

Concrete structures in a single-family-house used as micro-energy hub for surplus wind power

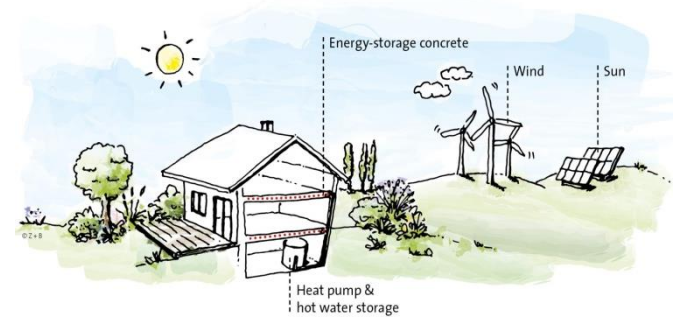
Sebastian Spaun, VÖZ

Roman Prager, WEB

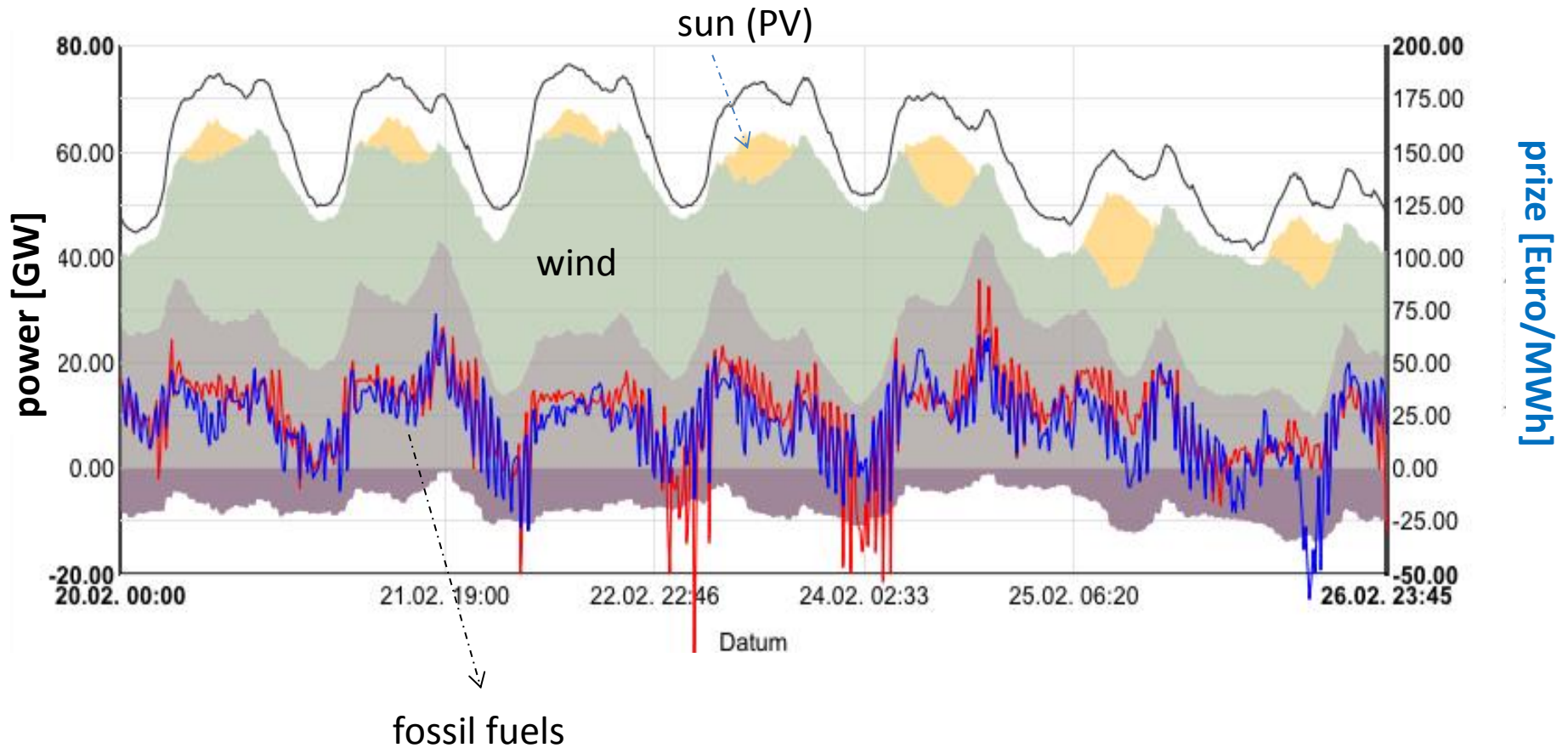
Vienna, 26 September 2017

Content

- Changes in the energy system
- Austrian demo project with wind surplus energy
 - Building physics
- Monitoring results
- Outlook

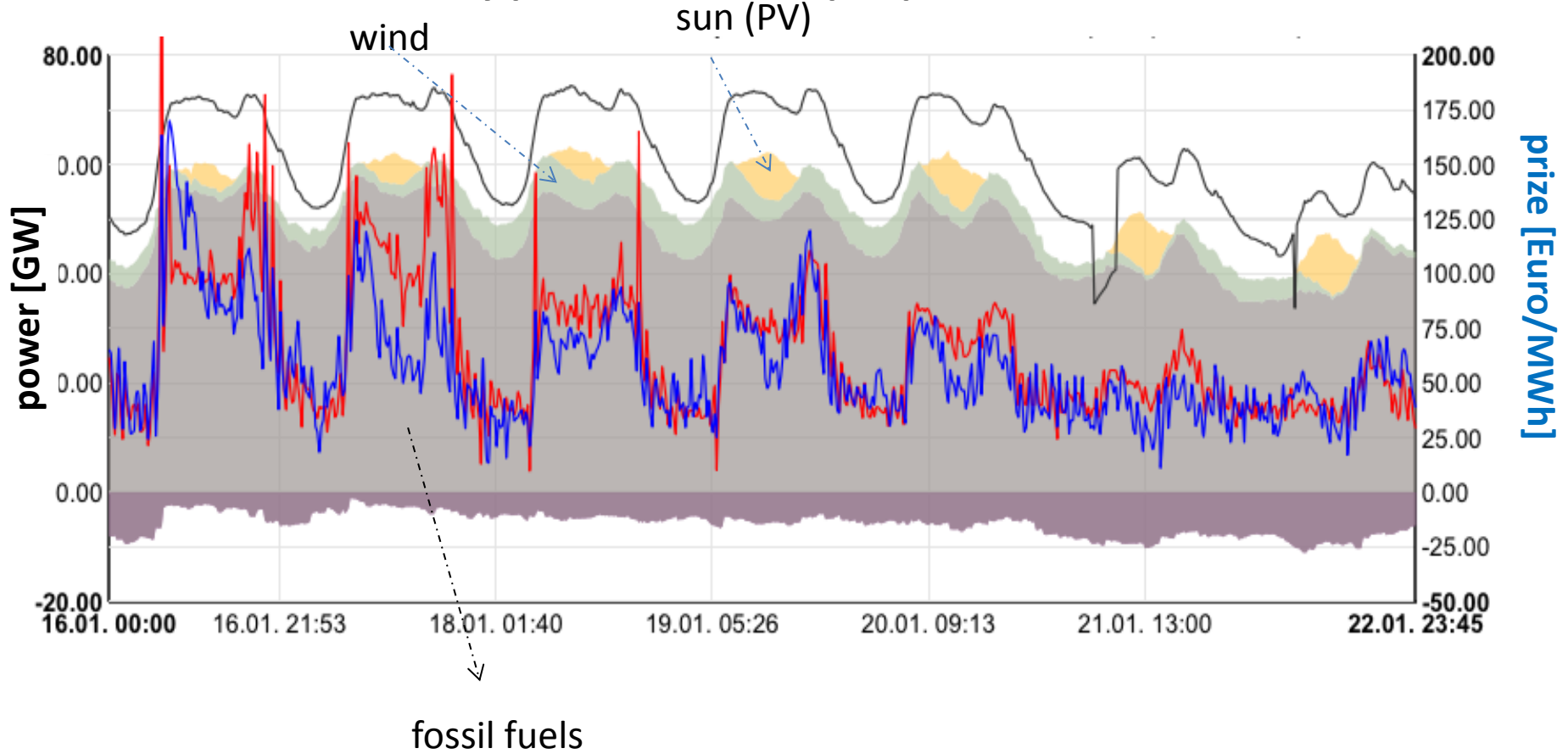


German electricity production and spot prices in week 8/2017



Source: Energy Charts, Fraunhofer ISE, 2017

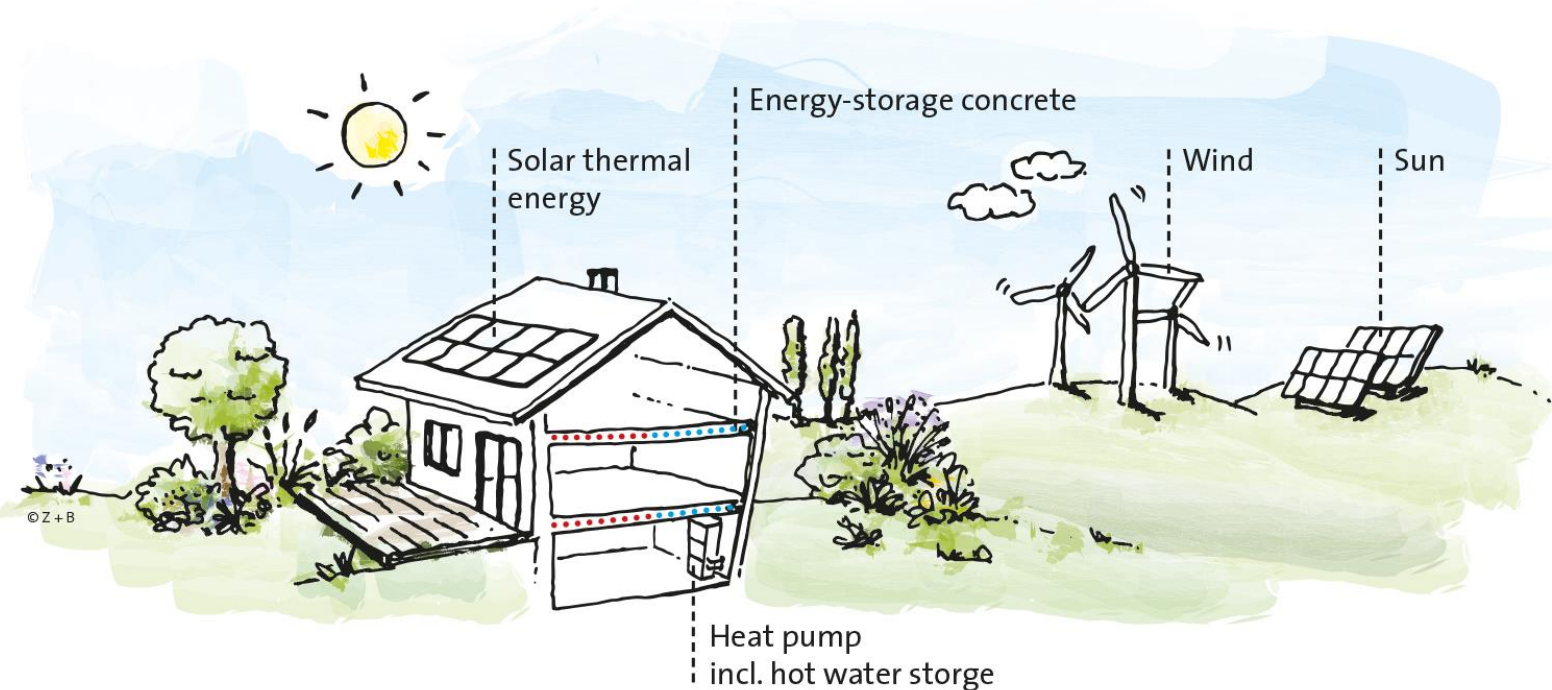
German electricity production and spot prices in week 4/2017



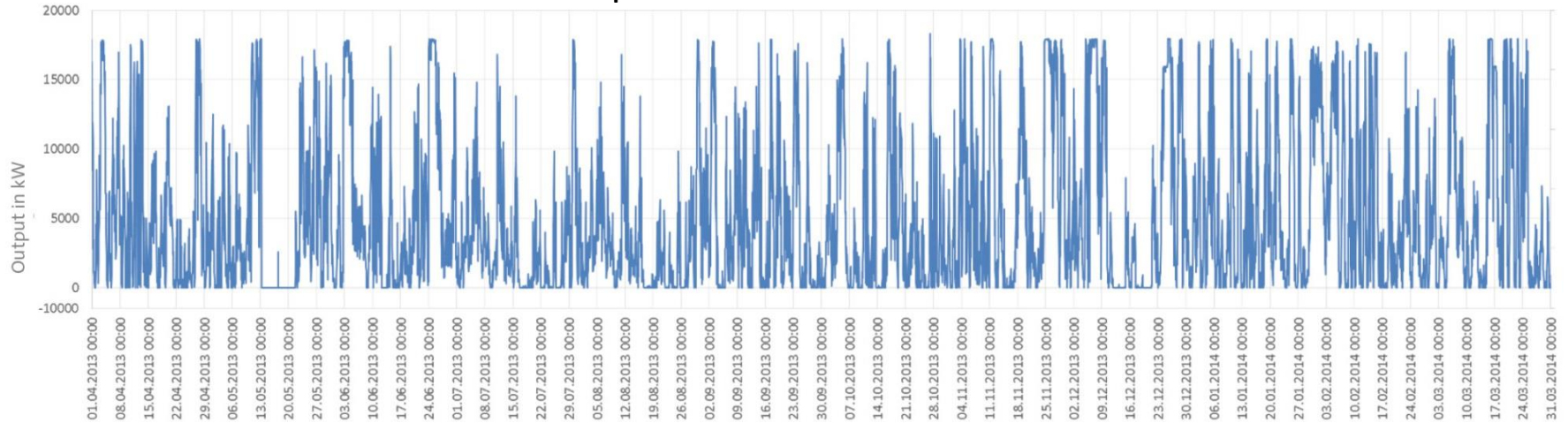
Source: Energy Charts, Fraunhofer ISE, 2017

Thermal storage of peak loads within the building structure by

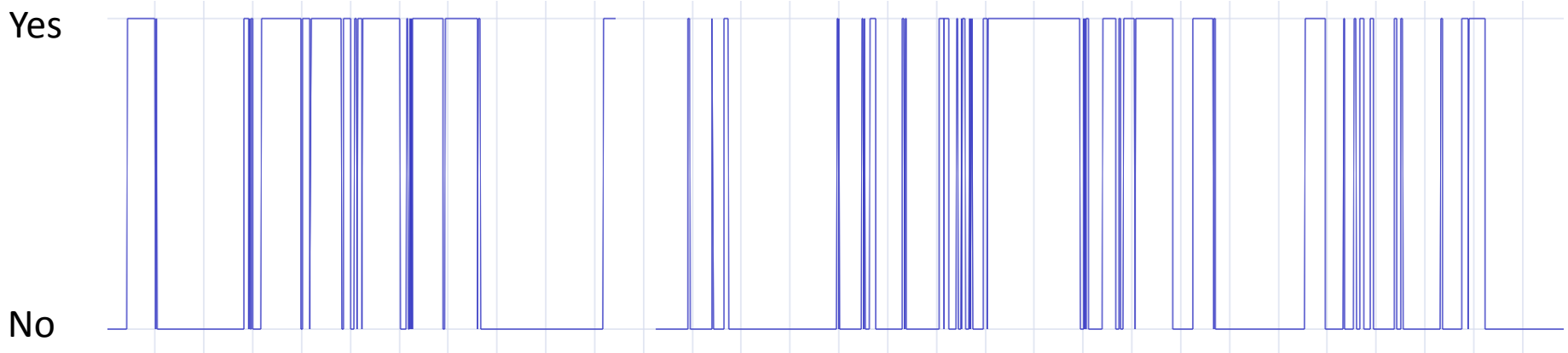
- activation of massive building parts in
- nearly zero energy buildings with energy supply
- via heat pump linked to the grid



April 2013 - March 2014



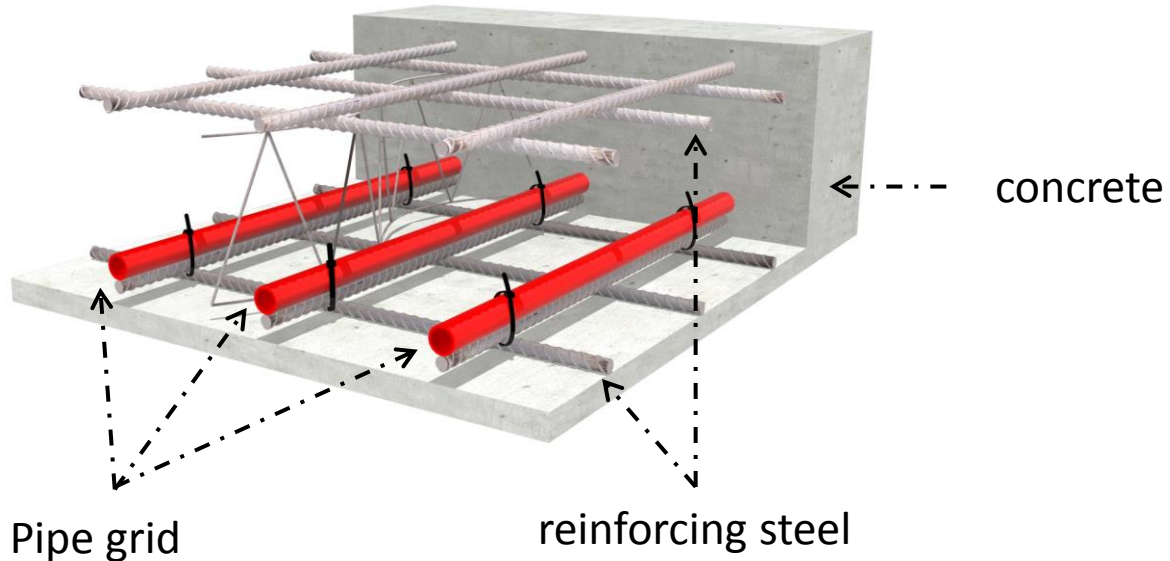
Available excess wind energy March 2017



(Source of data: [WEB15])

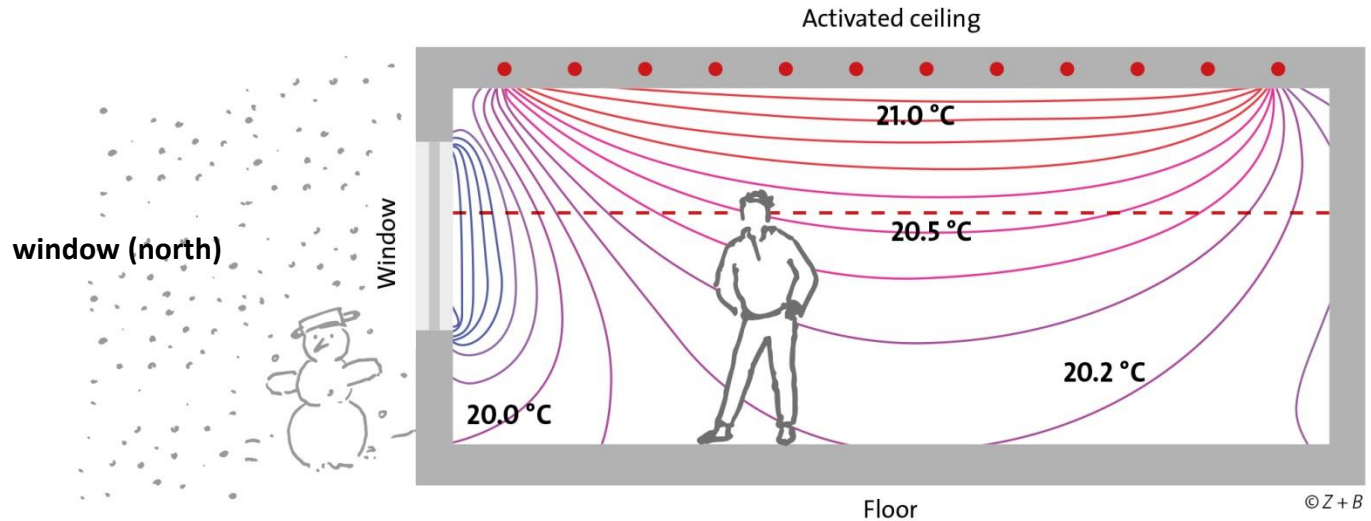
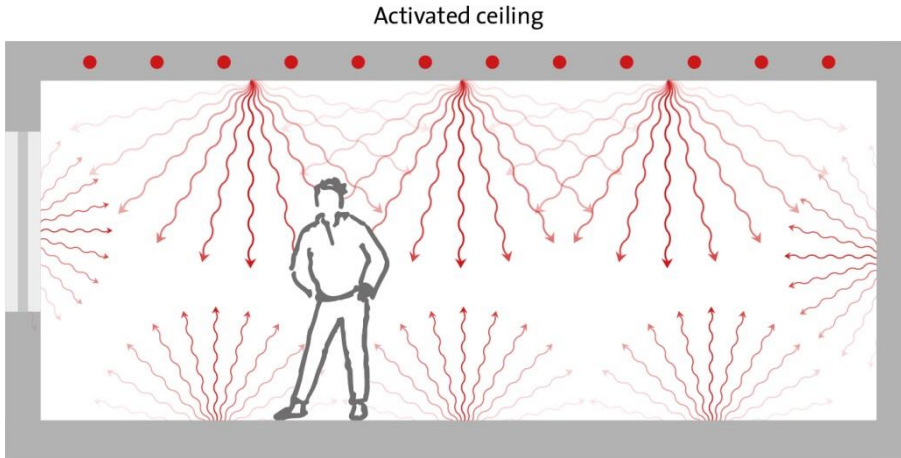


photo credits: Aichinger
Hoch- und Tiefbau



High living comfort in the room

- Heating load $\leq 25 \text{ W/ m}^2$
- Cooling load $\leq 40 \text{ W/ m}^2$
- low surface temperatures
- heating medium 25 - 30 °C



Why is concrete the material of choice? “Concrete feels cold - thank God!”

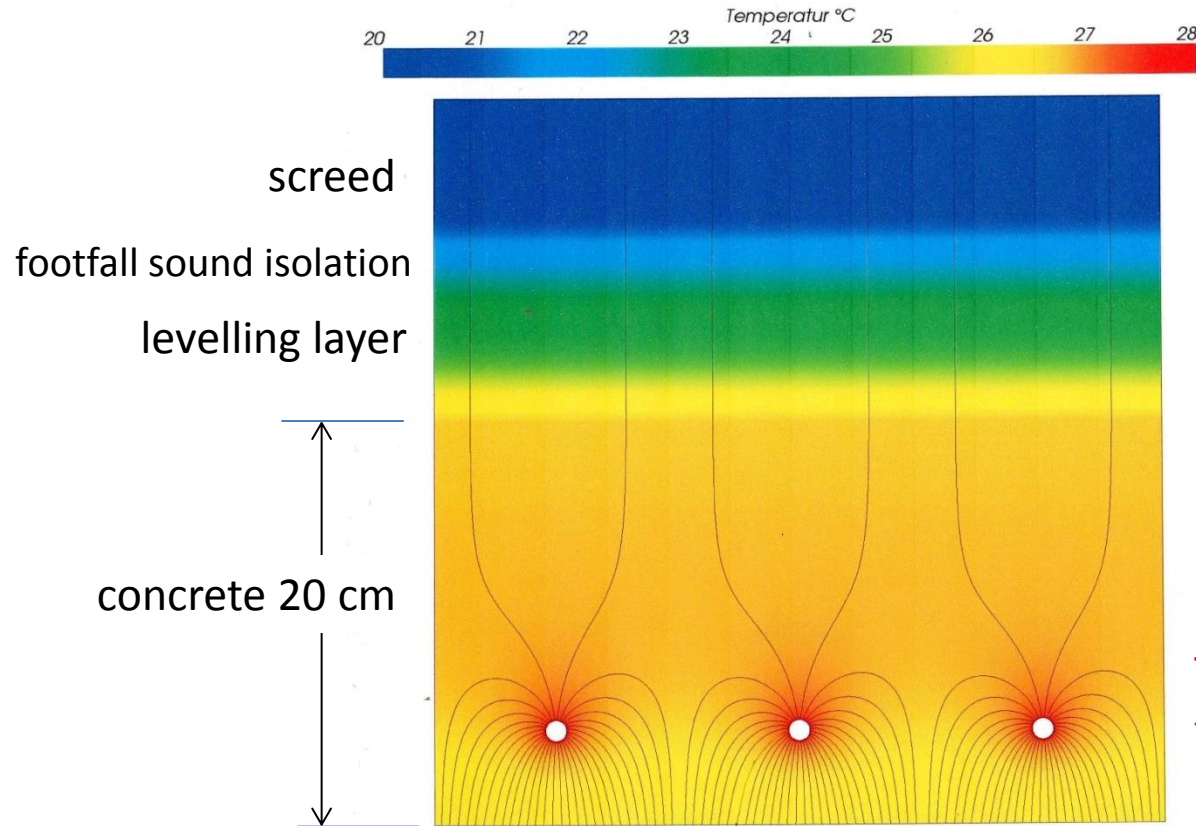
It is the combination of:

- high heat conductivity [2,5 W/mK]
- high specific gravity [2.400 kg/m³]
- high heat storage capacity [1 kJ/kgK]



➔ **the effective areal storage capacity [KJ/m²K] is the decisive property!**

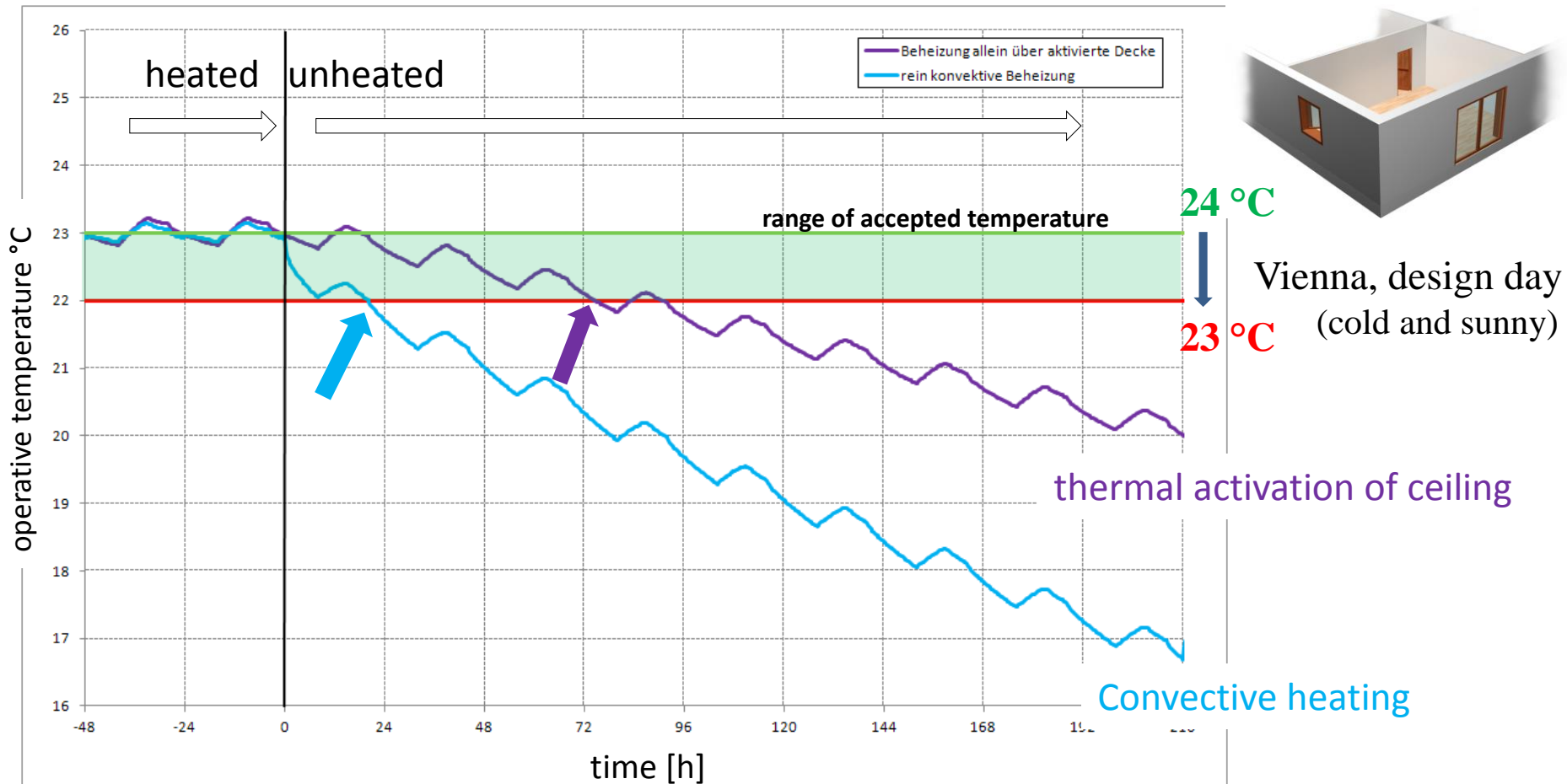
Heat flow lines



No change of the standard ceiling structure!

The major part of heat released by the pipe register flows to the room below the ceiling

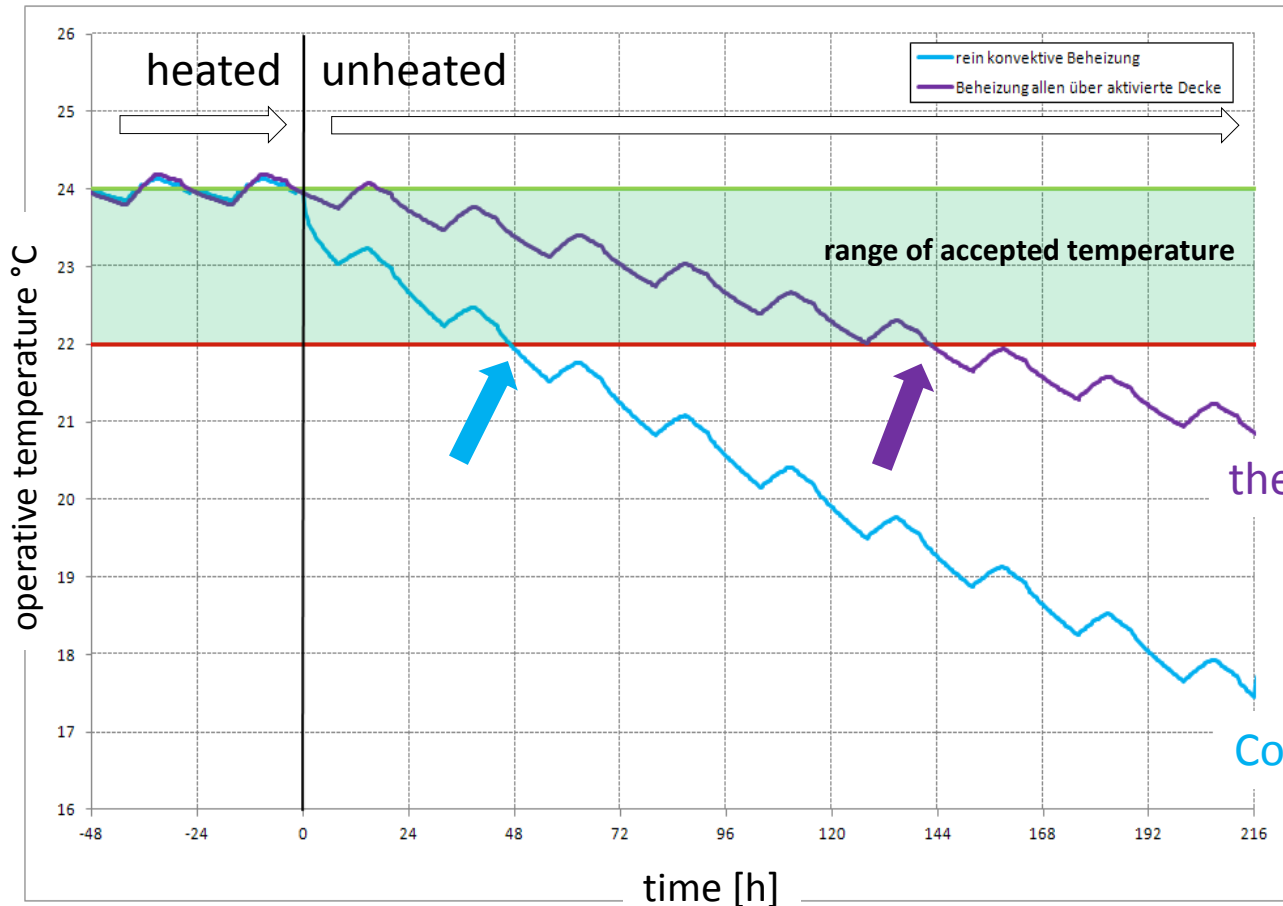
AnTherm V.7.125 2013.10.03 © T.Kornicki www.kornicki.com



Period without heating demand:

convective heating: **20 h**
thermal activation of ceiling: **75 h**

© Dr. Klaus Kreč



24 °C

22 °C

Vienna, design day
(cold and sunny)

thermal activation of ceiling

Convective heating

Period without heating demand: convective heating: **47 h**
thermal activation of ceiling: **142 h**

© Dr. Klaus Kreč

Utilisation of excess peak electricity via concrete structures

- One family house close to Vienna, ca. 120m² living aerea
- **Construction** | mid-July 2015 to mid- December 2015

Objectives

- Energy supply solely via heat pump:
- Excess peak electricity from wind power - Ground collector
- Simplest possible Heating/cooling System
- Simplest possible control
- Most economic solution

Partners

Planning of the building services | FIN – Future Is Now, Kuster Energielösungen GmbH
Supporting research | Univ.-Prof. Dr. Klaus Kreč , TU Wien| Dr. Simon Handler, Allplan
Partner wind energy: Roman Prager, W.E.B. wind energy company, Austria
Cement Industry: Dipl.-Ing. F. Friembichler, Dipl.-Ing. S. Spaun, VÖZ





**Demo
project:**

**Single-family
house in
Austria**



Sebastian Spaun , Roman Prager



photo credits: Aichinger
Hoch- und Tiefbau

„Renewable (surplus) energy for everyone“

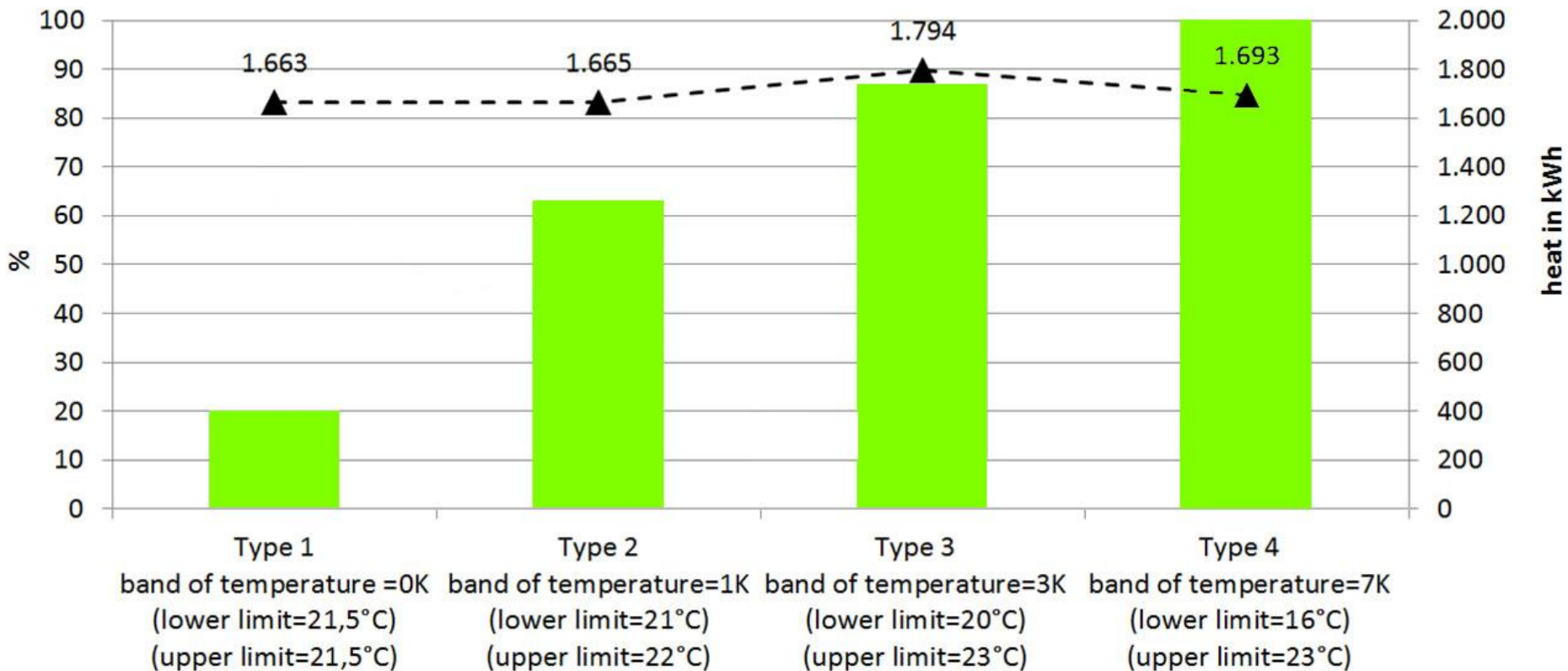
Official opening on 2 June 2016



(Fotos: © Z+B/Herfert)

■ heat loaded into the building structure during times of wind release in % of the overall heat delivery

-▲- overall heat delivered to the building in kWh



Source: S. Handler & K. Kreč, Int. Passive House conference, Vienna, 29.4.2017

Promising results for the first winter 2016/2017

„**70 %** of the heating demand from **renewable and surplus wind *) energy**“

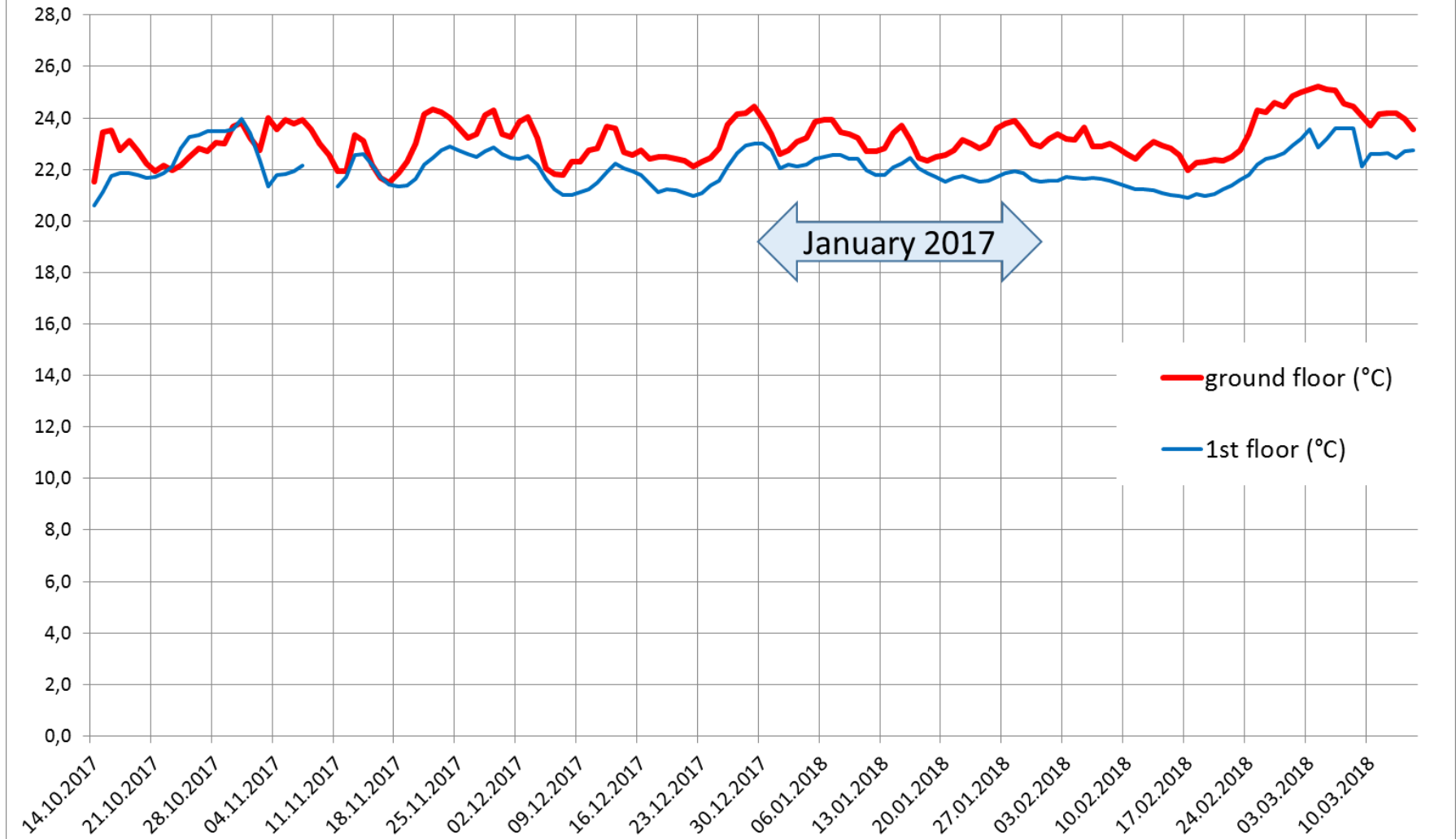
93% in November 2016 (steady winds)

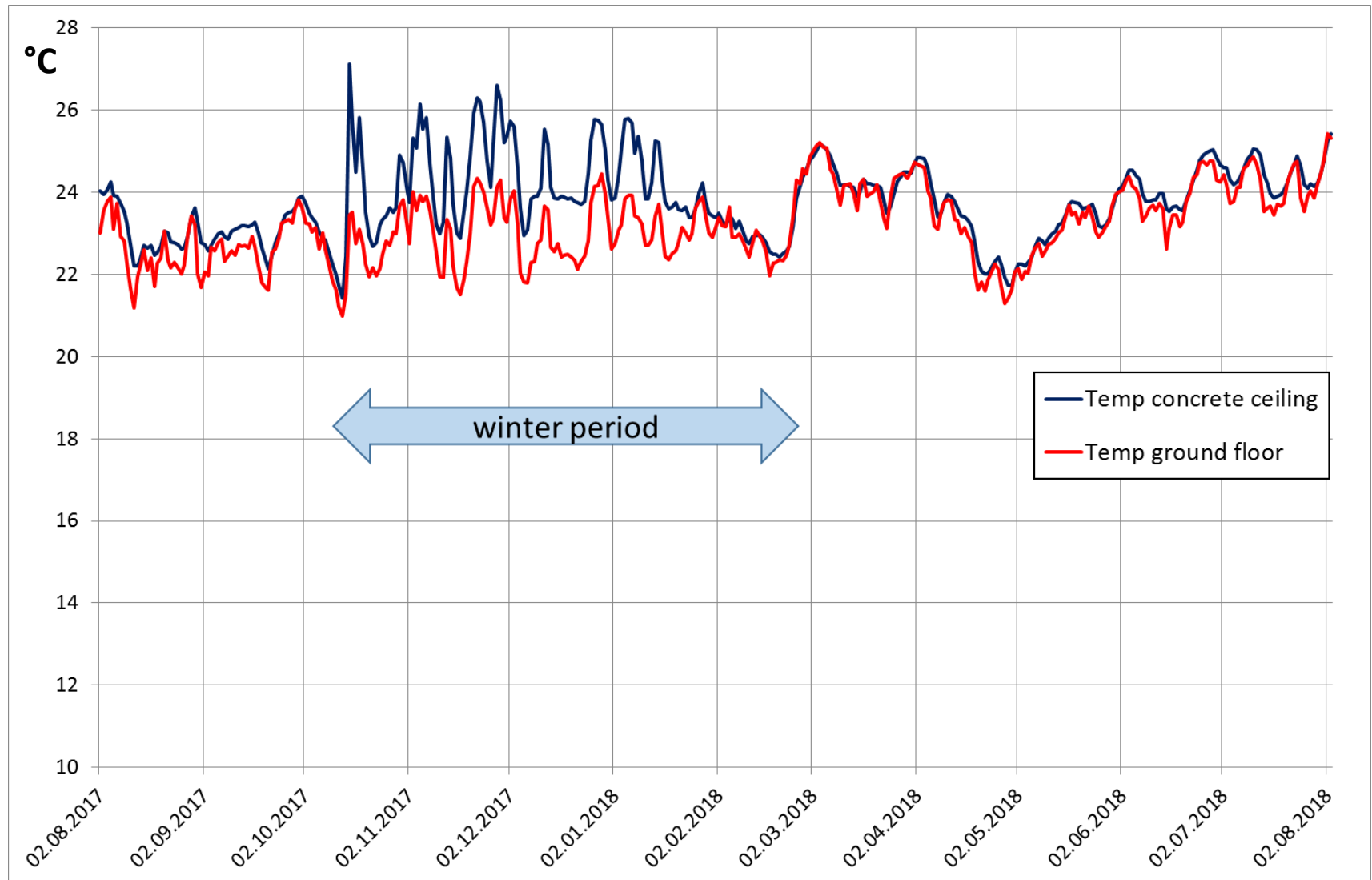
63% in January 2017 (coldest since 30 years!)

Expecting >> 80 % (mean) in the second monitoring year
(improving the air-tightness, dry building fabric)

*) one single wind park

winter 2016/2017





Vienna: Multi-family house (155apart.)



Source: www.wohnen.at/angebot/objekt-detail/?id=223

Construction starts end 2017

Vienna: Apartment house (14 apart.)



Construction starts 11/2017



windpark under construction



- **Wellbeing and thermal comfort through the use of efficient radiant heat**
 - **No (dust) turbulences**
 - **Uniform heat distribution**
 - **Ecologically cooling possibility**
- **Use of ambient heat and renewable energy sources**
- **Heating and cooling and buffering with a single system**
- **Independent of urban space conditions**
- **No additional construction measures**
- **Almost no additional costs for efficient buildings**



Thank you for the support!!

A project report
in the framework of the program



on behalf of the Federal Ministry
for Transport, Innovation and Technology



Research results and data bases:
<http://zement.at/services/publikationen/energiespeicher-beton>

Thank you for the attention!

Sebastian Spaun

ASSOCIATION OF THE AUSTRIAN CEMENT INDUSTRY

Franz-Grill-Straße 9, O 214

A-1030 Wien

Tel.: + 43 1 714 66 81 51

Mobil: + 43 (0) 664 415 33 50

E-Mail: spaun@zement.at

www.zement.at

