Institute of Thermal Engineering

Institut für Wärmetechnik (IWT)

Graz University of Technology

Research Area „Energy-Efficient Buildings“

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2020

Research Areas

Thermal Energy Systems

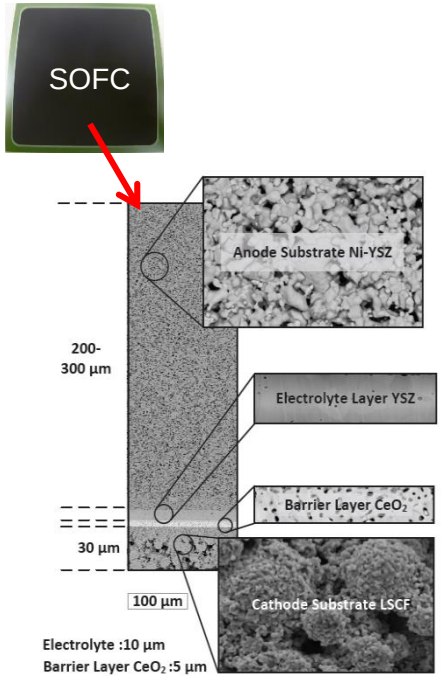
- Combustion and gasification of biomass
- Fuel cell research
- Modelling and simulation of high temperature processes

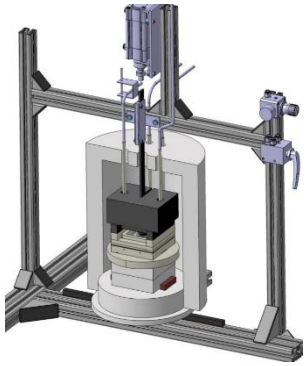
Heating, Refrigeration & Air-Conditioning

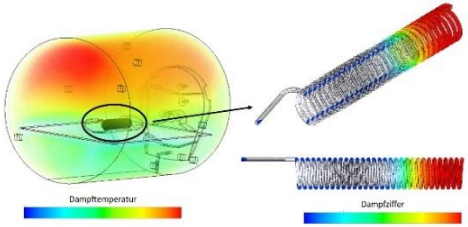
- Heat pumping systems
- Compression & absorption systems
- Stationary & mobile applications
- Alternative refrigerants & processes

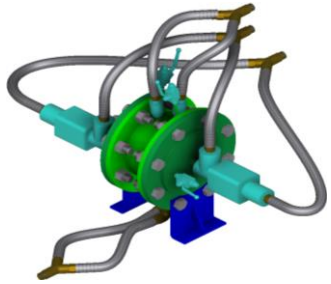
Energy-Efficient Buildings

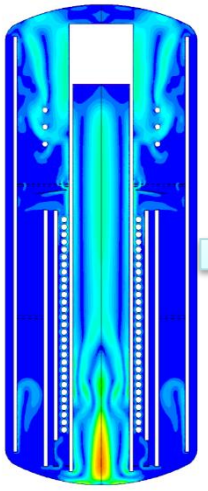
- Development of energy-related components
- Thermal simulation of buildings and energy systems
- Urban decentralized and central energy supply concepts







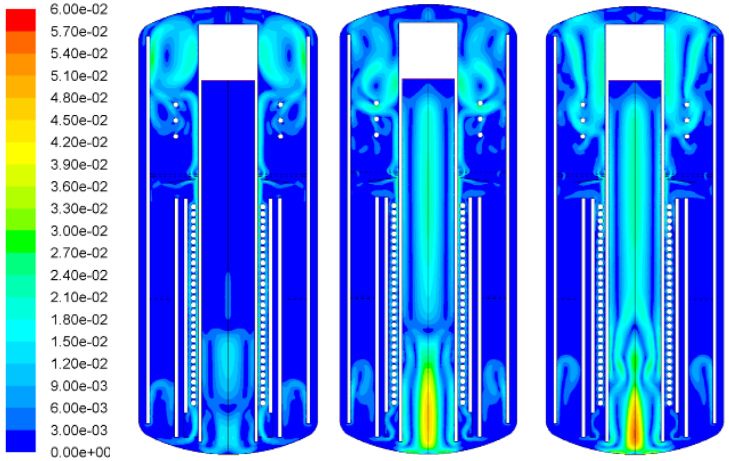




Energy-related components – Energy Storage

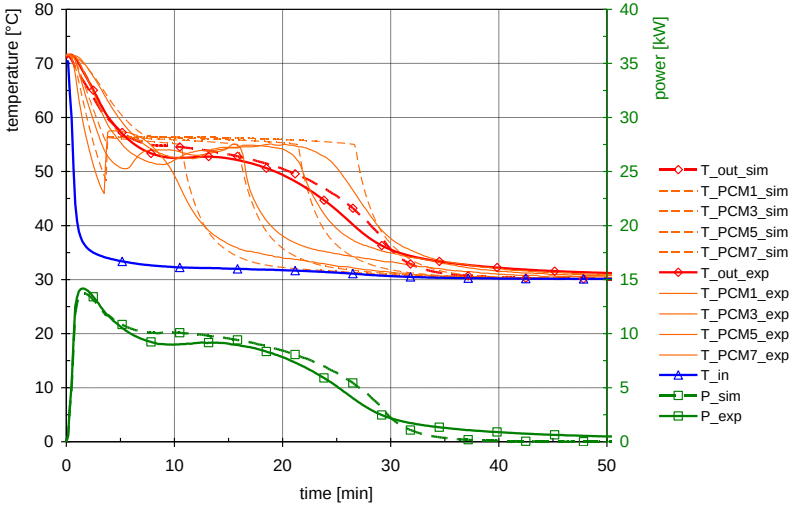
Main research areas in the field of energy storage

- Increase of the storage density (e.g. PCM)
- Reduction of heat losses
- Improvement charging & discharging unit
- Development of simulation models
- Storage concepts for new applications (e.g. rail vehicles, seasonal storage)



Optimisation of charging and discharging unit - water storage tank

Measurement: Transparent storage tank



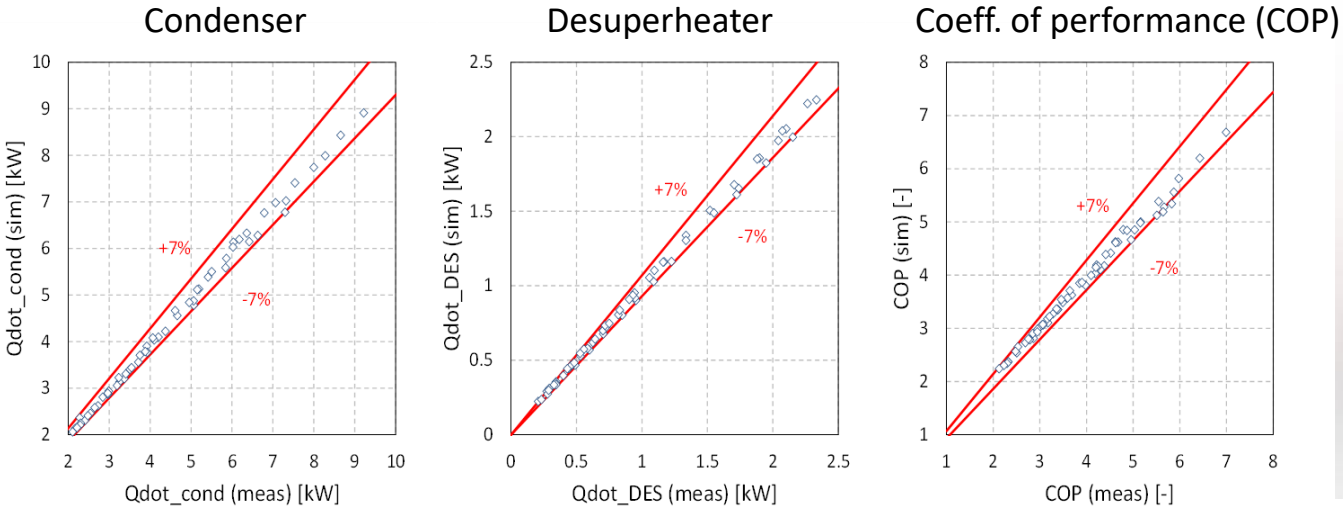
Comparison between simulation and measurement for discharging the tank (PCM Sodium Acetate Trihydrate)

Contact: andreas.heinz@tugraz.at, hermann.schranzhofer@tugraz.at

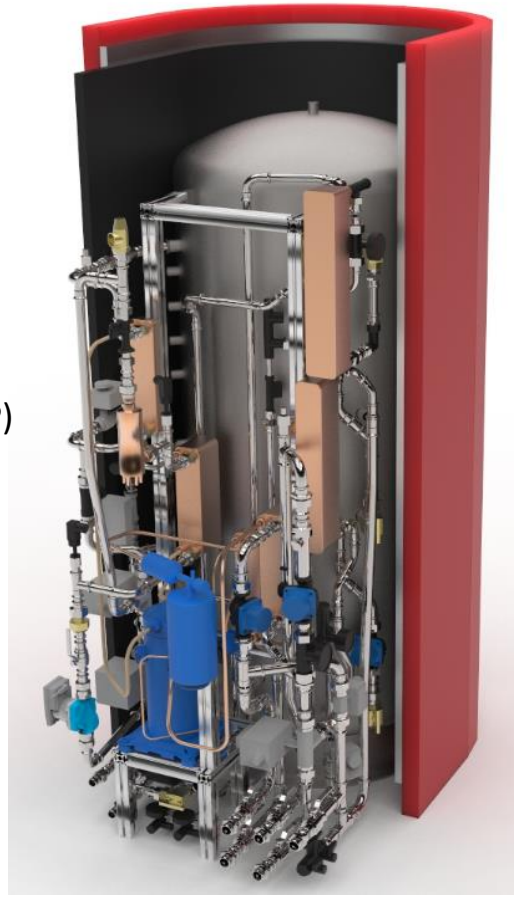
Energy-related components – Heat Pumps

Development and modelling of highly efficient heat pump circuits

- Construction and measurement of heat pump prototypes
- Hardware in the Loop - Operation
- Development of detailed heat pump models with experimental validation



Validation of the simulation model incl. economiser and desuperheater



CAD-illustration system
Source: HSR-SPF

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Project example – ABS-Network

Sandwich panels for forming the thermal building envelope – with solar thermal activation

- Developing a solar thermally activated facade panel in order to reduce the energy demand of a building.
- Solar absorber with roll-bonding technology
- Combined CFD and FEM are used together in one simulation environment.

Method: Conception, simulation, test setup, measurement, validation, revision of the concept

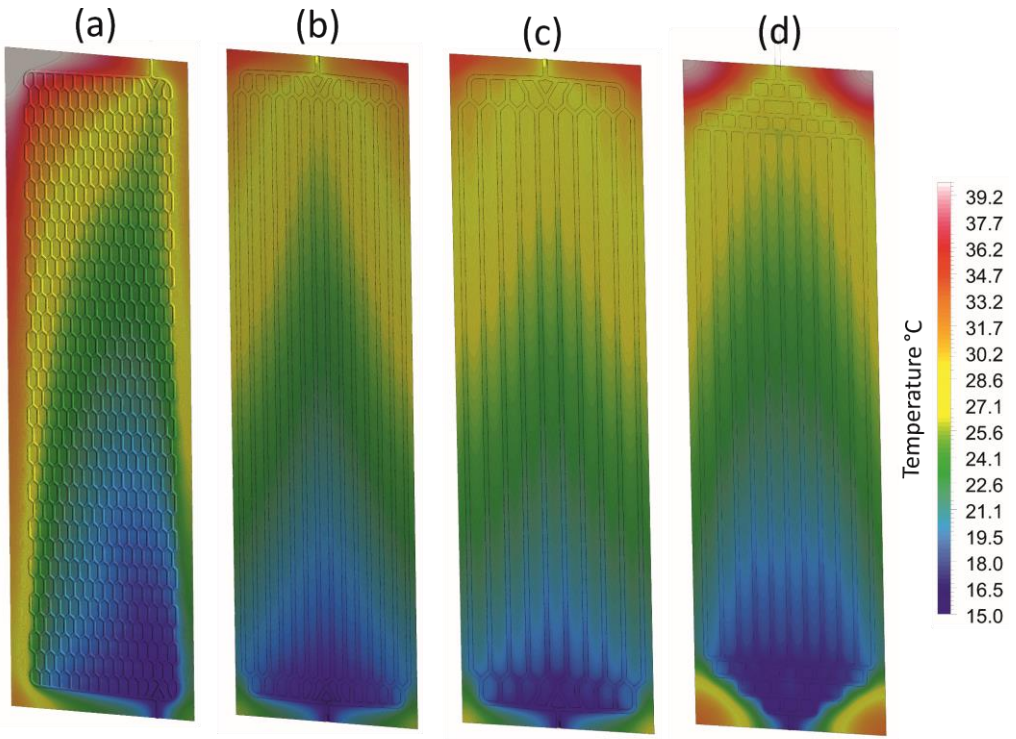

Illustration absorber temperature for four different absorbers

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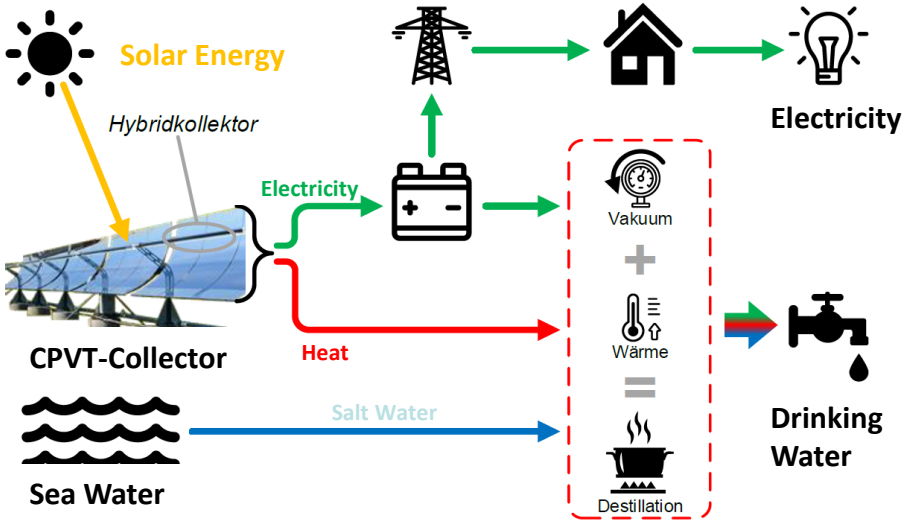
Project example – NEWSUN

A new CPVT Collector for Desalination

- Development of an energy autarkic system for desalination with a Multi-Effect Distillation (MED)
- Thermo-electrical simulation of the system for dimensioning the components (collector, storage, battery) and FEM/CFD analyses for optimal cooling of the CPV

parabolic trough concentrating collectors



energy autarkic system for desalination

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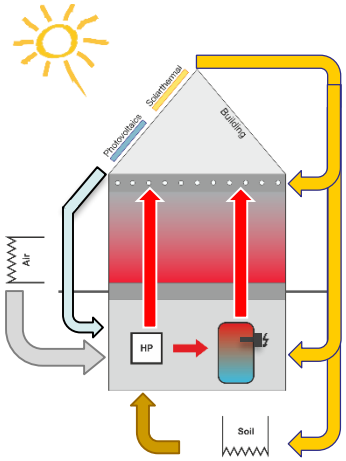
Project example – solSPONGEhigh

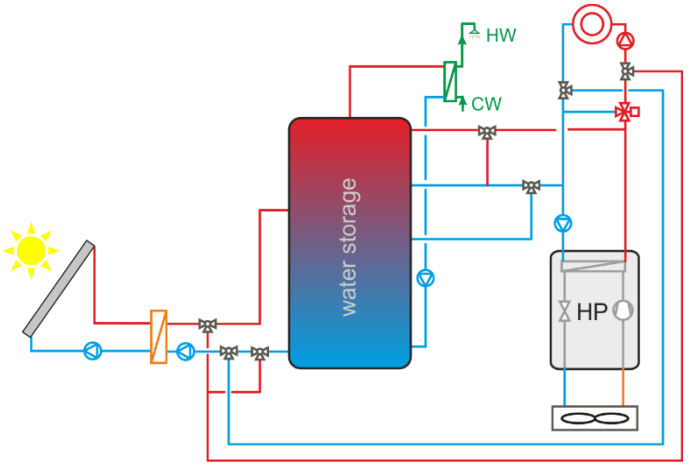
High solar fraction due to thermally activated concrete cores

- Detailed analysis of the behaviour of thermally activated construction elements
- Increasing the solar fraction by using the building's immanent storage mass
- Optimization of the control strategy for loading the concrete core
- Techno-economic analysis of system variants

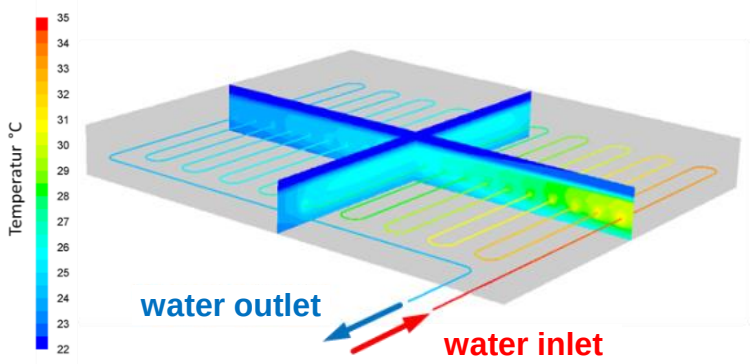
Method: measurement of realized concepts, programming (control), validation, thermal buildings and system simulation



System concept



Hydraulic system layout - solar thermal concept



Installation variant - TABS

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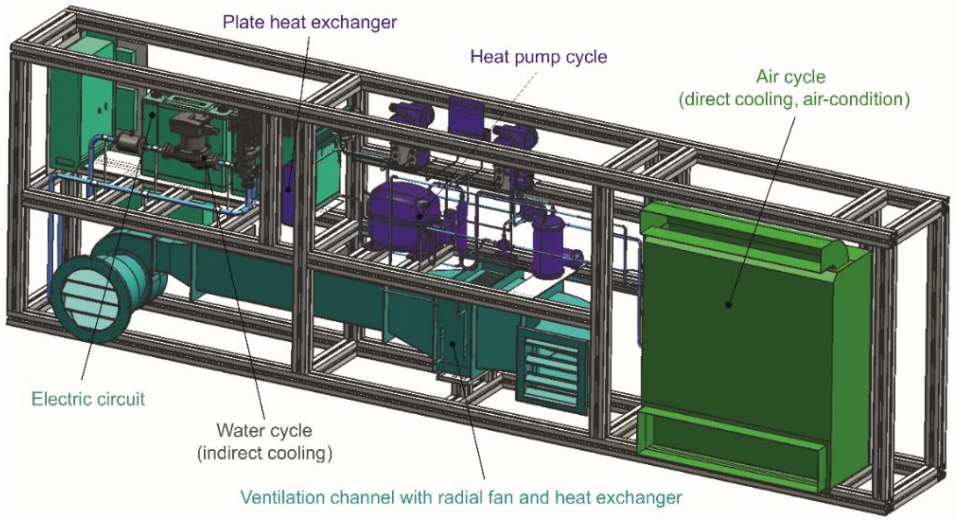
Project example – COOLSKIN

Autarkic Cooling via the Building Envelope

The solar irradiation onto the façade is converted to electrical energy, which is directly or time-delayed used to cool the adjacent room. Energy supply is energetically autonomous and is not dependent on energy from external sources.

Method: Development, Simulation, Realization, Measurement, Validation, further development of the concept

Test building with autonomous cooling PV system



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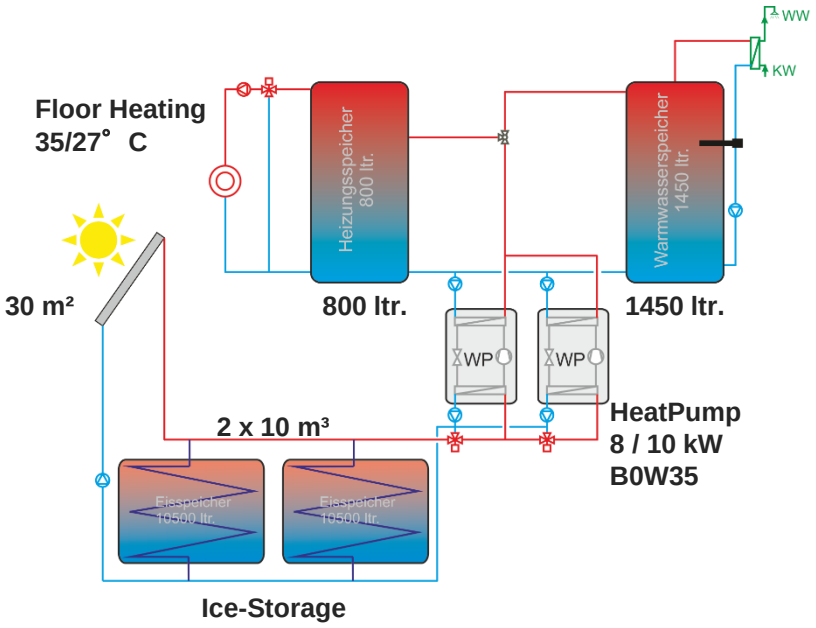
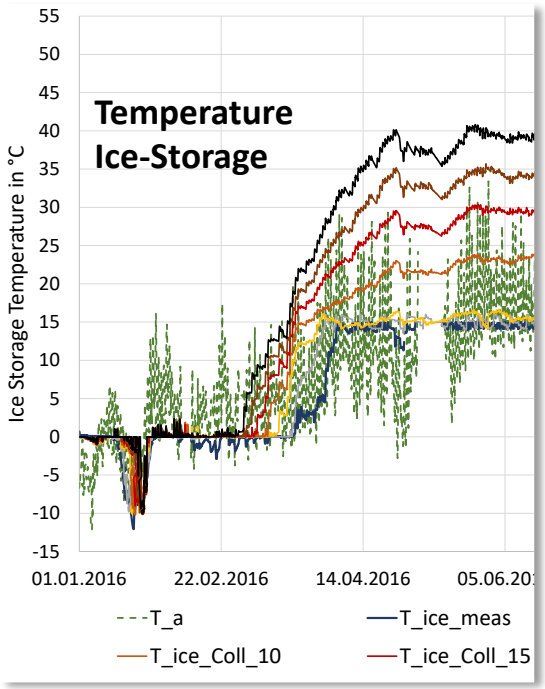
Project example – HotIceWeiz

Heating and cooling concept with Ice Storage

Latent heat utilization with ice storage, heat pump, solar thermal and PV system for heat, electricity and cooling supply to an apartment building

Method: system-evaluation, -measuring, -simulation, -validation and system-optimization





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Project example – EnergySimCity

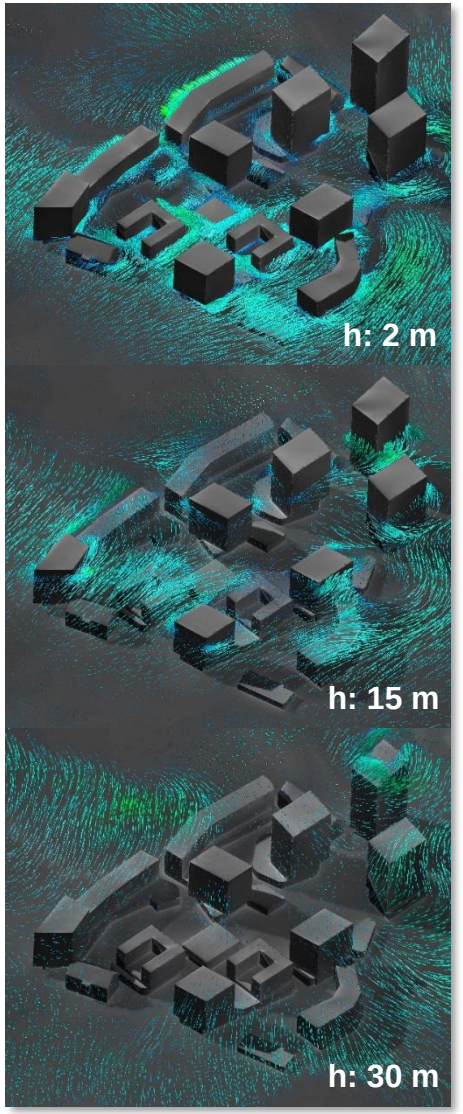
Research Studio Austria - EnergySimCity

For the development of a simulation platform for the modelling of complex urban energy systems with the features …

multisectoral (heat, electricity, gas)
interactiv (conversion, transport, storage, consumption)
universal (Macro-, Meso,- und Micro-level)
transient (high temporal resolution)

transient, multisectoral simulation - illustration spec. heat and cold load

air flow simulation quarter



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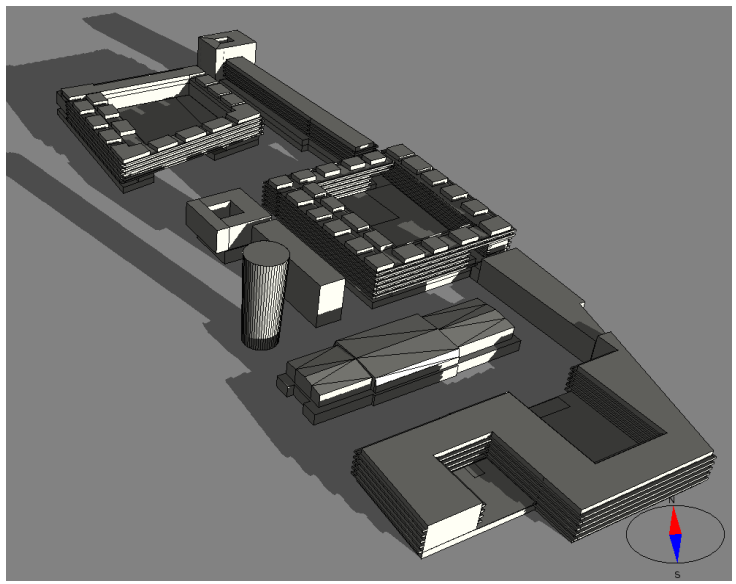
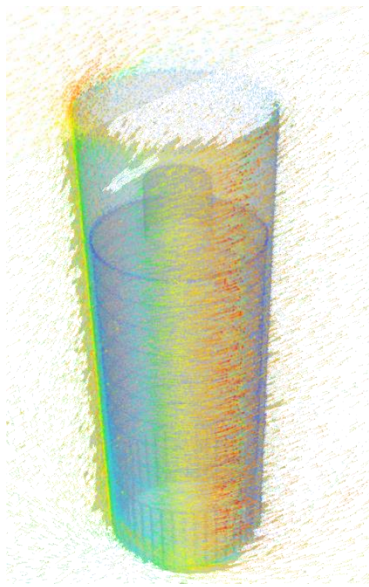
Project example – Smart City Project Graz Mitte

“Graz is developing into a smart city”

- Graz strives to increase the quality of life and reduce CO_2 emissions.
- By 2050, only one fifth of resource consumption is to be consumed.
- Energy- and resource-optimized urban development in the fields of energy, ecology, infrastructure, mobility, urban planning, society, buildings and business.
- First pilot projects are implemented in defined target areas (e.g. Waagner-Biro), from which an overall urban strategy is derived, taking into account the regional context.





Near the main railway station the urban district „Smart City Graz“ is being developed

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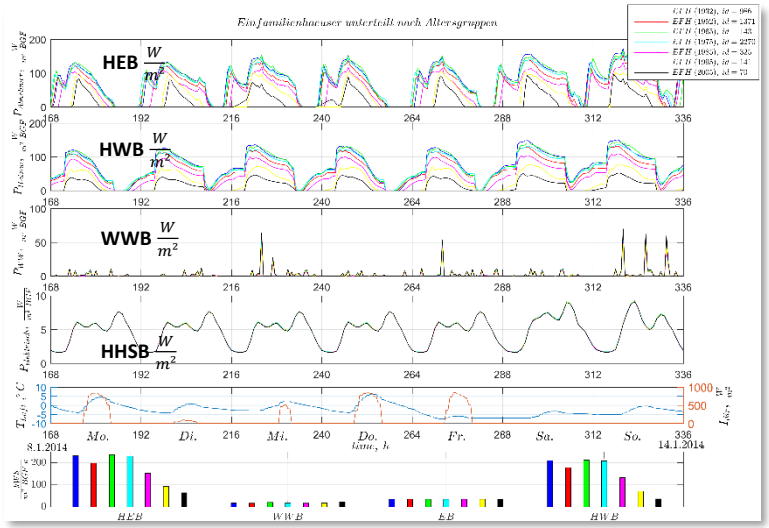
Project example – EnergyCityConcepts

Integrated analysis & simulation of energy systems in cities and urban districts

- The aim is to develop a **sustainable energy supply concept** for the Salzburg district of Schallmoos and to anchor concrete implementation strategies in the **urban development visions**.
- The energy supply and energy infrastructure for the Salzburg-Schallmoos district will be mapped in the designed toolbox, validated and future development scenarios simulated.



heating energy and electricity demand simulated in detailed temporal resolution

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