



HAARLEM (The Netherlands)

70% energy saving

Total living expenses after renovation stayed the same

Solar heating and DHW (total capacity of 2MW), heat storage, LT heating

Project data

Location, address:	Schalkwijk residential area
Region:	Noord Holland
Surroundings:	Close to the sea shore
Climate:	Mild and humid
Heating degree days:	2675 (KWA Bedrijfsadviseurs, www.kwa.nl)
Year of construction and renovation:	Around 1960 (constructed); 2001 - 2003 (renovated)
Typology:	Apartment buildings
No of dwellings:	382 dwellings (in nine complexes)
Total floor area:	34,380 m ² (around 90 m ² each)
Owner:	Elan Wonen, De Woonmaatschappij, Pre Wonen (housing associations)
Architect and Builder:	DWA (project leader: energy, installation and financing advice);
Costs of energy saving measures:	€ 47.500 per flat (incl. VAT and advice)
Renovation financed by:	The owner; Eneco energy company; EU and governmental subsidies



Objectives and Results

The three involved housing associations have succeeded to fulfil the main project objectives: to lower the energy consumption by 50%; to use renewable energy on large-scale and to guarantee that the total living expenses for tenants would not increase.

The project has shown that renewable energy system can serve as an aesthetic roof upgrade and be as well a part of an integral energy concept, which includes several innovative technologies and can lower the energy consumption considerably.

Renovated apartments in Haarlem (courtesy of DWA Installatie- en energieadvies)

Renovation concept

Key renovation features

- Insulation of side façade
- Insulation of ground floor
- High efficiency insulation glazing and frames
- Collective solar heating
- Collective solar DHW
- Mechanical ventilation
- Low temperature heating
- Efficient DC fans
- Individual thermostats
- Underground heat storage
- Gas-driven absorption heat pumps

State-of-the-art

Before renovation

Constructions [U-values: W/m^2K]

- Insulated roof
- Non-insulated façades
- Non-insulated ground floor
- Single [5,1]² and double glazing

Installations

- Collective central heating boiler with conventional efficiency
- Individual open gas boilers for DHW
- Natural ventilation
- No individual thermostats

After renovation

Constructions [U-values: W/m^2K]

- Insulation of side façades [0.27]
- Insulation of ground floor [0.27]
- High efficiency glazing (HR++) [1,2]¹
- High efficiency plastic window frames

Installations

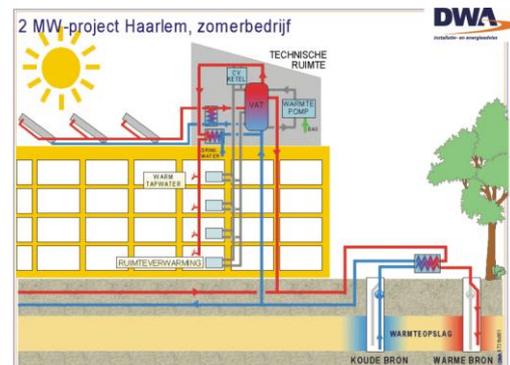
- Collective solar central heating
- Collective solar domestic hot water heating
- 7,6 m² solar collector per dwelling
- Mechanical ventilation
- Low temperature space heating
- Efficient DC fans
- Individual thermostats
- Underground heat storage
- Gas-driven absorption heat pumps

Energy saving and monitoring

Energy consumption before renovation:
 KWh/m²: 207 (gas only)
 Energy Index³: 1,33

Energy consumption after renovation:
 KWh/m²: 61 (gas only)
 Energy Index: 0,76
 Percentage saving⁴: >70%

The total installed capacity of renewable heat is 2MW. After the renovation, the consumption is 1.050 m³ gas equivalent per flat a year, out of which 20% gas and 80% renewable.



Scheme of the system with solar collectors, boiler, heat pump and heat storage, in summer operation mode (courtesy of DWA installatie- en energieadvies)

Additional information

- Old central boiler house became technically and environmentally dated. The housing associations aimed at new energy supply installation, which would lower the energy consumption, would be renewable and would not raise the total living expenses.
- Each apartment building has a new boiler room in the attic with connected solar collectors. The warm water delivered by solar collectors is after-heated by a gas boiler.
- Eneco energy supply company is the owner of the installation up to the meters. The rest of the installation is in the ownership of housing associations. Eneco has closed a contract per each apartment building for energy supply and maintenance of the heating installations.
- Superfluous heat is stored in a reservoir. If the reservoir is full, the warm water is stored in an underground aquifer. The stored heat of maximal 45°C can be used for heating in winter.
- The total living expenses has not changed after the renovation. Only new tenants will pay higher rent.
- During the renovation, tenants could move to so-called 'flex-flats' in the surroundings.
- Tenants have been involved in the project from the beginning through a tenants committee and individual discussions with housing associations.
- Renovation brought a lot of nuisance for the tenants. One flat has been renovated within 1-2 days.

Lessons learned and conclusions

- Each housing association has contracted different builders for the same renovation activities. This has not proven to work good. In the future, housing association will make agreements and contract one company.

References

- [1] 'Voorbeelden uit praktijk; Energiebesparing in corporatiewoningen'; Novem, Utrecht, 2001
 [2] www.dwa.nl

¹ U-value of the glazing only

² Total U-value of glazing and the window frame

³ Calculated by EPA - Energy performance Advice programme

⁴ Compared to the situation before renovation