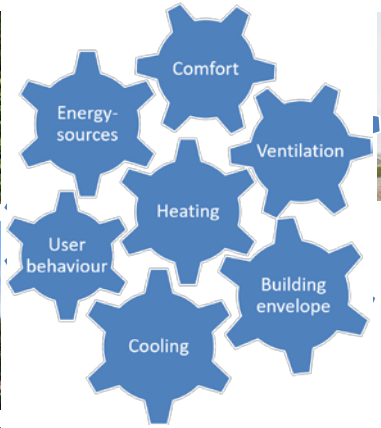
Monitoring results of innovative energy-efficient buildings in Austria









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SBE2019, Session „Processes 6“
13. Sept 2019

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Objective

- Project commissioned by the Austrian Federal Ministry of Transport, Innovation and Technology, financed within RTI-program „Stadt der Zukunft“, 11/2015 – 12/2017;

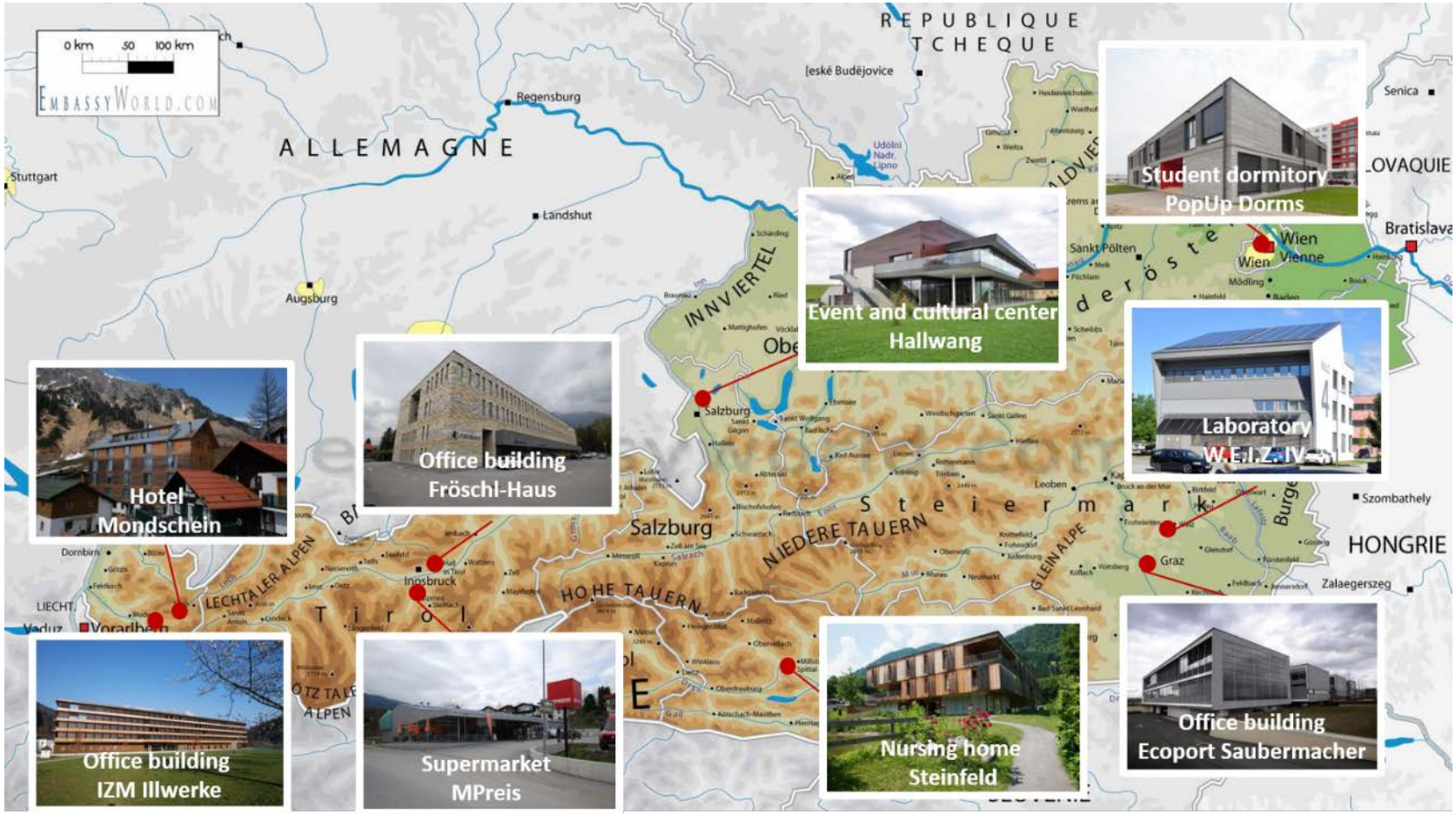
- **Objective**: present nine innovative energy-efficient service buildings in Austria and make the potential of innovative building concepts and technologies visible, but also point to possible areas of improvements

Use category	PV	Solar-thermal	Heat pump	Free Cooling	Active cooling	District heating	Steam humidifier	Component activation
Office building 1			✓	✓	✓		✓	
Office building 2	✓	✓	✓	✓		✓		✓
Office building 3			✓	✓				✓
Laboratory building	✓			✓	✓	✓	✓	✓
Nursing home						✓		
Market	✓							
Hotel			✓					
Event center	✓	✓		✓				✓
Student dormitory			✓					

Innovative energy-efficient buildings

- minimize energy-losses of the building envelope
- use renewable, freely available environmental or waste energy sources
- have an intelligent control of mostly complex technical HVAC systems
- provide a satisfying user comfort

Monitored buildings



Methods applied

- **Monitoring of energy performance**:
  - Heating + cooling energy, hot water, electricity demand of the HVAC components, lighting, other building equipment, using **heat flow and electricity meters** (15 min-mean,12 months)
  - Calculation of **energy indicators** per gross floor area [kWh/m²a]: heating energy (temperature adjusted), cooling energy, warm water, final energy consumption (HVAC+lighting)
  - Analysis of operation and **parametrization** of mostly fully automated HVAC systems for optimization potentials
- **Monitoring of comfort parameters**:
  - temperature, humidity, partly CO2 sensors (installed in rooms with different uses and solar expositions during different seasons,15 min)
  - average room temperatures during the different seasons
  - overheating hours
  - relative humidity indoor in heating period and in summer

Methods applied

- **Evaluate buildings according to Austrian sustainability rating system TQB- Total Quality Building (V2010)**
  - **5 equally weighted criteria groups** (each max 200 pts, >50 indicators)
    A location+facilities,
    B economy+technical quality,
    C energy+supply,
    D health+comfort,
    E resource efficiency
  - Assessment based on information provided by building operators + monitoring data
    Buildings were **not TQB-certified** in this project, results are therefore estimated and presented in ranges (e.g. 800-900 points of 1.000 max)
  - **Ecological indicators** OI3 (embodied life-cycle based impact of building envelope, combining global warming potential, acidification potential, non-renewable primary energy demand) and disposal indicator EI (V1.0)
    (details www.oegnb.net/tqb, LCA-data from database www.baubook.at, building-products specific LCA-Tool eco2soft from IBO Austrian Institute for Healthy and Ecological Building)

Selected results – 3 office buildings

IZM - Illwerke (Vandans)

- 13.000m² GFA, 270 employees
  Electricity supply company
- Hybrid timber building system, with prefabricated components
- Heat pump with waste heat of power plant generators
- Free Cooling with storage basin, supported by AC
- Retrofitted steam humidifier

Ecoport Saubermacher (Graz)

- 5.500m² GFA, 230 employees
  Waste + recycling company
- Facade integrated PV
- Groundwater heat pumps
- Free Cooling groundwater
- Solar thermal for hot water
- District heating (backup)
- Concrete core activation

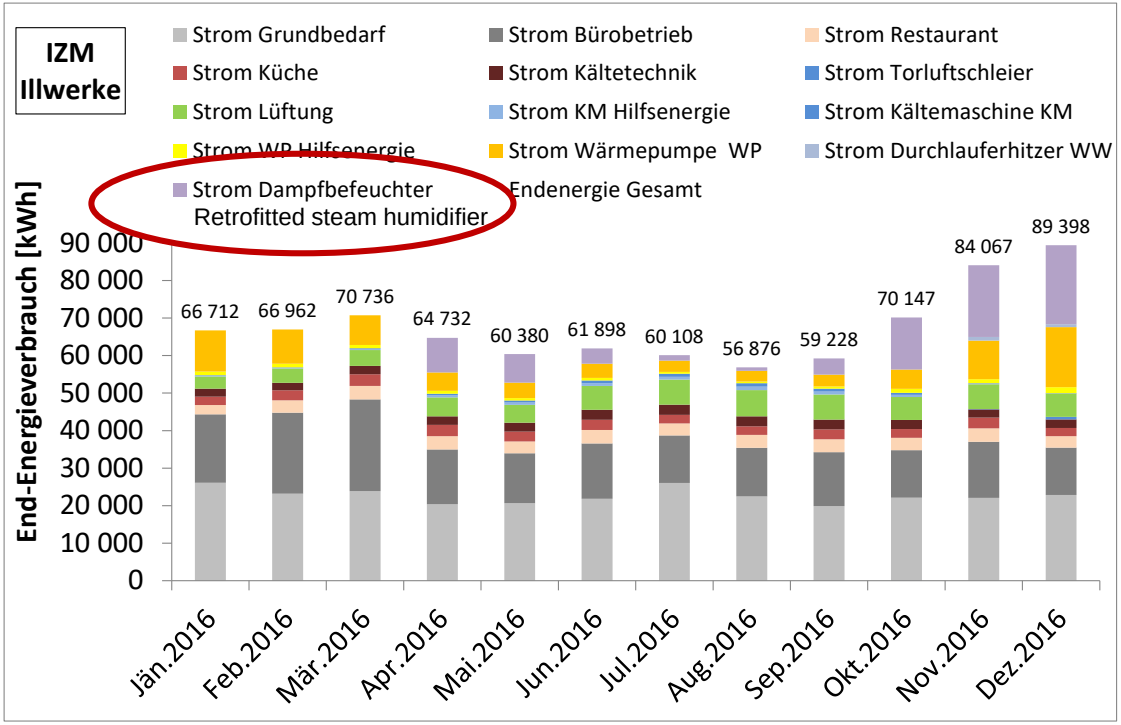
Fröschl Haus (Hall i. Tirol)

- 4.900m² GFA, 130 employees
  Construction company
- Stamped-concrete facade
- Groundwater heat pumps
- Free Cooling groundwater
- Concrete core activation

Selected results – 3 office buildings

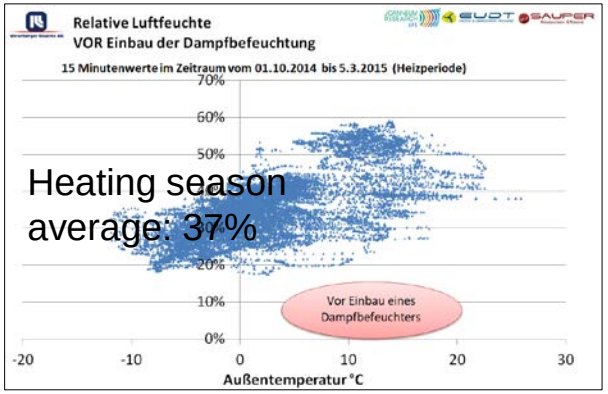
	IZM Office building 1	Ecoport Office building 2	Fröschlhaus Office building 3
Gross floor area [m²]	13.051	5.535	4.878
Surface volume ratio [1/m]	0.29	0.42	0.81
U-mean value [W/m²K]	0.33	0.38	0.24
Heating energy consumption [kWh/m²a]	17	44.2	25.2
Warm water consumption [kWh/m²a]	1.3	3.3	0
Cooling energy consumption [kWh/m²a]	12.9	20.1	9.2
Final energy consumption HVAC [kWh/m²a]	21.4	44.1	19.7
Mean room temperatur (ambient T<15°C / >15°C) [°C]	22.8/23.9	24.1 / 24.8	23.5 / 24
Overheating hours >26°C (ambient T<15°C / >15°C) [%]	0 / 0	0 / 3-11	0 / 0-8.6
Mean relative humidity (ambient T<15°C / >15°C) [%]	46.8 / 55.7	29.9 / 49.4	34.4 / 51.3
TQB score (range out of 1 000 points)	800-900	700-800	800-900
OI3-Indicator (BG1)	52	176	309
EI (V1, 2012)	2.6	2.3	2

Selected results – IZM office building

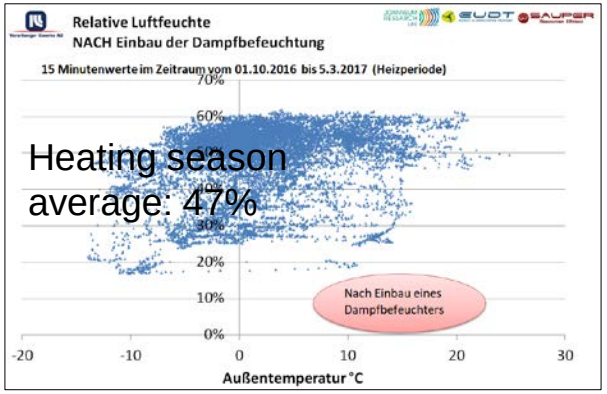


Steam humidifier increases annual electricity consumption
of HVAC-system by 64%,
of the entire building electricity consumption by 14%.

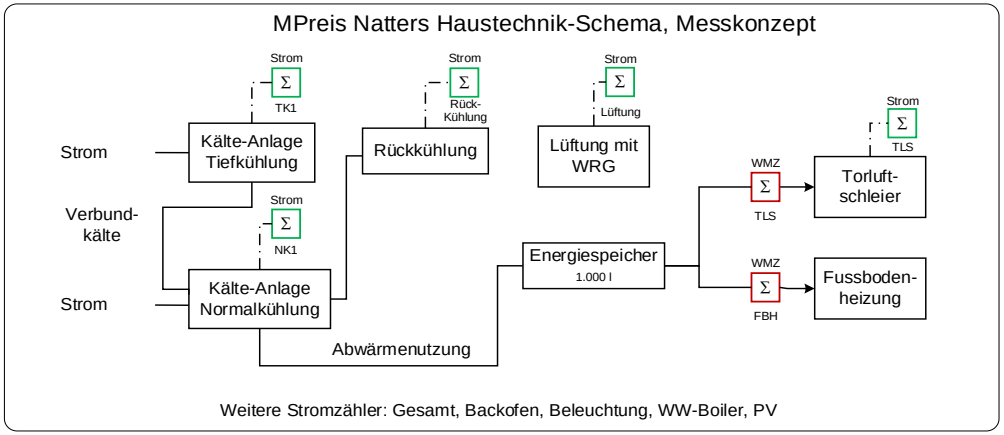
Relative humidity before installation of steam humidifier



Relative humidity after installation of steam humidifier



Selected results – MPreis Supermarket Natters (Tirol)

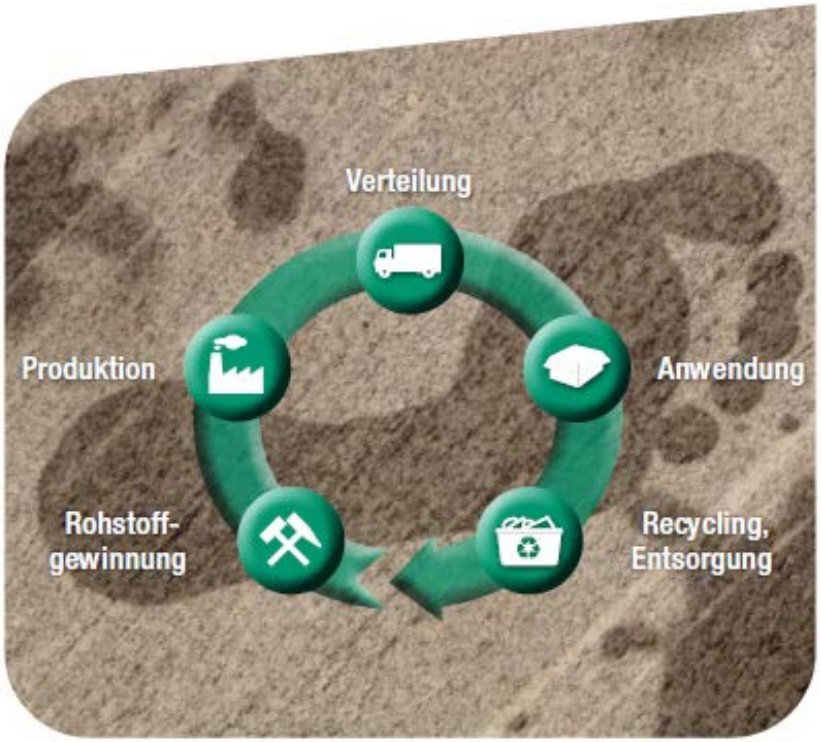


- Second passive house supermarket in Mid-Europe by MPreis
- **Heated only with the waste heat of the refrigeration system for the market products**
  This building does not need a separate technical heating system and therefore almost no final energy for heating!
- So-called “cold market” - internal heat sources are negative in this supermarket, which means that the heat extraction by the refrigeration units is higher than the internal heat sources - heat needs constantly to be supplied to the building, otherwise the market would cool down

Summary

- Final energy demand for HVAC systems in good accordance with planned values (energy certificates) of most monitored buildings
  - Use of freely available environmental and waste energy is the base for low final energy demand
- Use comfort is an issue concerning overheating in summer and relative humidity in winter
  - Overheating can be reduced/avoided by structural solutions (IZM, Fröschl)
  - (Steam) Humidifiers are very energy intensive
- TQB sustainability assessment shows high level of buildings
  - Health indicators often not measured (e.g. formaldehyde in indoor air)
  - Environmental indicators depend on materials used (OI3-indicator: hybrid timber vs concrete, EI disposal indicator: isolation material synthetic vs mineral materials)
- Monitoring report (only German) available for download
  https://nachhaltigwirtschaften.at/de/sdz/projekte/gema-messtechnische-untersuchung-von-energieeffizienten-demonstrationsgebaeuden.php

Your contact



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