Case studies on NZEB: Dutch experience with schools

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Summary of some of the major targets for NZEBs around the world [Kilkis 2010]

2010: Present know-how and tools for NZEBs

2019: All new constructed buildings are near net-zero energy targets (Europe)

2030: Commercial buildings new to the stock are NZEBs (US)

2030: All new building (pending) and new public buildings are NZEBs (Japan)

2050: 100% of commercial buildings are NZEBs (US)

2020: Develop tools for market-viable NZEBs (ASHRAE)

2020: New residential buildings are to be NZEBs (CPUC)

2040: 50% of commercial buildings are NZEBs (US)

New Targets?
Schematic of the photovoltaic and active (thermal) solar heating systems and Zero-energy house
School F2: from 19 kWh/m²y to a Netto energy building in 2002!

Heating around 4000m³ gas ~ 16,000 kWh covered by participation in a wind turbine park

Electricity consumption around 14,650 kWh supplied by 145 m² PV-panels on the roof
Results measurement Dutch passive houses

<table>
<thead>
<tr>
<th>Town</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of house</td>
<td>Terraced house</td>
<td>Villa</td>
<td>Villa</td>
<td>Terraced house</td>
</tr>
<tr>
<td>Bedroom 1 [2 persons]*</td>
<td>800</td>
<td>750</td>
<td>950</td>
<td>600</td>
</tr>
<tr>
<td>Bedroom 2*</td>
<td>800</td>
<td>700</td>
<td>1650</td>
<td>600</td>
</tr>
</tbody>
</table>

*Average night time level CO2 [ppm]
University for applied science the Hague Delft
Christian Huygens College Eindhoven with energy roof
Renewable heat and cold Christiaan Huygens College

PV-cells

Energy roof

Source

Heat pump

Low temperature heating
High temperature cooling
: floor
Energy roof construction

- Polystyrene Roof insulation
- Aluminium profile
- Plastic tube
Building when nearly completed
The Veldhuizerschool Ede
## Overview Dutch UKP NESK school projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Year</th>
<th>Special features of project</th>
<th>PV m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baken Poort</td>
<td>Almere, 6800 m²</td>
<td>2013</td>
<td>Energy neutral high level insulation, low temperature heating, HR ventilation, HP, aquifer</td>
<td>3000</td>
</tr>
<tr>
<td>Hart van Oijen</td>
<td>Lith, 2447 m²</td>
<td>2012</td>
<td>Energy neutral by applying a biogas-CHP, low temperature heating, HP, aquifer</td>
<td>150</td>
</tr>
<tr>
<td>VMBO Huygens College &amp; De Polsstok</td>
<td>Heerhugowaard, 4257 m²</td>
<td>2012</td>
<td>Energy neutral based on applying Passive house-concept, R=10 insulation, HR ventilation, HP, aquifer, solar boiler.</td>
<td>2000</td>
</tr>
<tr>
<td>SO/VSO OdyZee</td>
<td>Goes, 2458 m²</td>
<td>2011</td>
<td>Energy neutral based on applying Passive house-concept, R=10 insulation, HP, solar boiler, low temperature heating.</td>
<td>499</td>
</tr>
<tr>
<td>MFC Brede School</td>
<td>Kollumerland, 1787 m²</td>
<td>2012</td>
<td>Energy neutral by applying a combination of sustainable energy technologies, R=6 insulation, HP, floor heating/cooling</td>
<td>1190</td>
</tr>
<tr>
<td>Klimaatneutraal DSK-II</td>
<td>Haarlem, 2735 m²</td>
<td>2012</td>
<td>Energy neutral, uses the heat of a computer server room for heating and hot water, HP, aquifer</td>
<td>1000</td>
</tr>
<tr>
<td>Het Klaverblad</td>
<td>Amsterdam, 3177 m²</td>
<td>2012</td>
<td>Energy neutral by applying PV-panels which are installed by the local energy distribution company without extra costs for the school, connected to district heating</td>
<td>1000</td>
</tr>
</tbody>
</table>
Conclusions

NZEB are already nearly possible now!

Architects in particular should apply appropriate design process in order to effectively initiate NZEB design.

It should be understood that in order to achieve a sustainable future the current design practice should be changed to Zero Energy Building design especially for schools.

Thank you for your attention
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