Thermal activation of concrete-based components – The Importance in an integrated energy system

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Content

• Changes in the energy system
• Demo projects in Austria
  – Heating and cooling with wind, sun and concrete
• Monitoring results
• Outlook
Share of new installed capacity 2016: Total 24,484 MW

51% OF NEW POWER CAPACITY IN THE EU CAME FROM WIND

86% OF NEW POWER CAPACITY IN THE EU CAME FROM RENEWABLES in 2016

Source: WindEurope
Renewable electricity and consumption in Lower Austria

- Wind
- Sun
- Water
- Biomass
- Power consumption
One sustainable solution!

Thermal storage of peak loads within the building structure by

- activation of massive building parts in
- nearly zero energy buildings with energy supply
- via solar energy
- or heat pump linked to the grid with DSM
Thermal activation of building elements (TABs)

Pipe grid

reinforcing steel

concrete

photo credits: Aichinger Hoch- und Tiefbau
Thermal activation of ceilings - cost effectiveness

Heat flow lines

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

No change of the standard ceiling structure!

- screed
- footfall sound isolation
- levelling layer
- concrete 20 cm

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Utilisation of excess peak electricity via concrete structures

- One family house close to Vienna, ca. 120m² living area
- Construction finished end 2015

- 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

(Fotos: © Z+B/Herfert)
Energy harvest from wind energy

April 2013 - March 2014

Resulting in an analog enable signal (20% of the time)

(Source of data: [WEB15])
Demo project:

Single-family house in Austria

“An idea as simple as it is brilliant”
Demo house monitoring data

Winter 2016/2017

January 2017

ground floor (°C)

1st floor (°C)
Demo house monitoring data

One year 2016/2017

winter period

Temp concrete ceiling
Temp ground floor
## Preliminary Monitoring Results

### House H. Stockerau, NÖ

**Share of the heat pump power consumption for heating**

<table>
<thead>
<tr>
<th>Period</th>
<th>With wind release (grid-friendly)</th>
<th>Without wind release (standard electricity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter 2016/2017</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>Winter 2017/2018</td>
<td><strong>90 % !!!</strong></td>
<td>12%</td>
</tr>
<tr>
<td>November 2016</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>January 2017</td>
<td>63%</td>
<td>37%</td>
</tr>
<tr>
<td>January 2018</td>
<td>94%</td>
<td>6%</td>
</tr>
<tr>
<td>February 2018</td>
<td>71%</td>
<td>29%</td>
</tr>
</tbody>
</table>
155 Wohnungen in der Mühlgrundgasse, Wien 22

Source: www.wohnen.at/angebot/objekt-detail/?id=223
155 Wohnungen in der Mühlgrundgasse, Wien 22
Windpark in Bau

Construction starts in May 2018
Thermal Component Activation (TCA): **Comparison of costs**

- Pb battery: 100 - 250 €/kWh
- Li-ion (LIB) 4V (2Gen):
  - Elon Musk (goal Giga factory): <300 - 700 €/kWh
  - Power to heat (district heating): 150 $/kWh
  - Power to heat (district heating): 80 - 180 €/kWh
- Water storage (solar puffer): 25 €/kWh
- Thermal Component Activation (TCA): few €/kWh

- Long service life
- Limitless cyclic stability
- No self unloading
- 100% recyclable

Source: www.speicherinitiative.at
• Wellbeing and thermal comfort (radiant heat)
• Heating and cooling with a single system
• Concrete’s thermal mass provides the flexibility/storage for demand response
• Low system temperatures predestine renewable energy sources
• Independent of urban space conditions
• No additional construction measures
• No extra cost! (compared to batteries or other devices)
Opportunities

• Demand response with **concrete thermal storage** - huge potential role in future energy markets!

• **Aggregation** of shiftable loads from thousands of buildings provide flexibility needed at grid level (Win – Win situation)
Thank you for the attention!

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