PAVLA HOROVA 17, 19

PILOT PROJECT OF DEEP RENOVATION OF RESIDENTIAL BUILDING IN BRATISLAVA

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The EU-GUGLE project

European cities serving as Green Urban Gate towards Leadership in sustainable Energy

- 6 Pilot cities: AACHEN, BRATISLAVA, MILAN, SESTAO, TAMPERE, VIENNA
- 3 associated cities: GOTHENBURG, GAZIANTEP, PLOVDIV
- 21 partners (9 different countries)
- 186,000 m² of living space renovated
- Target: up to 82% primary energy savings
- 5 + 1 years (2013 – 2019)
EU-GUGLE project: OBJECTIVE

- Achieve better energy performance than defined by national regulation
- Reach parameters in BEST Sheets (Building Energy Specification Table)
- Subsidy 50% of additional costs, maximum 50€/m²
- Costs at least or higher than 100€/m²
- Demonstration (refurbishment), research and replication
SITUATION IN SLOVAKIA, APARTMENT HOUSES

146 682 flats (in Slovakia 890.000 build until 1992)
2 987 (in Slovakia 21 000) houses various construction type
Private property of apartment owners
Renovated buildings: approximately 55%
Individual renovation solutions
TIGHTEN OF REQUIREMENTS ON THERMAL PROTECTION

require higher thickness of the thermal insulation layer (ETICS)
PROJECT DEVELOPMENT
BUILT-UP AREA TYPICAL FLOOR:
540,9 m²

TOTAL FLOOR AREA OF THE RESIDENTIAL AREA:
3 786,3 m²

ENCLOSED VOLUME:
10 774,7 m³

NUMBER OF FLOORS:
7

NUMBER OF HOUSING UNITS:
42
GOALS AND CHALLENGES OF THE PROJECT
BUILDING STRUCTURES AND BUILDING PARTS

» replacement of opening structures (replacement of all opening constructions in the house even those in replaced in the recent years)

» installation of a central system of controlled ventilation with heat recovery in each apartment.

» thermal insulation of external walls
BUILDING STRUCTURES AND BUILDING PARTS
» renovation and insulation of roof with an increase of the attic and modification of the installation shafts with new ventilation

» replacement of exterior doors, at the doorway and glass walls

» renovation of balconies and their glazing
TECHNICAL BUILDING SYSTEMS

» modernization of vertical distribution systems, cold and hot water and circulation including their thermal protection

» modernization of sewerage, horizontal and vertical gas installations and exhaust air ducts replacement of exhaust fans in toilets and bathrooms

» removal of the original piping required special measures to be taken to dispose of harmful asbestos-based waste - the ventilation system piping in the installation core
RENEWABLE RESOURCES

- 10 kWp photovoltaic on roof
- Cascade of 4 electric heat pumps air / water with additional electric heating pads
- The total installed thermal power for heating and hot water: 98,92 kW
REDUCTION OF ENERGY CONSUMPTION FOR HEATING

Energy for heating 98.692 kWh (Heating and DHW 193.408 kWh)
Electricity for Heating 28.573 kWh (Heating and DHW 72.332 kWh from grid and PV)

In 2018
94.003 kWh
31.82 kWh / m²

Share of PV electricity is 9.47%
As a result of storage in water, 77.28% of the electricity produced was used
INVESTMENT COSTS OF THE PROJECT

<table>
<thead>
<tr>
<th>Energy efficiency in the building</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrofitted area</td>
<td>3.786,30 m²</td>
</tr>
<tr>
<td>Total costs</td>
<td>920.520 €</td>
</tr>
<tr>
<td>Costs per m²</td>
<td>243,12 €</td>
</tr>
<tr>
<td>Payback period</td>
<td>7,8 years</td>
</tr>
<tr>
<td>Energy demand (baseline)</td>
<td>93,32 kWh/(m².yr)</td>
</tr>
<tr>
<td>Energy demand (after)</td>
<td>8,91 kWh/(m².yr)</td>
</tr>
<tr>
<td>CO₂ reduction</td>
<td>117 tCO₂/yr</td>
</tr>
<tr>
<td>Energy supply</td>
<td>Solar PV, heat pumps</td>
</tr>
</tbody>
</table>


## RETURN ON INVESTMENT

<table>
<thead>
<tr>
<th></th>
<th>2016 Costs after 1 y</th>
<th>2017 Costs after 2 y</th>
<th>2018 Costs after 3 y</th>
<th>2019 Costs after 4 y</th>
<th>2020 Costs after 5 y</th>
<th>2021 Costs after 6 y</th>
<th>2022 Costs after 7 y</th>
<th>2023 Costs after 9 y</th>
<th>2030 Costs after 15 y</th>
</tr>
</thead>
<tbody>
<tr>
<td>DH</td>
<td>€93,821</td>
<td>€119,289</td>
<td>€145,209</td>
<td>€172,117</td>
<td>€200,052</td>
<td>€229,056</td>
<td>€259,172</td>
<td>€290,446</td>
<td>€322,925</td>
</tr>
<tr>
<td>REN</td>
<td>€161,537</td>
<td>€177,460</td>
<td>€193,193</td>
<td>€209,522</td>
<td>€226,469</td>
<td>€244,060</td>
<td>€262,321</td>
<td>€281,280</td>
<td>€300,965</td>
</tr>
<tr>
<td>Savings</td>
<td>€126,727</td>
<td>€60,000</td>
<td>€120,000</td>
<td>€180,000</td>
<td>€240,000</td>
<td>€300,000</td>
<td>€360,000</td>
<td>€420,000</td>
<td>€480,000</td>
</tr>
</tbody>
</table>
ENERGY AND ECONOMIC EFFICIENCY

Comparison of selected monthly prepayment for using a 70.16 m² flat with actual monthly costs in 2016

<table>
<thead>
<tr>
<th></th>
<th>till 29.02. 2016</th>
<th>from 01.03.2016</th>
<th>costs 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupancy of 4 people</td>
<td>1,00 EUR / m²</td>
<td>1,75 EUR m²</td>
<td></td>
</tr>
<tr>
<td>Fund for operations,</td>
<td>70,16 €</td>
<td>122,78 €</td>
<td>114,67 €</td>
</tr>
<tr>
<td>maintenance and repair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat - Costs for CH</td>
<td>58,26 €</td>
<td>10,11 €</td>
<td>6,00 €</td>
</tr>
<tr>
<td>Heat – HW heating</td>
<td>22,22 €</td>
<td>6,56 €</td>
<td>7,55 €</td>
</tr>
<tr>
<td>Heat - HW heating basic</td>
<td>3,27 €</td>
<td>0,73 €</td>
<td>1,64 €</td>
</tr>
<tr>
<td>constituent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW - water sewerage</td>
<td>9,10 €</td>
<td>9,10 €</td>
<td>8,71 €</td>
</tr>
<tr>
<td>CV - water sewerage</td>
<td>15,53 €</td>
<td>15,53 €</td>
<td>10,91 €</td>
</tr>
<tr>
<td>Electricity – common rooms</td>
<td>4,88 €</td>
<td>2,60 €</td>
<td>2,31 €</td>
</tr>
<tr>
<td>Monthly deposit total</td>
<td>223,53 €</td>
<td>210,05 €</td>
<td>189,71 €</td>
</tr>
</tbody>
</table>

The essence of energy efficiency projects based on future energy cost savings is the fact that less money is spent from wallets or domestic budgets. Thus, the ultimate effect is also an improved economic result.
ENVIRONMENTAL COMPARISON OF HEAT SOURCES

Calculation of ecological impact (equivalent CO\(_2\) leakage in kg) of compared heat sources for one year

<table>
<thead>
<tr>
<th></th>
<th>MJ</th>
<th>DH</th>
<th>REN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total heat consumption</td>
<td>kWh</td>
<td>201 752</td>
<td>201 752</td>
</tr>
<tr>
<td>COP</td>
<td></td>
<td>2,72</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>CO(_2) / kg</td>
<td>-</td>
<td>0,178</td>
</tr>
<tr>
<td>DH heating</td>
<td>CO(_2) / kg</td>
<td>0,2365</td>
<td>-</td>
</tr>
<tr>
<td><strong>Annual CO(_2) emissions</strong></td>
<td>kg</td>
<td>47 714</td>
<td>13 203</td>
</tr>
<tr>
<td>Savings</td>
<td>%</td>
<td>0</td>
<td>-72,33</td>
</tr>
</tbody>
</table>

calculated in terms of the real values of emissions, in the conditions of Slovakia it is possible to calculate with the value of 0.1780 kg CO\(_2\) / kWh (data of Slovak Power Plants) *
for district heating with natural gas, calculated with experimentally detected values of 0.2365 kg CO\(_2\) / kWh *

MAIN LESSONS LEARNT

Technical
» Building companies profit orientated, adjusting quality of components (e.g. inferior thermal insulation, but changed to required after inspection of construction works)
» Low skilled workers for technical systems/new technologies
» New technologies – HVAC, fire barriers, leveling the façade (thermal insulation) with loggias, disconnection from district heating (technical and technological), new boiler room with cascading heat pumps connected to PV, intelligent monitoring system
» Problems with bird protection, asbestos, acoustics of the heating room

Management / organizational issues
» Problems with disconnection from district heating
» Change of the law on disconnection from district heating
» Permits for deep renovation time demanding
MAIN LESSONS LEARNT

Economic / financial

» Return of interest surpassed calculations, better than standard refurbishment even 3-times expensive

» Reciprocity: electricity is given for free into the network, there is no concession when taking it back

» Legislation – heat producers not forced into renewables, problems with primary energy factor, “protected” by legislation against disconnection

» Combination of loans – Own, Bank, State Housing Development Fund

Societal

» The knowledge acquired by the renovation of was applied in the second phase of the process of deriving the cost-optimal levels of the energy performance requirements for Nearly Zero Energy Buildings (Directive, required by the European Commission till end of March 2018)

» as well as the basis for the processing of the amendment of the national standard STN 73 0540-2 Functional Requirements. Thermal protection of buildings.
THANK YOU FOR ATTENTION

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