buildings as energy storage for the grid
-
example of a multifamily home in Vienna
the architectural design

building data:

- 1400 m²
- 11 flats (for rent - not sale)
the location of building site
1130 Wien, Granichstättengasse 73
the location of building site
1130 Wien, Granichstättengasse 73
the developer’s interests

- exterior design
- costs
- ...

- sustainability
- cooling wanted
- ventilation system not necessary
- floor heating not necessary
- focus on long term cost efficiency
the building envelope

- U-value exterior wall = 0.13-0.15 W/m²K
- U-value roof = 0.11-0.14 W/m²K
- U-value cellar ceiling = 0.17 W/m²K
- U_{w}\text{-value windows} = 0.9 W/m²K

- heating demand OIB RL 6 = 24.5 kWh/m²a
- heating demand simulation = 20.0 kWh/m²a

- heat load ÖNORM H7500 = 27 kW
- heat load simulation (peak) = 22 kW
- heat load simulation (24h average) = 18 kW
the building envelope

- U-value exterior wall = 0,13-0,15 W/m²K
- U-value roof = 0,11-0,14 W/m²K
- U-value cellar ceiling = 0,17 W/m²K
- Uw-value windows = 0,9 W/m²K
- heating demand OIB RL 6 = 24,5 kWh/m²a
- heating demand simulation = 19,5 kWh/m²a
- heat load ÖNORM H7500 = 27 kW
- heat load simulation (peak) = 22 kW
- heat load simulation (24h average) = 18 kW
the accessible energy sources

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Description</th>
<th>Availability</th>
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<tbody>
<tr>
<td>district heating</td>
<td>Wiener Netze</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td>others</td>
<td>not available</td>
</tr>
<tr>
<td>heat pump</td>
<td>groundwater</td>
<td>not available</td>
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<tr>
<td></td>
<td>geo thermal</td>
<td>possible</td>
</tr>
<tr>
<td></td>
<td>air</td>
<td>possible</td>
</tr>
<tr>
<td>fossil</td>
<td>gas</td>
<td>possible</td>
</tr>
<tr>
<td></td>
<td>oil</td>
<td>not wanted</td>
</tr>
<tr>
<td>biomass</td>
<td>pellets</td>
<td>possible</td>
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<tr>
<td></td>
<td>wood chips</td>
<td>not wanted</td>
</tr>
<tr>
<td>production at site</td>
<td>solar thermal</td>
<td>possible</td>
</tr>
<tr>
<td></td>
<td>PV</td>
<td>possible</td>
</tr>
<tr>
<td></td>
<td>wind</td>
<td>not wanted</td>
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</tbody>
</table>

energy costs for heating & ww in Euro/a
the hydraulic system

- high temperature distribution for warmwater & bathroom radiators
- low temperature distribution heating and cooling
- free cooling
- apartment stations (4 pipe system)
the building mass &
it’s thermal storage capacity

<table>
<thead>
<tr>
<th></th>
<th>mass (t)</th>
<th>storage capacity (kJ/K)</th>
<th>dT = 2 K</th>
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<tr>
<td>ext. walls concrete</td>
<td>120</td>
<td>132000</td>
<td>70 kWh</td>
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<td>int. walls concrete</td>
<td>205</td>
<td>225500</td>
<td>130 kWh</td>
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<tr>
<td>slabs concrete</td>
<td>820</td>
<td>902000</td>
<td>500 kWh</td>
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<tr>
<td>sum</td>
<td>1145</td>
<td>1259500</td>
<td>700 kWh</td>
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<tr>
<td>ext. walls brick</td>
<td>104</td>
<td>228800</td>
<td>130 kWh</td>
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<tr>
<td>int. walls brick</td>
<td>25</td>
<td>55000</td>
<td>30 kWh</td>
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<tr>
<td>other int. Walls</td>
<td>25</td>
<td>55000</td>
<td>30 kWh</td>
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<tr>
<td>sum</td>
<td>154</td>
<td>338800</td>
<td>190 kWh</td>
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<tr>
<td>sum</td>
<td>1299</td>
<td>1598300</td>
<td>890 kWh</td>
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</table>
concrete slabs for thermal activation

- screed 5 cm
- insulation 3 cm
- EPS fill 5 cm
- concrete 20 cm

<15 %

>85 %
the concept - roundup

- high quality envelope
- geothermal heatpump system
- 2 temperature distribution levels
- apartment stations
- activation of concrete slabs
- smart grid connection to the grid operator needed to use storage capacity
the problem until now…

… the developer has difficulties getting the official permission according to architectural design
main goals:

- thermal comfort inside
- overall energy efficiency
- detailed knowledge about the dynamic storage behavior
- experiences in operation of multi-family houses as thermal storage for the grid

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

a 2 years program enabled by BMVIT
any questions?