



**FOR ALL CURIOUS  
PEOPLE  
RESEARCH  
PROJECTS IN THE  
AREAS ENERGY,  
ENVIRONMENT  
AND BUILDINGS**

## FOREWORD



Burgenland is on the road to success. In the years 2012 to 2016, our home country achieved the highest average economic growth of Austria with a plus of 2 percent. In 2017, we were again able to increase this growth by 3 percent. With an annual average of over 102,700 employees, a new employment record was achieved in 2017, while at the same time unemployment fell noticeably. So far, this positive trend has continued in 2018.

Our home country has also made considerable progress in research and development in the past few years. The research quota of Burgenland has been raised in recent years from 0.6 to 1 percent. This is a significant increase and I would like to thank everyone who contributed to it. We have achieved a lot, but we want to become even better. An important prerequisite for this was the pooling of the forces that we have in research. In the previous year, we merged the activities of three research companies into a single one – Forschung Burgenland.

For the implementation of our research strategy, 15 million euros are available from the provincial budget and another 41 million euros can be raised from the ERDF program. We will consistently implement what we have committed to in our research strategy. It was right to focus on topics such as renewable energy, buildings or health. For the future of the business location, it is crucial that we extend this range by projects in megatrends such as digitization and Industry 4.0.

With investments in research and development, in training and further education, in the infrastructure of the business location, a continued prudent financial and economic policy, as well as further subsidies from the EU, the federal government and the state, Burgenland will remain in the fast lane also in the future.

**Hans Niessl**  
Governor of Burgenland

## FOREWORD



By merging two companies (FTI and TOB) under the umbrella of Forschung Burgenland, it was possible to create great synergies, whereby the strengths of the individual organizations complemented each other. The most important strategic development was the orientation towards application-oriented research, which aims to increase the great potential of local companies through increased cooperation with industry and the respective funding agencies.

In addition, an intensive network of experts from Burgenland (provincial government, publicly owned companies, enterprises, research institutions, etc.) with researchers from other federal states was created.

It is thanks to this new, innovative company that Burgenland is successfully making its way towards the future.

**DDr. Gabriele Ambros**

Chairperson of the supervisory board Forschung Burgenland GmbH

Chairperson of the Council for Research in Burgenland



From our beginnings to today, research at the University of Applied Sciences Burgenland has always played a key role. Together with Forschung Burgenland, a wholly owned subsidiary of UAS Burgenland, the university acts as a hub for research and development projects in the region. This cross-linkage of research and teaching brings advantages especially for students, who gain an insight into the current state of scientific development through their active involvement in research projects.

Our activities in the area of research, technology and innovation make us an attractive partner and regional driving force for the economy. Together with Forschung Burgenland our aim in this area is the following: What we do is special, how we do it is special and the outcome is very special.

**Mag. Georg Pehm**

CEO University of Applied Sciences Burgenland



Forschung Burgenland has had an exciting research year. Together with the University of Applied Sciences Burgenland, we are currently conducting research in more than 100 research and consulting projects with a financing volume of more than 8 million euros. The spectrum of research activities ranges from international projects with up to 100 partners to on-the-spot contract research. In this way, we link teaching, research and business, thus contributing to increasing the innovative capacity of our location.

**Prof.(FH) Mag. Dr. Silvia Ettl-Huber**

Vice Rector for Research and Innovation  
University of Applied Sciences Burgenland

# About us



*„We do research to solve problems and improve people's lives.“*

Forward-looking control concepts for modern buildings, smart energy systems and security solutions for information technology are just a few examples for topics where the team of Forschung Burgenland together with the University of Applied Sciences play a key role in the development.

To this end Forschung Burgenland operates 2 Research Centers and 5 so-called Pre-Centers, where trends and new research concepts are being worked out and developed:

- Center for Building Technology
- Center for Cloud & CPS Security
- Pre-Center Smart Energy and Innovation
- Pre-Center Heat Pump Technology
- Pre-Center Thermal Power Engineering, Process Simulation and -evaluation
- Pre-Center Health Promotion Research
- Pre-Center Social Science Methodology Competence

Our R&D activities take place in our facilities in Pinkafeld and Eisenstad. At the University of Applied Sciences in particular we do research along the degree programmes of Energy and Environmental Management, Business, Information Technology and Information Management, Social Work and Health.

Let us look back on our most successful year of research 2017 reviewing past highlights, looking behind the scenes of Forschung Burgenland and experiencing research first-hand. This booklet shows examples of our research activities in the areas of energy, environment and buildings.

A handwritten signature in blue ink, which appears to read 'Keding'.

**DI Marcus Keding**  
CEO  
Forschung Burgenland

*Location Eisenstadt*



*Location Pinkafeld*



# Timeline History of Forschung Burgenland

## **1994 – Foundation of the University of Applied Sciences Burgenland**

Start of two scientifically conducted diploma courses as the first courses at a university of applied sciences that were approved in Austria.

## **2002 – Foundation of Forschung und Technologietransfer Pinkafeld GmbH**

The purpose of FTP is to carry out R & D projects and application projects for external clients.

## **2009 – Opening of the laboratory hall in Pinkafeld**

With the opening of the new laboratory hall the study centre in Pinkafeld turns into a research centre for energy and the environment.

## **2010 – Research Forum of the Austrian Universities of Applied Sciences at Campus Pinkafeld**

The University of Applied Sciences Burgenland hosts the fourth Research Forum of the Austrian Universities of Applied Sciences. The venue is the newly expanded research centre in Pinkafeld.

## **2015 – Opening of Energetikum Pinkafeld**

This modern office building is designed as a „living lab“, meaning that research is carried out while the building is actually used in everyday life. In 2015, it won the Klimaaktiv Bronze Award.

## **1999 – Research Laboratory opens its doors**

Groundbreaking ceremony for the Technologiezentrum Süd, which provides space for a research laboratory.

## **2007 – Pinkafeld bursts at the seams**

Due to the steadily increasing number of students and the large number of research projects, the technology centre in Pinkafeld is expanded to include seminar and office space as well as a laboratory.

## **2009 – Opening of the Josef Ressel Centre**

The University of Applied Sciences Burgenland opens the Josef Ressel Centre (CFD-Centre Austria), one of three centres approved in Austria.

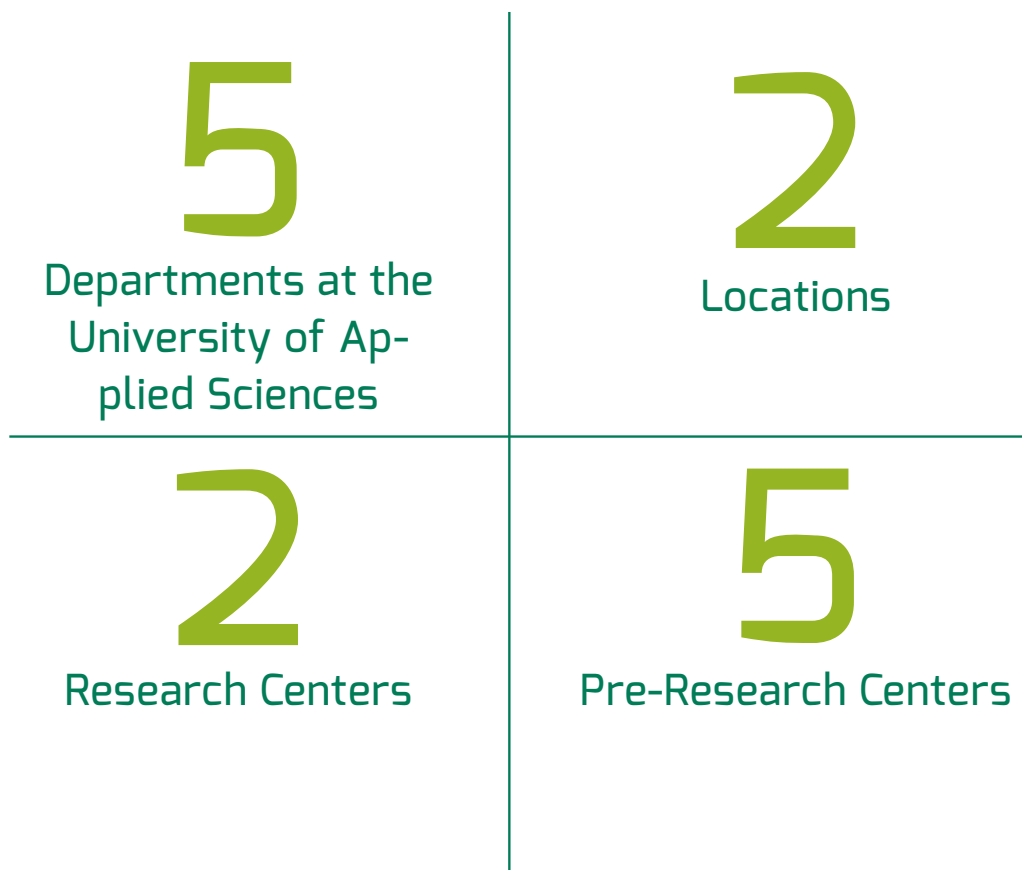
## **2013 – Foundation of Forschung Burgenland GmbH**

Forschung Burgenland GmbH is founded as a wholly owned subsidiary of the University of Applied Sciences Burgenland. A new structure, more competencies and also more money - that's how Forschung Burgenland GmbH wants to continue to score in the next few years with innovative research projects.

## **2016 – Forschung Burgenland becomes an associate member of ACR and Forschung Austria**

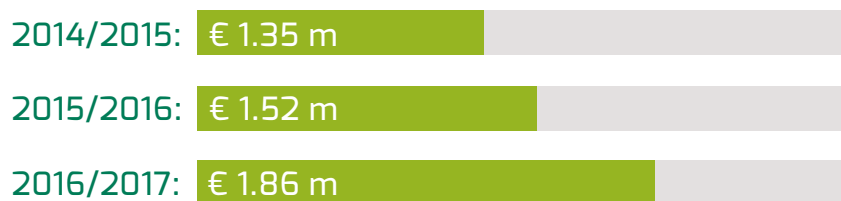
Energy, the environment, building technology, health - these are the fields of expertise that Forschung Burgenland contributes to the network of Austrian Cooperative Research (ACR) and to Forschung Austria, the national umbrella organization for non-university, application-oriented and business-oriented research and technological development.

## FACTS AND FIGURES:



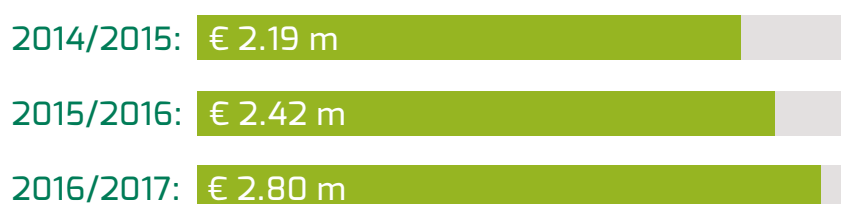
### R&D Revenue Performance

Forschung Burgenland



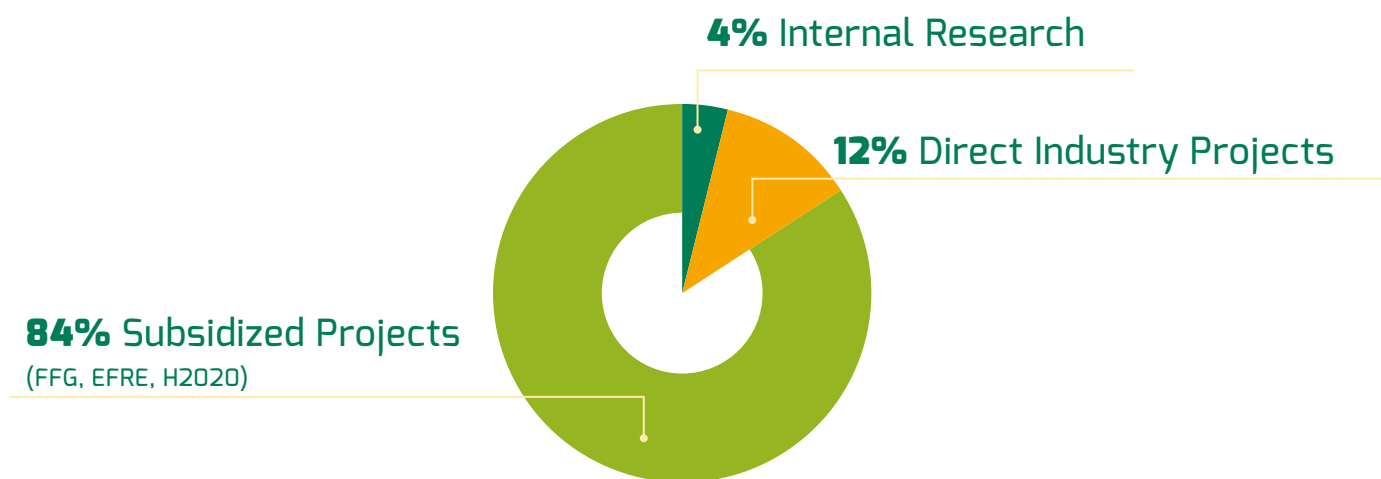
### R&D Revenue Performance

Forschung Burgenland + University of Applied Sciences total



# Division of Research Revenue

## Forschung Burgenland 2016/2017



## Staff

Forschung Burgenland

2014/2015

 **15**

2015/2016

 **23**

2016/2017

 **30**



# Highlights 2017



01/2017

Foundation **Center for Building Technology**



02/2017

An exchange of research ideas between the Center for Building Technology and the **Polytechnical University Hongkong**



03/2017

Staff members Markus Puchegger and Richard Krottil and our graduate Anna Grubbauer are speakers at the **Windvermarktung** (Wind marketing)



08/2017

At the **European Forum Alpbach** a delegation of UAS Burgenland and Forschung Burgenland took part in the University and Technology Talks.



07/2017

Carmen Braun and Katharina Hauer from the Pre-Center Health Promotion Research represented Forschung Burgenland at the **19th Austrian Health Promotion Conference** in St. Pölten.



07/2017

Presentation of current research by staff member Florian Wenig from the Center for Building Technology at the **ISIE 2017 Conference** in Edinburgh.



09/2017

Intelligent energy management systems for a smart city is the goal of the project „**Empower Citizens**“



10/2017

Managing Director Marcus Keding represents Burgenland at the **FTI Stakeholder Talk** of the OECD Review Team.



10/2017

Young researchers at work at the „**6th International Summer School on Sustainable Buildings for Europe**“ at Campus Pinkafeld.



12/2017

The future of buildings and areas was the focus of the scientific conference **e-nova 2017** in Pinkafeld.



12/2017

Staff member Doris Rixrath and lecturer Günter Wind initiate collaborations with the Technical University of Mbeya and projects in the field of renewable energies in Africa.



11/2017

Presentation of the results of the **EUROSYN** project as part of the „Week of Regions“ in Brussels by staff member Michael Sedlak.





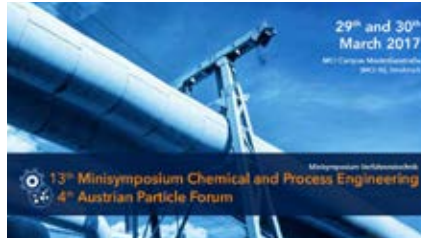
03/2017

Staff members Markus Puchegger and Richard Krotl and our graduate Anna Grubbauer are speakers at the **Güssing17 conference**.



04/2017

Staff member Doris Rixrath talks about „The energetic use of various resources - a comparative life-cycle assessment“ at the **13. Minisymposium Chemical & Process Engineering**



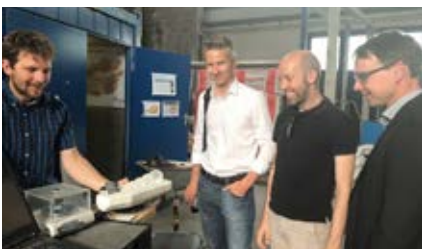
05/2017

Girls can experience research at first hand at the **Girls Day MINI** organised by MonA-Net at FH Burgenland.



07/2017

UAS Burgenland and Research Burgenland explore new **partnerships with IBS**.



06/2017

**Merger** of the two companies FTI Burgenland GmbH and Technologieoffensive Burgenland GmbH into Forschung Burgenland GmbH. The sole managing director is Marcus Keding.



05/2017

Staff member Gernot Steindl comes second at the **FBK Research Forum** with his paper „Thermo-hydraulic simulation for the investigation of the storage potential of district heating networks“



10/2017

Members of staff of Forschung Burgenland give lectures on “Smart Energy and Innovation” at the „**12th Conference on Sustainable Development of Energy, Water and Environment Systems**“ in Dubrovnik.



10/2017

Staff members Gernot Steindl and Christian-Pfeiffer speak at Austria's main **Conference for Predictive Analytics**.



11/2017

Gabriele Ambros, the chairperson of the supervisory board, is awarded the **Grand Decoration of Honour** of the Province of Burgenland.



11/2017

Creation of future-oriented laboratory equipment in the laboratories in Pinkafeld as part of the project „**Low Cost Demand Side Flexibility**“ funded by the European Regional Development Fund (ERDF)



11/2017

Together with Energie Burgenland, Forschung Burgenland takes part in the largest Austrian innovation project „**Green Energy Labs**“



11/2017

Workshop on the „Use of drones for corporate purposes“ together with the Skyability GmbH as part of the project **Smart Production**



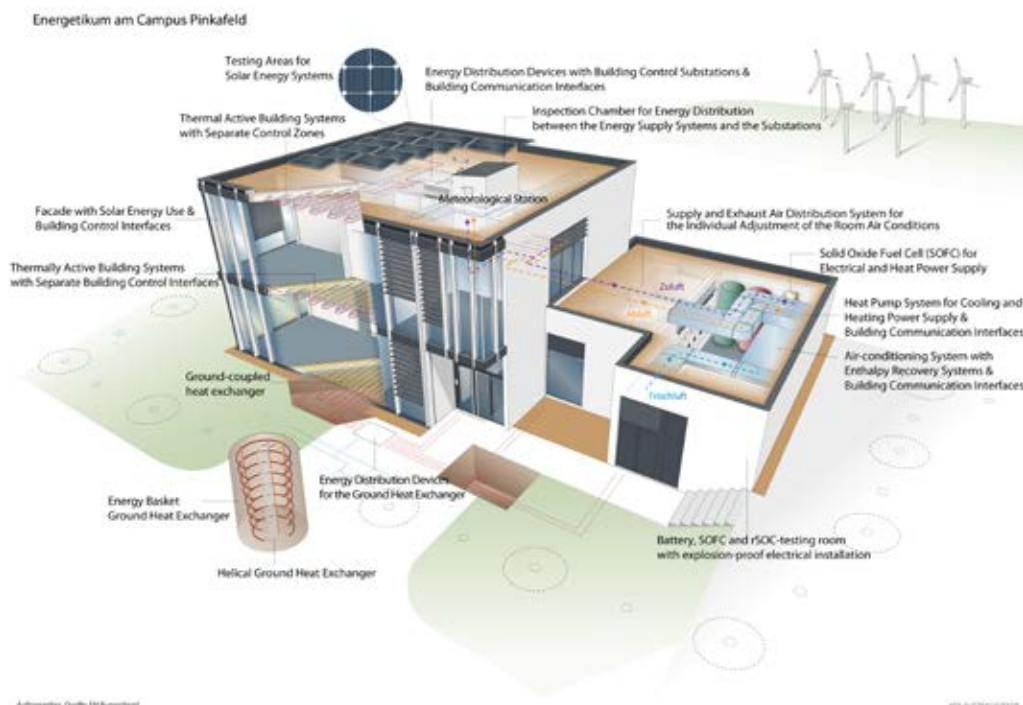


Center for  
**Building Technology**

# Center for Building Technology

With over fifteen scientists and professors, the Center for Building Technology researches efficient system solutions for the sustainable energy supply of buildings. It takes into account user-specific requirements, current developments in the regulatory framework and economic factors. This comprehensive approach encompasses efficiency measures with regard to construction physics, but also the research on decentralized energy supply concepts with the integration of renewable energies and the necessary intelligent communication between production, distribution and use. A particular focus of the research activities is the development of scalable load and storage management solutions, taking into account thermally activated components as well as user-specific comfort.

Due to increasing complexity as well as rising user-specific demands on quality, costs and flexibility, the maintenance of buildings, besides the energetic supply, is becoming more and more important. However, the dynamic load behavior of the facilities leads to complex systems that are difficult to analyze and often operate inefficiently, thus causing high operating costs and wasting resources. The combined use of building automation and modern IoT and IoS (Internet of Things / Sensors) technologies is currently creating new possibilities for the efficient monitoring of individual system components and entire systems. Structurally stored measurement data from building services systems and components also have immense information value for the respective manufacturers. For example, real-world field data can be used to detect possible errors, to determine increases in efficiency, and to investigate the effects of disruptive and environmental factors. Traditional principles of product development are replaced by the integration of field data and customer loyalty is enhanced by the expansion of digital remote maintenance and remote optimization options. However, this requires new methods with which the complex data can be pre-processed in a structured way, analyzed and summarized in a result-oriented way for all involved stakeholders (users, manufacturers, operators, owners, etc.). The center develops this kind of methods.



### Our offer:

The work of the center is supported by extensive laboratory equipment and state-of-the-art simulation methods. For the development of components, for example, the following facilities are available:

- Laboratory air conditioning system
- Climatic chamber
- Low temperature chamber
- Heat pump test stand with the integration in a „hardware in the loop“ environment
- Particle Image Velocimetry & Laser Induced Fluorescence
- Spectroradiometer
- Acoustic chamber with sound pressure and sound intensity
- Tracer gas measurement technology
- Water laboratory
- Mass spectrometry
- Flame Ionization Detector (FID)
- Combustible analysis (calorific value, moisture content, ash content, etc.)
- PV, PVT and PV battery test environment
- Thermal comfort measurement
- Two outdoor tracking systems (2-axis tracked, application areas: solar thermal systems, photovoltaics (PV), façade elements)
- Indoor air quality measurement
- Mobile exhaust gas measuring technology
- Mobile thermal load simulators
- Mobile measurement technology for recording the thermal and electrical load and yield profiles of buildings and of decentralized energy supply units for field measurements
- Hydraulic balancing (investigation of interactions between control groups, partial load behavior)
- Hydraulic balancing and control engineering, experimental modeling
- CFD software and CFD computing cluster
- Building and HVAC-plant simulation cluster

For the development of monitoring systems, control technology concepts, intelligent communication strategies for sector coupling and integrated system optimization, a separate test building was built. The so-called Living Lab ENERGETIKUM is equipped with the following features:

- Weather station with short-wave and long-wave radiation sensors
- Mobile radiation sensors for the thermal analysis of glass facades
- Various geothermal heat exchanger systems
- Extensive system hydraulics for the testing of various thermally activated component systems
- Open building management system for the development and validation of model-based control strategies
- Various BACnet interfaces for the development of intelligent monitoring and communication system control strategies
- Test environment for the integration of SOFC fuel cell systems
- Test environment for the integration of Geo-Exchange heat pump systems

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## Low Cost Demand Side Flexibility



One aspect of European socio-political strategy is the development of a sustainable and independent energy supply. This target can be met by extending the reach of regenerative energy systems and weaving an intelligent network between energy supply, storage and distribution. Solutions that keep in mind optimized overall systems present a promising technological approach.

Austria has a leading position in developing and distributing bio mass boiler installations. The larger an installation, the more varied the fuels are that it has to be able to process; this in turn increases the requirements an installation has to meet in terms of combustion control and low emissions combustion.

Researchers in building technology as well as in energy & environmental management work on developing cost-efficient heat pump systems with demand-side-management capabilities and expand the range of fuels, including their optimal combustion.

The Regionalmanagement Burgenland provides EFRE-funds in the amount of 730,000€ so researchers can adapt and improve their laboratory infrastructure. These funds allow purchasing a low-temperature-range climate cabin, a mobile monitoring system and a weather station to enable our researchers to explore DSM-ready system solutions. In order to chart the thermodynamic states of individual building zones based on sensor data, existing sensor data is adapted to provide a solid data base for the continuous development of air conditioning systems. A thermostat and a vacuum chamber are installed to further develop small heat pump technologies so researchers can simulate precisely defined heat pump operating conditions. In addition to the experimental methods there will be an HPC-infrastructure that generates numerical simulation environments (ANSYS FLUENT and COMSOL Multiphysics).

The prerequisites in terms of infrastructure needed for future research projects in fields such as combustion analytics and emission control technology, as well as different test stands for the treatment and processing, energetic usage and even for combustion sensor systems are also acquired with funds that stem from this project. Finally yet importantly, the project enables the purchase of an extended simulation software for the development and optimization of thermodynamic circular processes.

### FACT BOX

Acronym	Low Cost Demand
Project duration:	11/2016 – 09/2017
Project budget (€):	> 500.000
Client/ Sponsor:	(ERDF) European Regional Development Fund



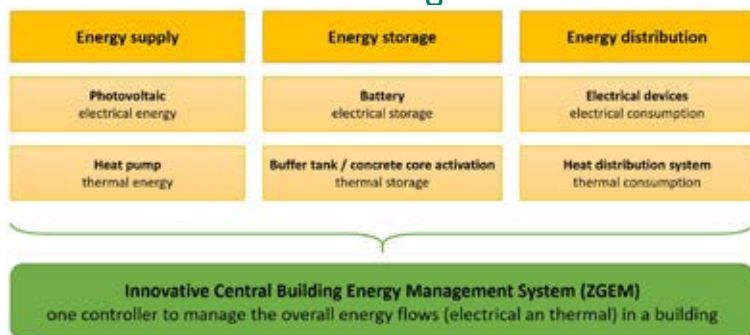
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<http://www.forschung-burgenland.at/infrastruktur/low-cost-demand-side-flexibility/>



## Central Building Energy Management System ( ZGEM - Zentrales Gebäude Energie Managementsystem) for heat pumps, PV, thermic and electric storage



*Integrated building management functions overview concerning the energy flow in a building*

A cross-branches partner network aims at developing an intelligent, integrated building control system designed to centrally control core components for energy supply, energy storage and distribution/consumption in a building based on the principles of energy and demand side optimization.

About 40% of energy is consumed in buildings; this makes building technology a key discipline when it comes to attaining European climate and energy goals. Developments on single technologies level are being replaced by developments aiming at comprehensive systems with coordinated yield and load profiles of all relevant energy forms. The development of efficient and economical system solutions requires a cooperative network featuring interdisciplinary know how.

To this end, a consortium made up of research and industry partners initiated the ZGEM research project. The project focuses on developing and testing an innovative and centralized building energy management system that is to integrate and optimize heat pumps, thermic storage systems (puffers), PV systems with three-phased self-commutated voltage inverters and battery storage systems integrating regional weather data in order to maximize the consumption of PV-energy and ease the load on the electric grid.

This goal can only be attained through a cooperative network of partners from a variety of branches that contribute their respective views and their respective expertise to a comprehensive identification of issues and the solution thereof.

### FACT BOX

Acronym:	ZGEM
Project duration:	11/2016 – 10/2018
Project budget (€):	> 500.000
Client/ Sponsor:	Austrian Research Promotion Agency (FFG) COIN „Network“ 8 <sup>th</sup> Call



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### PARTNER:

Güssing Energy Technologies GmbH (LEAD)  
Herz Energietechnik GmbH  
Energiefreund - ZET & BZR GmbH  
Ingenieurbüro Ing. A. Karner  
Absolut Autark Plus Haus GmbH  
eEnnovation  
Salzburg Wohnbau GmbH

<http://www.forschung-burgenland.at/gebaeude-technik/zgem/>

## Exergy- optimized micro networks via demand-oriented temperature levels for distribution, storage & supply

The further roll-out of renewable energy systems requires the availability of efficient and affordable storage technologies. At present, it is very expensive and complex to store power. The direct storage of net energy, e.g. as heat or cold, can be realized more effectively. Heat pump based thermic micro networks can take a key role in the development.

In order to identify possible development potentials exergy-based system evaluations by means of coupled building and systems simulations are carried out. The following sub-topics are examined in doing so: heat provision and supply, the use of exergy-optimized components, optimized active cross-building storage applications, the creation of compatible interfaces between stakeholders and the overall system optimization.

By means of cross-building overall simulations various solutions are developed for the exergetic optimization of thermic networks. A core element in the process is the use of a low-temperature storage potential of thermically active building components and geothermal heat exchangers.

## PV-hybrid modules and heat pumps system combination with ground collectors designed to increase both systems' energy efficiency

The project examined possibilities to increase the efficiency of combined systems comprising hybrid collectors and heat pump installations. Since the electricity yield of PV-modules increases when the cell temperature decreases the hybrid collectors of PV modules are cooled using heat pumps. Due to the low temperature range this waste heat cannot be used for warm water treatment. Thus, new usage scenarios have been analyzed for heat pump systems.

### FACT BOX

Acronym:	Low-ex Microgrid
Project duration:	07/2014 – 06/2017
Project budget (€):	100.000 - 250.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) e!MISSION.at 4 <sup>th</sup> Call



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### PARTNER:

Technisches Büro TBH  
Herz Energietechnik GmbH  
REHAU GmbH  
ECOsmart GmbH  
AEE - Institut für Nachhaltige Technologien



### FACT BOX

Acronym:	Cool PV
Project duration:	04/2014 – 01/2017
Project budget (€):	100.000 - 250.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) e!MISSION.at 4 <sup>th</sup> Call

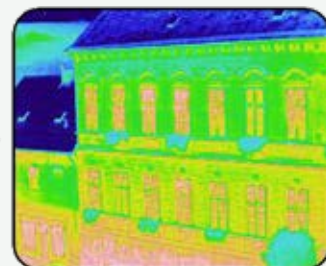
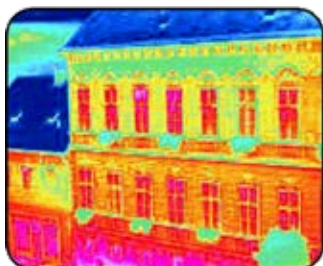
For example, tests were carried out that aimed at increasing the heat pumps' condensation temperature with waste heat in an effort to increase its year-work-unit. Special attention was paid to the active use of ground collectors as heat storage units for the load distribution between waste heat availability and demand. Various control-oriented and hydraulic concepts were developed; their overall energy efficiency was verified through dynamic facility and building simulations.



## Optimizing the energy efficiency of buildings by means of a model based energy flow distribution analysis with non-invasive sensors

OptiMAS examines energy flow distribution within buildings and building complexes through model-based data analysis; non-intrusive sensors are attached to hydraulic lines and heat supply systems in order to monitor, analyze and finally optimize existing buildings independent of climatisation systems and their automatisisation components.

Building systems often run for years in less than optimal operating conditions and thus cause huge operating costs and waste resources. Except for when a system fails completely (e.g. a room is no longer heated) optimization issues often go unnoticed. Energy services, e.g. energy savings contracting, require both the quantification of increases in efficiency and the identification of optimization options as well as the savings such measures yield. Monitoring the energy flow distribution is expected to optimize a building's operation and lower its primary energy demand.



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### PARTNER:

Güssing Energy Technologies GmbH (Konsortialführer)

ASIC - Austria Solar Innovation Center

S.O.L.I.D. GmbH Solarinstallation und Design



### FACT BOX

Acronym:	OptiMAS
Project duration:	10/2016 – 03/2019
Project budget (€):	100.000 - 250.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) City of tomorrow 3 <sup>rd</sup> Call



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### PARTNER:

Donau Universität Krems - Zentrum für integrierte Sensor Systeme

Siemens AG Österreich

Reder Domotic GmbH



## Metal hydride technologies for non-dissipative seasonal heat storage

The seasonal and non-dissipative storage of heat holds an enormous energy savings potential when it comes to the heating of rooms and the provision of warm water. Reversible metal hydrides are a very useful class of compounds that could potentially offer ways to seasonally store heat in a non-dissipative way (use of the heat produced in reversible chemical reactions). This project aims to identify possible technological interfaces between building technology and metal hydride research. In detail, the project looks at the model case 'single family home' in combination with various concepts for seasonal metal hydride heat storage.

For long-term heat storage the use of reaction enthalpy caused by reversible chemical reactions could take on an important role. Practical reversibility and large reaction enthalpy oppose each other. Thus, the number of reversible chemical reactions is low. Metal hydrides present a good compromise in this context when applied to seasonal, non-dissipative heat storage. However, research concerning heat storage in metal hydrides is still in its infancy. The project in hand looks at the possibility for using metal hydrides as heat storage for homes. To this end, the ideal heat storage demand in relation to the collectors' yield and thus the collectors' ideal temperature shall be defined. Based on these data, researchers evaluate the pros and cons of various metal hydride collectors as seasonal heat storage. The project's result is expected to define the feasibility of a seasonal metal hydride heat collector for a single-family home according to modern building standards.

### FACT BOX

Acronym:	MH4HeatStorage
Project duration:	10/2015 – 03/2017
Project budget (€):	100.000 - 250.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Energy Research Programme 1 <sup>st</sup> Call (e!MISSION)



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#### PARTNER:

Fotec GmbH (LEAD)



## Flexible FE/BE Sensor Pilot Line for the Internet of Everything



IoSense's overall project goal is to boost the European competitiveness of the electronics components and systems industries by increasing the pilot production capacity and improving time-to-market for innovative microelectronics, accomplished by establishing fully connected

### FACT BOX

Acronym:	IOSense_H2020
Project duration:	05/2017 – 04/2019
Project budget (€):	250.000 - 500.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) ICT of the Future



#### PROJECT MANAGER:

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pilot lines in 'More than Moore' technologies, supporting discrete and integrated sensor solutions including ASICs (Application Specific Integrated Circuit), test beds, device packaging and assembly to accelerate the uptake of KETs (Key Enabling Technologies). The new pilot lines will form a network with existing specialized R&D and manufacturing lines to work as a European modular solution system. In particular the segment of sensor technologies and MEMS. (Micro Electro Mechanical Systems)(IoSense homepage, 2016)

IoSense spans expertise and partners along the whole value chain involving main actors in the respective domains. All partners complement each other in a well-balanced and structured way avoiding overlaps and covering all then expertise needed. Large companies, SMEs and research institutes have the capabilities and necessary infrastructure for research, manufacturing as well as bringing the results to market. The IoSense consortium connects 33 partners from 6 countries in Europe, cf. Figure 1. (IoSense homepage, 2016)

Within the IoSense project the University of Applied Sciences Burgenland demonstrates the improvement of heating, ventilation and air conditioning capabilities by integrated sensor solutions and smart gas sensor networks. This offers new approaches for sustainable energy generation, reduction of energy consumption and efficient energy management in future buildings of urban environments across Europe.

## Advancing competence for the development of model-based data mining analysis methods in the field of building technology

An essential element of European socio-political strategy is the development of a sustainable, independent energy supply. This objective can only be reached through the continued expansion of regenerative energy systems and an intelligent network between energy provision, energy storage and energy distribution. In this context, building technology is a key discipline due to the unchanged high portion of energy demand for heating and air conditioning. Therefore, the building of the future will have to be able to take on tasks related to energy production, as well as short- and long-term energy storage. Solution strategies based on coordinated and comprehensively optimized overall system designs using individual buildings or building units as energy storage constitute a promising alternative. Net energy storage concepts such as power-to-heat and power-to-cool technologies offer more flexibility for future energy supply systems (demand side management). This type of energy management requires precise knowledge regarding buildings' load behavior and the utilization of possible storage potentials always considering individuals' comfort and process requirements.

### FACT BOX

Acronym:	EDMA
Project duration:	01/2017 – 12/2020
Project budget (€):	250.000 - 500.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) COIN 6 <sup>th</sup> Call



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[www.forschung-burgenland.at/gebaeudetechnik/edma/](http://www.forschung-burgenland.at/gebaeudetechnik/edma/)

Massive price reductions in the field of sensor technology (see Fig. 1) and wireless data transmission, as well as the promotion of IoT (Internet of Things) and IoS (Internet of Sensors), enable new, cost-efficient possibilities in the near future to control relevant variables and provide this data in digital form. This allows for new possibilities in model-based data analysis and the system identification and modelling based on affordable sensors and sensor networks, respectively.

Reasonable use of these technologies requires new analysis methods that allow for the intelligent interpretation of measured data. In addition to statistical methods, model-based methods are expected to come into play. These methods offer a high degree of flexibility regarding the assessment and interpretation options in order to generate added value from the data made available and to provide this information in a goal-oriented manner to support demand side management. The development of such analytics requires information about the current thermic conditions of a building and its expected future energy demand. It is the aim of the project on hand to build and establish the competences and infrastructure in the form of a high-performing research group.



## Expanding business competence to improve the development and realization of innovative sustainable building concepts

The qualification initiative ‚HdZ2Market‘ is an initiative that looks at expanding the competences and qualifications of research and innovation personnel in companies dealing with sustainable building technology. The initiative addresses the following issues: innovative building basics, e.g. structural physics, ecology, energy efficiency, architecture, efficient supply and productions (technical facilities), energy storage, smart homes, integrated PV. Interdisciplinary cross section modules, e.g. Business Model Innovation, LCA and technological impact assessment, project and strategy workshops, e.g. for the development of new business models or for the initiation of new F&E projects.

The topics identified are dealt with in full day interdisciplinary workshops. Didactics comprise dialog-oriented adhoc presentations, group discussions, topic-related workshops, project work (in small groups), and excursions. Important goals of the qualifications network comprise the anchoring of know-how and increase of innovation capability in the companies that partake as well as the setup of long-term cooperation between the companies involved in the project and between the research community and businesses.

### FACT BOX

Acronym:	HDZ2Market
Project duration:	04/2017 – 12/2018
Project budget (€):	20.000 - 100.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) R&D Competences for Industry 3 <sup>rd</sup> Call



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#### PARTNER:

Technikum Wien GmbH  
ÖGUT  
4ward Energy Research GmbH  
IBO – Österreichisches Institut für Bauen und Ökologie GmbH  
ATB Becker Green Technologies  
Nikko Engineering GmbH  
Nikko PV GmbH  
MS.GIS Informationssysteme GmbH  
Sonnenplatz Großschönau  
Dr. Lunzer Energie und Umwelt eU  
TBH Ingenieur GmbH  
Weissensteiner Holz-System-Bau GmbH  
caFM engineering GmbH  
ATP Sustain GmbH  
e2 engineering GmbH  
Fronius International GmbH  
EWS Consulting GmbH  
Vasko+Partner Ingenieure ZT

## Home & Habitate

We spend the bigger part of our lives in buildings. The project allows children and young adults to examine their living quarters. The tasks are adapted to their age range and experts accompany them in meeting their tasks. They think about topics such as architecture, building materials and light and their respective effects on well-being. The insights gained from the project will be compared with data and facts (e.g. statistical data) from other regions and countries (especially to the countries of origin of pupils with a migration history); the data will be compared with local data and serves as basis for project-related discussions. Based on the data collected, pupils share their expectations and needs regarding housing. They will draw simple plans and then look at and discuss the ecological and societal impact of their plans. Workshops are organized that turn children and young adults into experts that pass on their newly acquired knowledge in terms of peer-to-peer tutoring to even younger children/youths and to their parents and/or guardians in workshops created for these target groups. Preschools, elementary schools and middle schools are involved in the project.

#### FACT BOX

Acronym:	Wwww1
Project duration:	09/2017 – 08/2020
Project budget (€):	20.000 - 100.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) Regional Talents 6 <sup>th</sup> Call



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#### PROJEKTPARTNER/FORSCHUNGSPARTNER:

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LUMITech GmbH  
Kardea  
HTL Pinkafeld  
NMS Oberwart  
VS Wolfau  
NMS Oberschützen  
VS Oberschützen  
Kindergarten Oberschützen

[www.forschung-burgenland.at/learning/www1](http://www.forschung-burgenland.at/learning/www1)



PreCenter  
**Smart Energy  
and Innovation**



## Pre-Center Smart Energy and Innovation

In order to achieve the energy transition and to master the challenges of climate change, a series of questions must be addressed. A central point here is the identification of flexibility and efficiency potentials in existing energy systems in order to enable the increased use of power plants whose power generation fluctuates and whose performance can therefore be influenced only to a limited extent. Measures for this can be identified, analyzed and used along the entire energy value chain and across all energy sources. The utilization always requires an integral, multi-dimensional analysis that takes into account all affected stakeholders. With its activities and analyses, the Pre Center for Smart Energy and Innovation stands for the development of solutions on a technical level with the help of participatory processes while integrating the results into existing structures and markets. All activities are always implemented with regard to their interaction with climate change, both in terms of climate protection and climate change adaptation. Strategic partnerships in projects and beyond are an essential aspect of all our work as well as of the implementation in demo projects. These partnerships encompass other research institutions, municipalities, technology partners, energy suppliers, public bodies, SMEs and also users (private and business) in the respective regions themselves.

In particular, the Pre-Center Smart Energy and Innovation has focused mainly on EU programs (Bilateral Territorial Cooperation, CENTRAL, Danube, Alpe Adria) and on national programs linked to energy issues (eg Smart Cities Demo, energy research, Showcase Region Energy, Mobility of the Future, ...).

### Focus:

**ENERGY INNOVATION** – Solutions for the following areas are developed in cooperation with international partners: alternative mobility, use of waste heat, prevention and recycling of waste, concepts and products to increase energy efficiency and the use of volatile renewable energy.

**SMART ENERGY** – experts do research in implementation projects on the basis of real application environments on new technical solutions, services and their user acceptance in the sense of sustainable market integration to increase the potential of renewable energies in the energy system.

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## Comprehensive model of waste heat utilization in CE regions

The CE-HEAT project is addressing the challenge on how to improve the governance of energy efficiency by focusing on the field of waste heat utilization. This field was identified as one of the most pressing issues at regional and local level. To improve waste heat utilization, better and comprehensive planning and monitoring tools are needed. CE-HEAT partnership designed a solution through three specific objectives:

- to provide an excellent analytical and monitoring platform through establishment of GIS based regional waste heat cadastres with waste heat sources classification and a monitoring tool
- to provide a comprehensive solution for managing waste heat utilization projects and strategies through the development of a waste heat utilization toolbox (leading stakeholders participation process, establishing feasibility etc)
- to incorporate a new approach into local, regional and national strategies by integrating a new cadastre and toolbox into existing spatial planning and energy management systems and spreading it throughout the CE area and beyond.

The first level of target groups of the CE-HEAT project are regional/local energy policy makers and spatial planners. The Second level is represented by waste heat producers, potential investors and local stakeholders. A transnational approach will enable partners to use different experiences, knowledge and competences to find solutions to a common problem in a common legal environment. It will also bring added value because solutions will be tested through pilot projects in very different scenarios.



CE-HEAT at the e-nova

### FACT BOX

Acronym:	CE-HEAT
Project duration:	06/2016 – 05/2019
Project budget (€):	250.000 - 500.000
Client / Sponsor:	Interreg - Central Europe 1 <sup>st</sup> Call



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<http://www.interreg-central.eu/Content.Node/CE-HEAT.html>

### PARTNER:

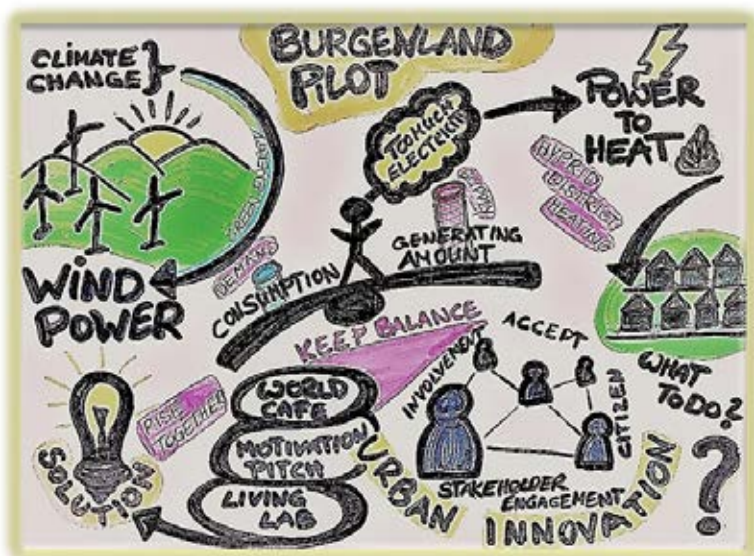
E-institute, institute for comprehensive development solutions (SI)  
Energy Management Agency of Friuli Venezia Giulia (IT)  
Energy Insitute Hrvoje Požar (HR)  
Drava Hydropower Plants Ltd (SI)  
Thuringian Energy and GreenTech Agency GmbH (DE)  
Jan Evangelista Purkyně University in Usti nad Labem (CZ)  
Poltegor-Institute (PL)  
National Centre for Energy Savings (CZ)  
Ministry of Industry and Trade of the Czech Republic (CZ)  
The Environmental Protection and Energy Efficiency Fund (HR)  
City Municipality of Maribor SI  
Marshall Office of the Lower Silesia Region (PL)



## Utilizing innovation potential of urban ecosystems

URBAN INNO – „Utilizing innovation potential of urban ecosystems“ is a project co-funded by the Interreg Central Europe Programme. It is addressing the challenge to make Central Europe more innovative and competitive by maximizing the innovation potential of smaller and medium sized urban ecosystems. A significantly better linkage of actors within urban innovation ecosystems is needed for a better use of innovation potentials.

URBAN INNO focuses on maximizing innovation potentials of urban ecosystems by establishing quadruple helix clusters/networks in the partner regions as well as by developing and implementing new participatory methods and tools to engage end-users in innovation processes with the objective to have educated and motivated users – SMART USERS. 5 new quadruple-helix networks will be established in partnership regions, and 6 regional/urban innovation plans will be developed. In parallel, new participatory methods and tools will be developed and tested in 9 pilot projects to be implemented in partner regions.



### FACT BOX

Acronym:	Urban Inno
Project duration:	06/2016 – 05/2019
Project budget (€):	250.000 - 500.000
Client / Sponsor:	Interreg - Central Europe 1 <sup>st</sup> Call



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Technical University of Kofice, Slovakia  
Municipality of Kielce/ Kielce Technology Park, Poland  
City of Rijeka, Croatia  
Ericsson Nikola Tesla d.d., Croatia  
Pannon Business Network Association, Hungary  
Vorarlberg University of Applied Science, Austria  
InformaticaTrentina Spa, Italy

### ASSOCIATED PARTNER

Economic Development Department Karlsruhe, Germany  
Vas County Authority, Hungary  
City of Pinkafeld, Austria  
City of Hartberg, Austria  
Kofice Self-governing Region





## Network stabilization and optimization of the distributions network using “Flexible AC Distribution Systems“

Whenever new energy supply and consumption patterns emerge the demand for storage systems is on the rise. Storage systems and their preceding converters can provide network services and help secure uninterrupted supply in network bottlenecks. The project FACDS examines the definitions of network conducive functionalities of future decentralized storage systems in electricity distribution networks with simulation-based validation on system level (network simulation) and on component level (control system development). FACDS also carries out a laboratory validation of converter systems. The FACDS-project's core component is the real-life implementation of test systems in Seestadt Aspern.

### FACT BOX

Acronym:	FACDS
Project duration:	03/2016 – 08/2018
Project budget (€):	20.000 - 100.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Energy Research Programme 2 <sup>nd</sup> Call



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[www.forschung-burgenland.at/energie-umwelt/facds/](http://www.forschung-burgenland.at/energie-umwelt/facds/)



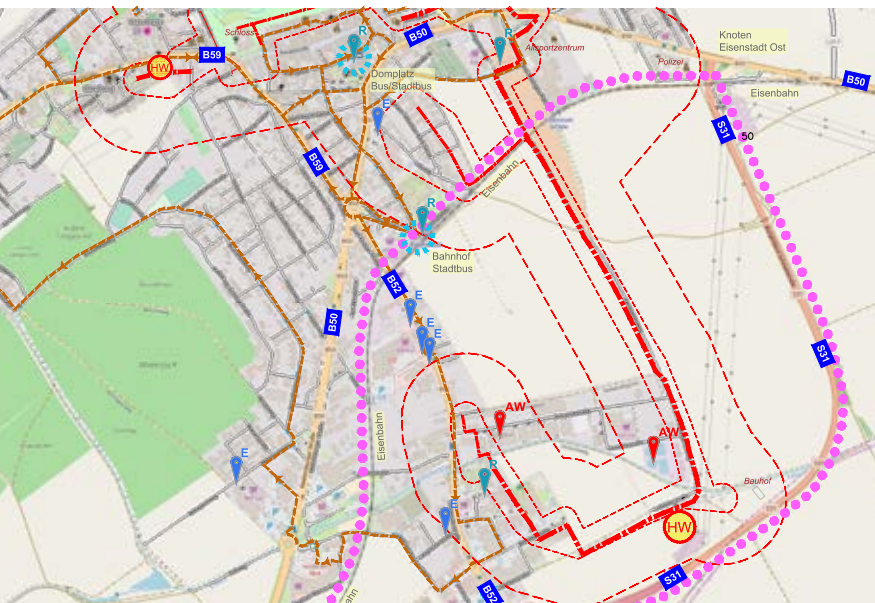
## Multifunctional energy networks for urban utilities supply

The project's area of interest comprises an area in the city of Eisenstadt that is home to an industrial zone; the project takes a closer look at this zone. This industrial zone is the project's linchpin; from there, one can deduce the project's overall energy concept. Due to the high energy consumption in an industrial area, the area lends itself to devising an energy concept that at a later stage can be rolled out to the adjacent parts of the city. This smart city start up project aims to develop and analyze scenarios and methods for the optimization of the industrial zone as the city's technology hub. Concepts for the realization of the above-mentioned challenges are designed within the framework of this project. A comprehensive participation process is planned in order to keep relevant stakeholders up to date with the project.

### FACT BOX

Acronym:	IrON Eisenstadt
Projekt duration:	09/2017 – 08/2018
Project budget (€):	20.000 - 100.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Smart Cities 8 <sup>th</sup> Call

## Section of the map of Eisenstadt



## Sample solutions for innovative pilot applications concerning the intelligent marketing of wind energy in Burgenland

The wind marketing project in Burgenland reflects the development of a region in which the generation of power from wind serves as precursor for an environmentally friendly energy supply in the future. Business models and areas of application shall be developed for wind energy production with support of system flexibilities that are exemplary. New business models are set up to improve the economics of wind power stations, especially after the end of the funding period. These models are also expected to serve as incentive for any further development of renewable energy production.



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<http://www.smartcities.at/stadt-projekte/smart-cities/iron-eisenstadt-multifunktionale-energienetzwerke-zur-versorgung-von-stadtgebieten/>

### FACT BOX

Acronym:	Windvermarktung
Project duration:	07/2016 – 03/2017
Project budget (€):	20.000 - 100.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Modell Region Energy 1 <sup>st</sup> Call



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Energie Burgenland Vertrieb GmbH & Co KG  
Enercon Service Austria GmbH  
4ward Energy Research GmbH  
Quadra Energy GmbH

[www.forschung-burgenland.at/energie-umwelt/windvermarktung/](http://www.forschung-burgenland.at/energie-umwelt/windvermarktung/)  
[www.vorzeigeregion-energie.at/projekt/klien/](http://www.vorzeigeregion-energie.at/projekt/klien/)



# Pre-Center **Heat Pump Technology**

# Pre-Center Heat Pump Technologies

Future buildings need new solutions in the area of building technology. Due to constantly improving thermal building envelopes, topics such as heating and cooling within the field of building technology also need to be adapted to these new conditions. In the last few years the following trends have arisen: decreasing heating loads, increasing cooling loads, stable hot water demand, increased user comfort requirements.

In the future the small power range requires adequate solutions that on the one hand can locally cover low heating loads without distribution losses and that are suitable for decentralized hot water preparation on the other hand. Additionally, the majority of the heat pump- and refrigeration technologies available on the market need climate-relevant refrigerants. In parallel, research has made great progress in the last few years so that – with the help of further research - alternative heat pump- and refrigeration technologies can become competitive using conventional technologies without climate-relevant refrigerants, without moving parts and without noise emissions.

Aim of the Pre-Center Heat Pump Technologies is to implement material and immaterial structures in the field of innovative decentralized heat pump technologies, with particular focus on new innovative approaches such as thermoelectrics, thermoacoustics and magnetocalorics.

Thereby experimental and numerical methods are being developed and applied in order to conduct deeper research for heating- and cooling applications in building technology.

The innovation rests on the focus of decentralized heat pumps on the one hand and on the application of the physical effects such as thermoelectrics, thermoacoustics and magnetocalorics for cooling and heating in building technology on the other hand.

## Our offer:

- Research in the field of compression heat pumps and thermally driven heat pumps
- Innovative research in the field of thermoelectric, thermoacoustic and magnetocaloric heat pumps
- Development of decentralized heating- and cooling applications, as well as applications in the field of decentralized hot water preparation
- Laboratory facilities for testing heat pumps
- Mobile measuring equipment for field tests
- Software for modelling and simulating energy-efficient integration into buildings

## Contact person



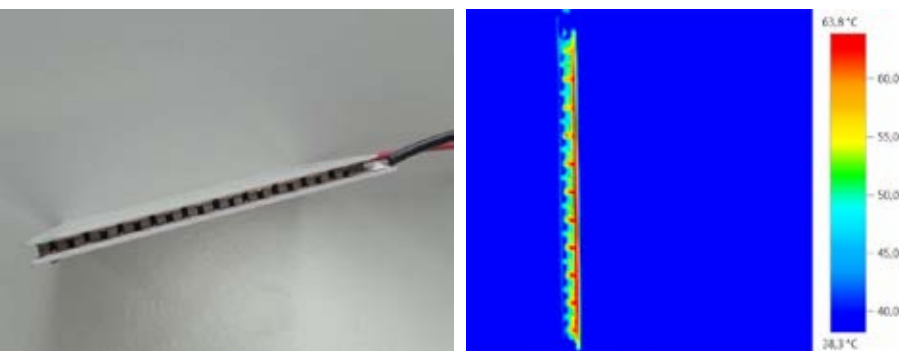
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## Heat Pump Without Climate Relevant Refrigerant

Due to the increasing building standard in the last years the specific heat energy demand for new buildings but also for refurbished buildings decreases. Due to this fact the percentage of end energy use for hot water production rises. But small scale devices, which can be used for decentralized applications, are hardly available. Usually devices with a high nominal power, short operation times and small capacity utilization are used. Therefore there is a lack on devices for heating and cooling for small scale applications ( $<2 \text{ kW}_{\text{thermal}}$ ), which do not have moving parts and therefore need low-maintenance, which have no noise emissions and therefore can be used for decentralized applications and which do not use climate-relevant refrigerants..



### OBJECTIVES AND METHOD

The aim of the project Peltier\_Heat\_Pump is to research a device for heating and cooling in the building technology for small scale applications ( $<2 \text{ kW}_{\text{thermal}}$ ). This device is characterized through long operation times and little electrical power consumption, through operation without climate-relevant refrigerants, through operation without noise emissions, through operation without maintenance and through the fact that it can be connected to PV without DC/AC conversion losses. This device for building technology applications is based on Peltier-elements and can be applied for heating, cooling and hot water production.

## Heating and cooling in low performance ranges ( $<2 \text{ kW}_{\text{thermal}}$ ) with thermocoustic heat pumps

The project researches various thermoacoustic heat pump concepts for low performance ranges ( $<2 \text{ kW}$ ) that can be used for building technology applications such as heating, warm water provision and air conditioning (cooling). The innovation lies in researching heat pumps that work according to the thermoacoustic principle and thus work without climate-change relevant cooling agents.

### FACT BOX

Acronym:	Peltier_Heat_Pump
Project duration:	05/2015 – 08/2018
Project budget (€):	250.000 – 500.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Energy Research Programme 1 <sup>st</sup> Call



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GAP - Solutions GmbH

<https://nachhaltigwirtschaften.at/de/e2050/veranstaltungen/2016/20160622-highlights-der-energieforschung-2016-die-rolle-der-waermepumpe-im-zukuenftigen-energiesystem.php>

This project is supported by the climate and energy fund and carried out within the framework of the energy research program 2014..



### FACT BOX

Acronym:	Thermoacoustic_HP
Project duration:	07/2016 – 06/2019
Project budget (€):	100.000 – 250.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Energy Research Programme 2 <sup>nd</sup> Call

## METHOD

- Development of a calculation method for thermoacoustic heat pump concepts adapted to energy efficient building technology applications including specifications for components.
- Construction of thermoacousting heat pump test stands for building technology applications such as heating, warm water provision and air cooling.
- Lab experiments are carried out to research the thermoacoustic heat pump test stand and its impact both on a system and on a concept level.
- Application of realistic loads with the help of hardware-in-the-loop simulations through coupling test stand and system simulation software.

At the end of the project, the team should have a low-performance range heat pump test stand that is based on the thermocacoustic principle that approaches the degree of quality one expects from conventional heat pumps. The application of realistic loads allows testing if it can be used for building technology applications.



## Testing for energy efficiency's own good

Forty percent of the energy consumed is consumed in buildings – that is more energy than the energy used in the industry. This poses a huge challenge for building technology professionals: they need to further increase the energy efficiency of buildings.

The University of Applied Sciences Burgenland (FH Burgenland) campus in Pinkafeld now launched an innovative test stand to help tackle the problem. The project “energy4buildings” allows systems such as chillers or heat pumps to interact via simulation programs.

The measuring of energy flows allows optimizing individual devices by means of ever new simulation scenarios. Also, the interaction of systems such as heat pumps and chillers or the interaction of electricity produced by the building with power that comes from outside the system can be measured and optimized in several test runs.

For increased energy efficiency units that cover both heating and cooling become increasingly important. New simulation cycles are created with a hardware-in-the-loop (HIL) test stand: e.g. the inlet



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<http://www.forschung-burgenland.at/energie-umwelt/thermoacoustic-hp/>

This project is supported by the climate and energy fund and carried out within the framework of the energy research program 2015..

### FACT BOX

Acronym:	energy4buildings
Project duration:	05/2013 – 04/2018
Project budget (€):	> 500.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) COIN 4 <sup>th</sup> Call

temperature of a heat pump is measured; the value is communicated to the building and facility simulation software. For example, it calculates the model for an office building with floor heating. The calculated back flow temperature is again entered in the heat pump as real temperature value. Then the next hardware-in-the-loop simulation cycle starts. The special interface between hardware and simulation software plays an innovative role here. With the hardware-in-the-loop principle FH Burgenland spearheads the area of building technology laboratory infrastructure.



*Test stand for electrically and thermally driven heat pumps and refrigeration systems*

## Analysis and further development of innovative heat pump technologies for future buildings

The project future heat pump aims at realizing material and immaterial structures in the field of innovative, decentralised heat pump technologies. It does so paying close attention to new innovative approaches such as thermoelectrics, thermoacoustics and magnetocalorics.

To this end, metering technology and simulation software is acquired, experimental and numerical methods are continuously developed and applied in order to carry out more substantial research activities for heating and cooling applications in building technology.

Innovation aspects surface in focusing on decentralized heat pumps on the one side and in the application of thermoelectrics, thermoacoustics and magnetocalorics for heating and cooling in building technology on the other side..



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AEE Intec

[www.forschung-burgenland.at/energie-umwelt/energy4buildings-waermepumpeneffizienz/](http://www.forschung-burgenland.at/energie-umwelt/energy4buildings-waermepumpeneffizienz/)

Bundesministerium  
Bildung, Wissenschaft  
und Forschung



Bundesministerium  
Verkehr, Innovation  
und Technologie

### FACT BOX

Acronym:	Future_Heat_Pump
Project duration:	01/2017 – 12/2021
Project budget (€):	> 500.000
Client / Sponsor:	Austrian Research Promotion Agency (FFG) COIN 6 <sup>th</sup> Call



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Experimental and numerical methods are developed, applied and validated within the framework of this project. The following methods are put to use in the following areas:

- Small heat pumps
- Test stand development designed to validate decentralized small heat pumps through experiments.
- Thermo electrics
- Development and application of test method to characterize thermoelectric materials concerning their efficiency in thermoelectric modules both in ambient settings and in vacuums.
- Thermo acoustics
- Development and application of a numeric method to examine thermo acoustic heat pumps and calculate their integration into buildings.
- Magneto calorics
- Development of a model for the numeric validation of magneto caloric heat pumps.

Pre-Center

**Thermal Energy Technology,  
Process Simulation and  
Process Assessment**

# Pre-Center Thermal Energy Technology, Process Simulation and Process Assessment

The center focuses on the development of new and existing technologies that promise to improve energy efficiency in the context of the entire system. Therefore, technical and environmental assessments of the entire system are emphasized at the center. The aim is to work with business partners and technology providers to strengthen their competitiveness. Innovations in the field of thermal energy technologies are at the heart of our research, including biomass combustion plants, thermodynamic cycles for waste heat utilization or technologies for combined cooling, heating and power generation.

For a holistic approach towards assessing technological developments, the following methods and tools are used: process development; technical, ecological and economic process assessment and experimental investigations.

Center staff offer a wide array of expertise in thermodynamic process simulation, as well as in measuring technology and data evaluation. For a comprehensive ecological and economic assessment of systems the methods of Life Cycle Assessment and Life Cycle Costing are applied. The necessary tools for simulating and assessing technologies are part of the Center's basic software equipment.

Project partners and customers will profit from extensive experience that builds on successfully completed projects in the following fields: utilization of novel biogenic fuels; combustion optimization; combined cooling, heating, and power systems; and power generation from low temperature heat sources (e.g. waste heat). Additional reference projects have dealt with the ecological assessment of energy systems at different scales (e.g. assessment of technologies, processes, regions or supply chains).

## Our offer

**Process simulation** – In this area thermodynamic processes are being developed and optimized through process simulations. The aim is to further develop those processes, frequently starting at a low technology-readiness-level, through variants calculations and parameter studies. Software tools being applied are IpsePro, EES and MatLab.

**Life Cycle Assessment** – Researchers investigate the environmental impacts of processes with the help of various software tools (GaBi, Gemis and OpenLCA) and databases. Based on contribution analyses and model scenarios, hot spots of environmental impacts can be found and impact reduction measures can be identified.

**Experimental investigations** – The available laboratory equipment and the Center's test stands focus on thermal biomass utilization. Ultimate and proximate fuel analyses can be carried out to explore possible fields of application for biogenic fuels. Furthermore, utilization possibilities for biogenic raw materials can be investigated, e.g. at the pellet test stand or at the biomass boiler test stand. Portable flue gas analytics for gaseous and particulate emissions is available for the optimization of firing systems and for combustion control concepts, both at the test stand on a lab scale or in full-scale real plant operations.

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## Emission Limited Biomass Combustion

Austria is a global leader in the development and spreading of biomass boiler heating systems for buildings, for industrial and commercial facilities and for local and district heating supply. The larger such heating systems are, the bigger the variability in fuel becomes. Due to the larger variability in fuels, combustion control requirements become more complex. Lambda sensors made of zirconium oxide are state-of-the-art in small-scale boilers. In mid-sized systems, lambda sensor controls cannot guarantee a low emission combustion due to the use of heterogeneous fuels. The project EmiL (Emission Limited Biomass Combustion) engages in fundamental research in order to create the basis for highly efficient low-emission biomass boilers.

The aim of a low-emission biomass combustion shall be attained by combining primary measures in the area of combustion sensor technology and combustion control with secondary measures concerning cost-efficient particulate matter separation technology. An integrated research approach optimizes these parts to an overall solution. The methodology is based on experimental investigations carried out on test stands and in field tests. An innovative, model-predictive control is being developed and implemented in a LabVIEW environment and is tested via an interface to the boiler control. In regard to particulate matter separation, tests are carried out on the basis of CFD-simulations and experimental research to investigate the integration of particulate matter separators inside the boilers.

The research institution, a university and boiler producers closely cooperate to achieve the planned research results. This industrial research project addresses mid-sized biomass boilers with capacities ranging from 50 kW to 1.0 MW.



*Test stand for standardized measurement of biomass boilers*

### FACT BOX

Acronym:	EmiL
Project duration:	04/2016 – 03/2019
Project budget (€):	> 500.000
Client / Sponsor:	Austrian climate and energy fund Austrian Research Promotion Agency (FFG) Energy Research Programme 2 <sup>nd</sup> Call



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## Ecological evaluation of energy systems

The environmental impact of energy consumption depends on the energy system and the type of resources used. The method to be applied for a comprehensive ecological assessment of systems is Life Cycle Assessment (LCA). The doctoral project at hand aims to compare and assess different sets of methods, rules or guidelines for determining the environmental effects.

The guidelines in literature very often have a different focus on what to evaluate or what rules to follow. The choice of the most suitable life cycle inventory and impact assessment method for answering a given question is challenging. This project aims to determine and compare various methods and tools with the focus on using them to perform an LCA study for energy systems. The evaluation has its focus on methods used in LCA studies of energy systems (on a technology basis and for the power supply of an entire region).

The dissertation investigates the ecological assessment of energy systems at different scales like the assessment of technologies, processes, regions or supply chains.

The project starts with a comprehensive literary research on methods and guidelines for the ecological evaluation of energy systems. The aim is to answer the following questions: What is “best practice”? What methods are used the most in literature?

The next step is a comparison of the methods. Various criteria are defined to provide a systematic comparison. Therefore, the requirements for analyzing energy systems are examined and defined, paying special attention to problems, data gaps, and weaknesses that can be found in literature.

Criteria for the review will be, for example:

- Which impact categories are considered?
- How can system borders be set; is a lifecycle approach required?
- How can the allocation of coproducts be handled (heat and electricity)?
- Does an international or regional standard or guideline exist?
- How can uncertainties be handled or indicated?

In addition, different energy systems and methods are selected for carrying out case studies. Differences will be evaluated and it will be determined to what degree systems are sensitive to changes in methods.

This evaluation is the starting point for developing a guideline for future evaluations. The result is an easy-to-apply and easy to understand evaluation method for energy systems. Emphasis is put on the

### FACT BOX

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