PROJECT SUMMARY
This single family house dates from 1939 and is in almost original state. It will be renovated to reduce fossil energy demand by a factor 7 and later even become net energy positive, once the compact heat storage system (in development at ECN/TNO) has been installed in the course of timed replacement of systems.

SPECIAL FEATURES
Passive House approach, conservatory, 95 m² PV, 8 m² vacuum tube collectors. Prepared to adapt to future technological developments.

RENOVATION TEAM
Ton Kowalczyk (architect), Ruud Luitjes (contractor), Gerben Bos (Isoplan: Passivehouse elements), Jorrit Laan (Infinity NRG: PV roof), Ab de Graaff (Storkair, ventilation), Willem Koppen (real estate measurements), Wouter Borsboom (TNO), Henk Kaan, Niels Sijphee & Martijn van Essen (ECN)

OWNERS/INITIATORS
Ivo & Sabine Opstelten

SFH PIAF® in Sint Pancras NL

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation
BACKGROUND

This building from 1939 was purchased for its poor energy signature and improvement potential. The owner, Ivo Opstelten, wanted an enlarged living area, good indoor climate, excellent energy signature and improved market value in a cost-effective way. To this end he used the PIAF® methodology, namely to:

1. Anticipate the optimal combination of energy-systems in 2020 to convert the building into E-neutral.
2. Plan a new building envelope fit for the future combination of energy systems, construct it now.
3. Determine the most cost-effective combination of energy systems assuring a good indoor climate until 2020.

SUMMARY OF THE RENOVATION

• Replacing the barn with an enlargement built with Isorast building blocks (375 mm)
• Insulation of the building envelope: roof (380 mm), facade (300 mm), beneath ground floor (200 mm)
• A new conservatory on the south side
• Adding 95 m² amorphous silicium PV panels and 8 m² vacuum tube collectors
• A new condensing boiler
• A new ventilation system (HRC 85 – 90%)
• Preparations (e.g. piping and electric fuse box) for seasonal heat storage
• Renovation of bathroom and kitchen

Total renovation costs: €150,000 (with a lot of effort by owner and friends). Total market value increase: €200-225,000 resulting from the enlargement and energy signature (label A++) exceeding current new build dwellings (label A). The building should be compatible with new buildings of 2020.
Motivation behind renovation:
value-driven instead of cost driven

Topics to address:
– Useless spaces (attic, barn)
– 120 m², 350 m³ on 600 m² area
– Draught discomfort
– Overheating in summer, cold feet in winter
– Too little daylighting (living room!)
– Noise (single-pane windows)
– Out-date bathroom (shower!)
– Health hazard
Thermograpical Analysis

The photos to the right of a room interior and the house exterior do not indicate any problems needing renovation.

However, thermographic images tell a different story:

The thermography image of the room wall illustrates comfort problem and mold growth / mite hazard from cold and condensation on surfaces (Pictures left).

The thermography image of the house identify exterior surfaces with greatest heat losses, i.e. windows, dormers, and the side walls. Unheated (unuseable) volumes are evident from the blue areas, i.e. attic (pictures right)
CONSTRUCTION

Floor construction  
U-value: 0.20 W/(m²·K)  
Poly-urethane 200 mm  
Air 350 mm  
Wooden floor 30 mm  
Parquet flooring 4 mm  
Total 234 (+350 air) mm

Wall construction  
U-value: 0.13 W/(m²·K)  
(interior to exterior)  
Plaster 8 mm  
Brick 11 mm  
Cavity 5 mm  
Brick 11 mm  
Poly-urethane 300 mm  
Plaster 15 mm  
Total 350 mm

Roof construction  
U-value: 0.10 W/(m²·K)  
(top down)  
Wooden ceiling plates 20 mm  
EPS 380 mm  
EPDM 2 mm  
PV-panels (S) or roof tiles (N) 20 mm  
Total 422 mm

Health hazard: Exhaust vent for flue gas from kitchen gas burner directly beside dormer window.
**Summary of U-values W/(m²·K)**

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attic roof</td>
<td>1.7</td>
<td>0.1</td>
</tr>
<tr>
<td>Walls</td>
<td>2.2</td>
<td>0.13</td>
</tr>
<tr>
<td>Floor</td>
<td>1.8</td>
<td>0.19</td>
</tr>
<tr>
<td>Windows’</td>
<td>3.3-5.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

**RENEWABLE ENERGY USE**

The complete south roof slope is used to capture solar energy. This implies the installation of app. 95 m² of integrated amorphous silicium solar panels. On the adjacent garage roof, 8 m² of vacuum tube collectors will charge the 500 l heat storage tank.

To minimise the energy demand for domestic hot water a shower-water heat recovery unit is installed (see picture to the left).

**ENERGY PERFORMANCE**

Space + water heating (primary energy)*
- Before: 275 kWh/m²
- After: 40 kWh/m²
- Reduction: 85%
- *Standard new: 60 kWh/m²

After the renovation the PV electricity production will be 1.5 times the total household electricity demand. After 15 years the space and water heating will require no primary energy.

**Brochure author**

Ivo Opstelten, Netherlands