MONITORING RESULTS OF NEARLY AND NET ZERO ENERGY DWELLINGS

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Can we renovate and build towards comfortable Net Zero Energy dwellings at a reasonable price, and of good quality which perform as promised?
INITIATIVE HOUSING CORPORATION “THE RAPIDS” (“DE STROOMVERSNELLING”)

- Four constructors and six housing corporations signed this deal in 2013
- Goal of this collaboration: to refurbish 111,000 homes to net zero energy
- Starting with 11,000 homes

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All these homes will be refurbished with no negative consequences in the total cost of living (rent and energy bill) for the tenants, leading to a positive business case for the housing corporation and constructors, without external financing.

Tenants will pay an Energy Performance Reimbursement fee (which will not be higher than the guaranteed reduction of the energy bill) directly to the housing corporation.

The corporation invests this money in refurbishing the homes.

Constructors will refurbish the homes to a zero-energy level.
INITIATIVE PRIVATE RESIDENCES
NEW DEAL RENOVATION

- Consortium of more than 150 organisations: banks, municipalities and contractors
- Realizing net zero energy dwellings
INITIATIVE PRIVATE RESIDENCES
NEW DEAL RENOVATION

- Stimulation of demand by municipalities, energy companies and local ambassadors
- Development of supply chain; need for cooperation of contractor and manufacturers
- Need of an enabler; set up of energy-neutral renovation mortgage

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Energy Leap Program ("Energiesprong")

- Innovation-implementation program “Energiesprong” (Energy leap in English) focuses on the development of marketable propositions for energy neutral (on the meter) buildings which are affordable, profitable for the building industry, provide good living conditions and realize the promised performance characteristics.

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ENERGY LEAP PROGRAM ("ENERGYSPRUNG")

- Integral monitoring of demonstration Net Zero Energy projects is an important part of this program.
- 200 dwellings have been monitored by:
  - Smart meters gas
  - Smart meters electricity
  - Temperatures living room, sleeping room
  - Outdoor climate (through weather stations)
  - Questionnaires
  - Blowerdoor, infrared, inspections

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**TYPICAL NET ZERO ENERGY CONCEPTS**

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Location</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trebbe</td>
<td>Maurik</td>
<td><strong>Condensing boiler</strong>, Demand contr. Vent., Rc = 5</td>
</tr>
<tr>
<td>Klimaatgarant</td>
<td>Rijswijk</td>
<td><strong>Ground source HP</strong>, Vent, heat recov., Rc = 3.5 – 5</td>
</tr>
<tr>
<td>Heijmans</td>
<td>Grijpskerke</td>
<td><strong>Ground source HP</strong>, Vent, heat recov., Rc = 10-14</td>
</tr>
<tr>
<td>Klaassen</td>
<td>Oosterhout</td>
<td><strong>Air/Water HP</strong>, Air heating system. Rc=8</td>
</tr>
<tr>
<td>Novitijd</td>
<td>Nieuwleusden</td>
<td><strong>HP</strong>, natural supply vent.. Rc = 6 – 9</td>
</tr>
<tr>
<td>Bam</td>
<td>Arnhem</td>
<td><strong>Air/Water Heat pump</strong>, demand control vent. Rc = 5.3</td>
</tr>
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RESULTS RIJSWIJKBUITEN

- New building: PV, ground source heat pump, energy efficient appliances
- Homeowner pays in addition 100 Euro/month for 25 years (Klimaatgarant)
- Guarantee of proper functioning of the installations
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RESULTS RIJSWIJKBUITEN

Energy consumption (kWh/year)  Set point temperature (°C)

Dwelling 1 (corner)  Dwelling 2  Dwelling 3  Dwelling 4  Dwelling 5 (corner)

Net use per dwelling  House hold use energy  Set point

Net use per dwelling

House hold use energy

Set point

Dwelling 1 (corner)  Dwelling 2  Dwelling 3  Dwelling 4  Dwelling 5 (corner)

Energy consumption (kWh/year)  Set point temperature (°C)

Dwelling 1 (corner)  Dwelling 2  Dwelling 3  Dwelling 4  Dwelling 5 (corner)

Net use per dwelling  House hold use energy  Set point

Net use per dwelling

House hold use energy

Set point
RESULTS COOLING MEASURES
MONTFERLAND - NO PASSIVE

› Measures
  › Floor, roof, facade insulation: R_c = 6
  › Heating: Combination of gas boiler and air/water heat pump
  › No passive cooling, some houses have active cooling (heat pump)

› Survey
  › 58 % satisfying temperatures in the bed rooms during the summer
  › 8% too hot
  › 17 % sometimes to hot
  › 17% fluctuating temperatures
RESULTS COOLING MEASURES KERKRADE - PASSIVE

› Measures
  › Floor: Rc = 5, roof: Rc = 10, facade: Rc = 7
  › Heating: gas boiler, ventilation with heat recovery
  › Passive cooling: overhang and night ventilation

› Survey
  › 95% of tenants stated temperature improved after renovation
RESULTS COOLING MEASURES MONTFERLAND - ACTIVE

- Measures
  - Floor: $R_c = 3.5$, roof: $R_c = 5$, facade: $R_c = 4$
  - Heating and cooling: ground source heat pump
  - No passive cooling measures
  - Cooling is used to balance ground source

- Survey
  - Tenant satisfied
  - Measurements of 5 homes

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RESULTS COOLING MEASURES

CONCLUSIONS

› Summer comfort is possible in net zero energy dwellings
› A good strategy has to be chosen
  › Passive measures to prevent cooling load or
  › In case of ground source heat pump cooling can be used to balance the ground source
QUALITY OF MEASURES

- Measurements and inspections show that there is a need for quality control
- To avoid higher infiltration which can not only lead to more energy use but also a need for more installed power for heating or cooling
- To guarantee proper functioning of the building and installation
- To prevent cold spots which can lead to moisture and mould grow
RESIDENTS SATISFACTION

- Residents should be informed within various stages
  - Before the renovation or when they buy a new house about the financial arrangements (energy-neutral renovation mortgage, performance contract)
  - Informed how to use the installations when they inhabit
  - Be able to ask questions to a contact person for a longer period of time
  - Be sure that the installations are maintained over the years
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BUSINESS CASE
COST AND BENEFITS ARE IN BALANCE

› Costs
  › Additional costs 70,000 – 80,000 Euro

› Benefits
  › Energy saving (45,000 Euro/20 years)
  › Reduction of maintenance costs
  › Increase of value of property

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WHAT WE HAVE LEARNED

- We can built satisfying net zero energy dwellings at a reasonable price
- With comfort and of good quality
- Which are reliable in the near future
- But we have to learn by doing

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THANK YOU FOR YOUR ATTENTION