providing renewable energy in line with demand. The Murau living laboratory is taking existing solutions and developing them further for a large-scale roll-out involving stakeholders from the local area and technology partners from much further afield.

In purely net terms, the region is already capable of meeting its annual electricity needs from local resources, although it does need some help from the higher-level grid for a certain number of hours in the winter. Future pathways for expansion will develop along

several technological axes: an increase in solar and wind capacity; electrification of mobility; sector integration of heating and heavy-duty transport with the power system by means of electrolysis; and a significant ramp-up of storage capacity to supply electricity in line with demand and take pressure off the power grids.

Various pioneering approaches are being pursued to create a “system power plant” for the region, core elements of which are hydropower, solar power, wind power and cogeneration plants. The added flexibility required to achieve a 100% renewable energy system is to be obtained by integrating large-scale and battery swarm storage systems as well as hydrogen technologies.

Auf dem Weg zu 100% erneuerbarer Energie bis 2040

MUR
REAL



MURREAL – an industrial region on the way to 100% renewable energy

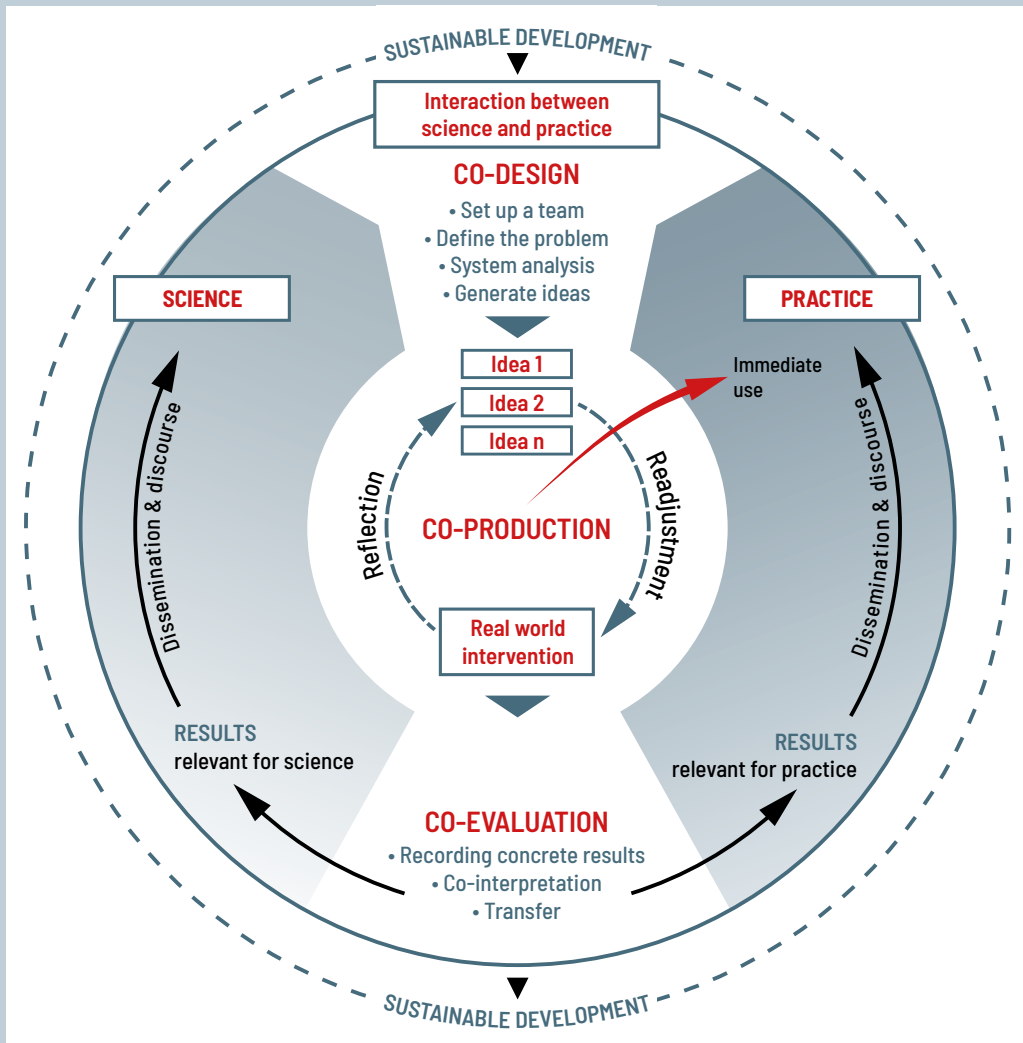
The district of Murtal in Styria is an industrial region made up of 20 municipalities and home to a large number of high-tech companies. The surrounding countryside offers significant potential for supplying renewable energy in the form of biomass, hydropower and wind and solar power. However, its energy demand is also disproportionately high on account of all the industry based there.

The exploratory study worked to identify development pathways, synergy effects and business models for a living laboratory for 100% renewable energy with an eye on the specific challenges posed by the region. The focus is on a cross-sectoral energy system that taps into the region's potential for renewable energy and utilises waste heat from its industrial companies. The project

analysed options for regulating loads and increasing flexibility in several sectors – e-mobility, businesses, residential property, and generating energy from biomass. Waste heat produced by one firm, Zellstoff Pöls AG, is already being exploited and is being piped from in and around the town of Aichfeld as far as Knittelfeld via a district heating system. Additional heat is being supplied by the Zeltweg biomass heating plant, which boasts a large storage system. The possibility of linking in more companies and their potential for contributing waste heat were investigated and evaluated, as was sector integration using biomass gasification with Fischer-Tropsch diesel production and bio-synthetic natural gas grid infeed. Organisational and financial aspects of a living laboratory were also explored in addition to the technical questions.

RESEARCH

PRACTICE

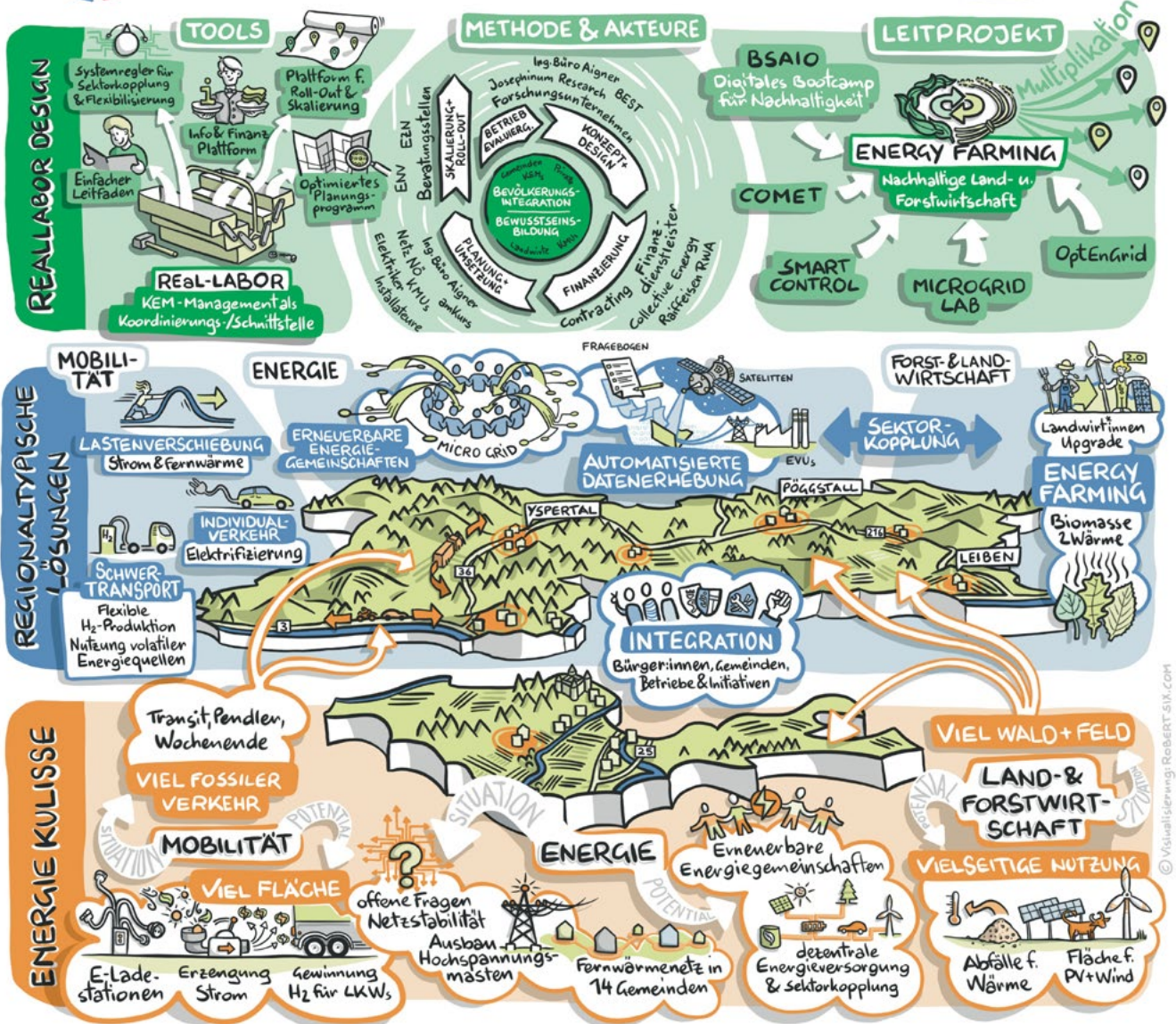


Knowledge processes/structured interaction between science and practice (Leuphana University Lüneburg)

LIVING LABORATORIES

Living laboratories are designed to offer a range of tools for tackling social problems at local level together with researchers, scientists and partners such as local authorities, associations and key business figures. The support provided by science and research enables processes of social transformation, such as the renovation of city neighbourhoods and the introduction of sustainable mobility or energy systems, to be understood and shaped more effectively.

REaL Das Reallabor für integrierte, regionale und erneuerbare Energiesysteme

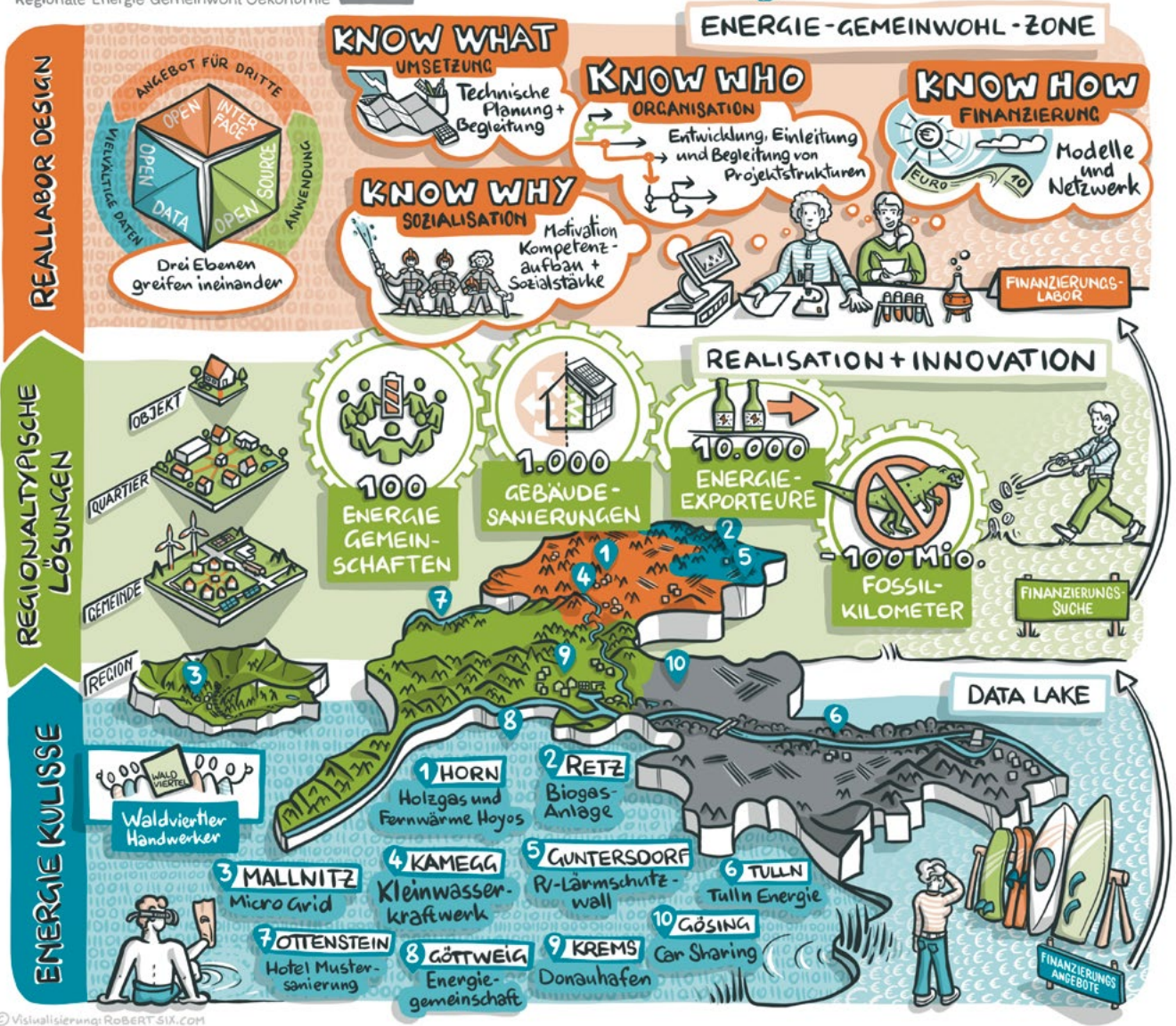


REaL – a scalable concept and digital solutions

REaL is a regional overall concept for making 100% renewable energy a reality by generating it locally and exploiting flexibilities. The chosen region is home to 13 municipalities in the Südliches Waldviertel climate and energy model region plus the municipality of Wieselburg-Land, where the research centre BEST GmbH operates a microgrid and test plant for renewable energy communities (RECs). The aim was to develop a scalable, user-friendly approach for sector-integrated municipal energy systems. Integrating the agricultural and forestry sectors is a key aspect. This is because farmland and woodland generate, besides food, forestry products and energy, also by-products that can be used in municipal recycling systems (incineration, pyrolysis, fermentation and power-to-gas).

The study also focused on developing concepts and tools for energy planning and optimised system operations. The overall concept has five main pillars:

- > Municipal agricultural solar and wind farms benefiting the whole community
- > Partially automated data acquisition and a living laboratory platform for energy and renovation planning for households, companies and local energy systems
- > Digitalising energy technologies and integrating them into an overarching control and regulation strategy
- > Furthering the development of a comprehensive system controller
- > Getting the public on board and involved



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REGOreal – an IT concept for a regional renewable energy system

The living laboratory covers 79 municipalities around Hollabrunn, Horn, Krems and Tulln in Lower Austria as well as Mallnitz in Carinthia. REGOreal is a scalable model for combined energy systems. Through four layers (building | neighbourhood | municipality | region), the 100% renewable energy approach develops in cellular fashion from layer to layer in four areas (1 “KnowWhy” – socialisation | 2 “KnowHow” – financing | 3 “KnowWho” – organisation | 4 “KnowWhat” – technology). It prioritises saving energy over generating it. Beside technological solutions the project focuses on other issues key to this 100% approach. Innovative solutions driving implementation, such as a regional model for contracting energy savings, are emerging to finance projects.

Increasingly, women as well as companies and associations in general are being brought on board to implement the 100% approach. A comprehensive open-data model based on the “system of systems” principle is being developed for the combined energy system to serve as a basis for planning and evaluating technological and methodological innovations as well as market innovations for local, regional and interregional value chains. Targets for four priority areas were set for the first five years:

- > 100 energy communities
- > 1,000 buildings renovated
- > 10,000 energy exporters (200 companies)
- > 100 million fossil-fuel kilometres saved

EXPERIMENTAL

OPERATIONAL OBJECTIVES OF THE

LIVING LABORATORIES FOR 100% RENEWABLE ENERGY

TRANSDISCIPLINARY

FOCUSED ON SUSTAINABILITY

SANDBOX

Within a set space, the living laboratory is designed to create a set of circumstances (real-world environment) that very closely reflects the situation to be encountered in the energy system of the future and that enables the desired scenario – an energy supply from 100% renewable sources – to be anticipated in model form.

VALIDATION

This chiefly concerns how infrastructure, plants and stakeholders interact to open up new opportunities for improved efficiency, flexibility, sector integration, resilience, etc. The validation, monitoring and real-life testing of technologies and components must always be viewed in the context of the system solution(s) being targeted.

MODELS OF GOOD PRACTICE

The living laboratory is a place where insights are gained into various prototypical characteristics of an integrated energy system in order to come up with solutions that can serve as models for similar regions in Austria.

INSIGHTS AND INSTRUMENTS

Within the living laboratory, the underlying principles and tools required for planning, creating and operating integrated regional energy systems (including energy communities) are devised.

KNOWLEDGE AND COMMUNICATION PLATFORM

Empirical knowledge about the transformation is gathered for all relevant target groups (advisory services, infrastructure operators, decision-makers at local authorities and companies, new stakeholders such as energy communities, and technology and solution providers).

DATA MANAGEMENT

Living laboratories require a systematic approach to solve major challenges in their chosen field as well as a plan for how they are going to manage their data.

LONG-TERM

Characteristics of living laboratories (Wuppertal Institute)

CHARACTERISTIC	SHORT NAME
Contribution to transformation	Sustainability-oriented
Experiments as core method	Experimental
Transdisciplinarity as core mode	Transdisciplinary
Learning processes and reflexivity	Reflexive
Orientation towards the long term, scalability, transfer	Long term

Source: Wuppertal Institute in brief 07/2019 based on Schöpke et al., 2018

REFLECTIVE



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TANZ – tourism as an opportunity for the energy transition in the Pinzgau region

Tourism is one of the most important sectors of the economy in rural parts of Austria. It also accounts for a significant amount of energy consumption, particularly during the winter season. As an area that depends on Alpine tourism, the Pinzgau – including the municipality of Zell am See – is facing major challenges. Although a large number of individual projects and initiatives are already under way in the region, it needs a common strategy to make its vision of a 100% renewable energy supply a reality.

The exploratory study devised solutions for transformation processes in three areas of innovation – sector integration, energy communities and sustainable heating – in partnership with all the relevant stakeholders.

The numerous ideas put forward were condensed into 14 real-life tests for sustainable tourism in the Pinzgau in order to enable 100% renewable energy to be used to get guests to and from the region, power their accommodation and leisure activities, and much more besides. These real-life tests are broad-based and cover everything from innovative energy and mobility solutions through to awareness-raising measures for locals and tourists. The organisational structure of the living laboratory and suitable business models were also devised. In the future, the model solutions developed for the Pinzgau region are to serve as a blueprint for other similar parts of Austria and help to spread climate-friendly solutions and get them implemented quickly.

WIR HELFEN DEN MENSCHEN DIE ZUKUNFT ZU GESTALTEN



A 100% renewable Waldviertel – a region with a lot of potential

The upper Waldviertel (Gmünd, Zwettl, Waidhofen/Thaya, Krems and Horn) with its 110 municipalities has been a pioneer in renewable energy supply for many years now. As part of the exploratory study potential and feasibility studies and a list of measures were carried out, initial concept prototypes and business models were evaluated, and a strategy for running a living laboratory for 100% renewable energy cost-efficiently was devised.

At 41%, the percentage of total energy consumption accounted for by renewable energy sources in the region is already well above the national average (33.4%). However, the analyses identified additional areas of potential such as biomass from forestry: the region has over 190,000 hectares of woodland and only 48% of annual net

forest growth is put to use. Solar energy supply (photovoltaics) also harbours significant scope for expansion at 93 GWh.

Two key measures were identified: smart integration of the power, heating and mobility sectors and the shared use of storage systems. Amongst other things, the possibility of integrating renewable energy communities (RECs) into the regional energy supply infrastructure was explored in detail.

The study also focused on the issue of electromobility, which is extremely important for individual motorised transport in rural areas in particular.

INFORMATION

INNERGY – a living laboratory in the central Inn valley for climate-neutral semi-urban areas

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LOW-TECH – creating climate-friendly, resource-efficient energy regions using innovative low-tech solutions

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MURREAL REALLABOR – heading for 100% renewable energy by 2040

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