TREES **Training for Renovated Energy Efficient Social housing**

Intelligent Energy -Europe programme, contract n° EIE/05/110/SI2.420021

# 3 Case studies

## 3.3 Kruitberg - Amsterdam

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### Partners

Armines/Ecole Nationale Superieure des Mines de Paris – CEP, France
Budapest University of Technology and Economics (BUTE), Hungary
EnerMa, Sweden
DHV, The Netherlands
SINTEF, Norway
University of Kassel, Center for Environmental Systems Research (CESR), Germany

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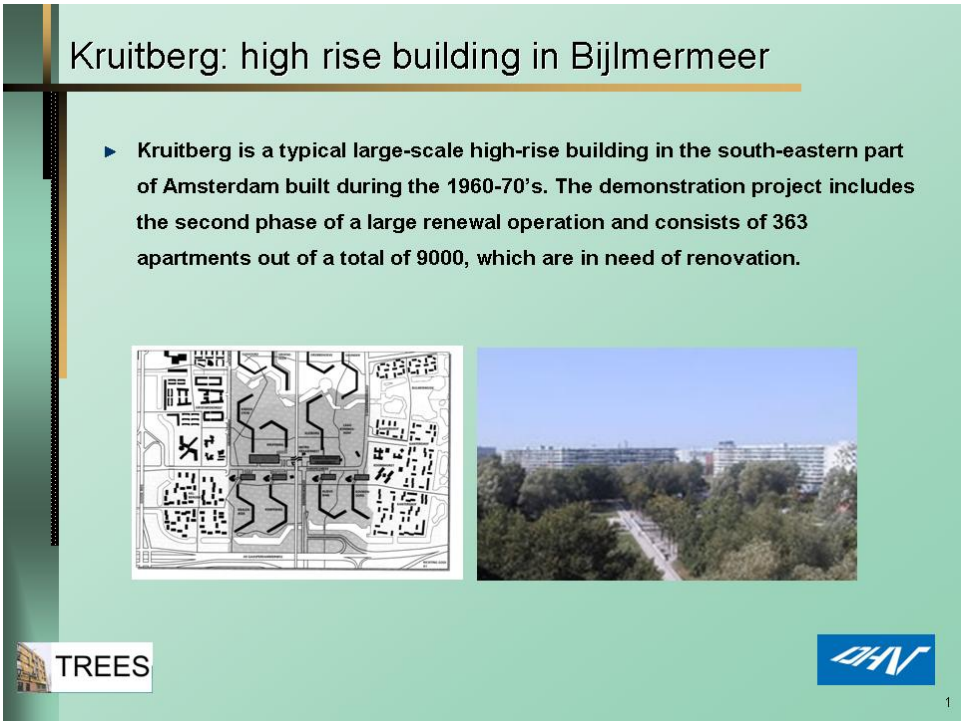
# 1. Introduction

In 1993 "Solar Energy in Building Renovation" was initiated within the IEA Solar Heating and Cooling Program. The work was concentrated on documentation and dissemination of suitable solar renovation concepts and resulted in a number of publications and sample projects. A major dissemination effort was a brochure package published by James & James (Boonstra et al, 1998).

This case study report describes a demonstration project that builds on the experiences from the IEA work, as well as experiences from previous national demonstration projects. The project was initiated at the time for the call for targeted projects for the THERMIE program in 1996, and has been carried out with financial support from EC (SHINE - BU/1051/96).

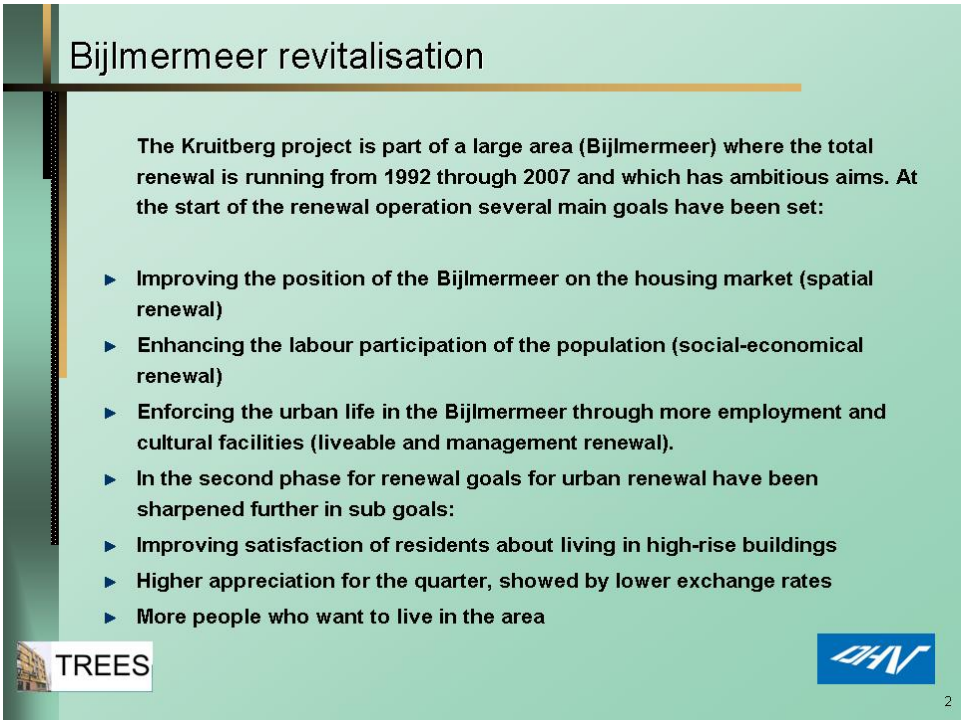
Kruitberg is a typical large-scale high-rise building in the south-eastern part of Amsterdam. The building is built during the 1960-70's. The demonstration project includes the second phase of a large renewal operation and consists of 363 apartments out of a total of 9000, which are in need of renovation.




[Powerpoint slide 1]

## 1.1 Revitalisation

This project is a comprehensive and cost-competitive sustainable renovation concept and process, which comprises energy conservation, utilization of renewable energy, improving comfort and tenants involvement. Building type, installation, and age are common. A large number of similar renovation situations will occur in the coming years in other similar urban areas: the replication potential is large.



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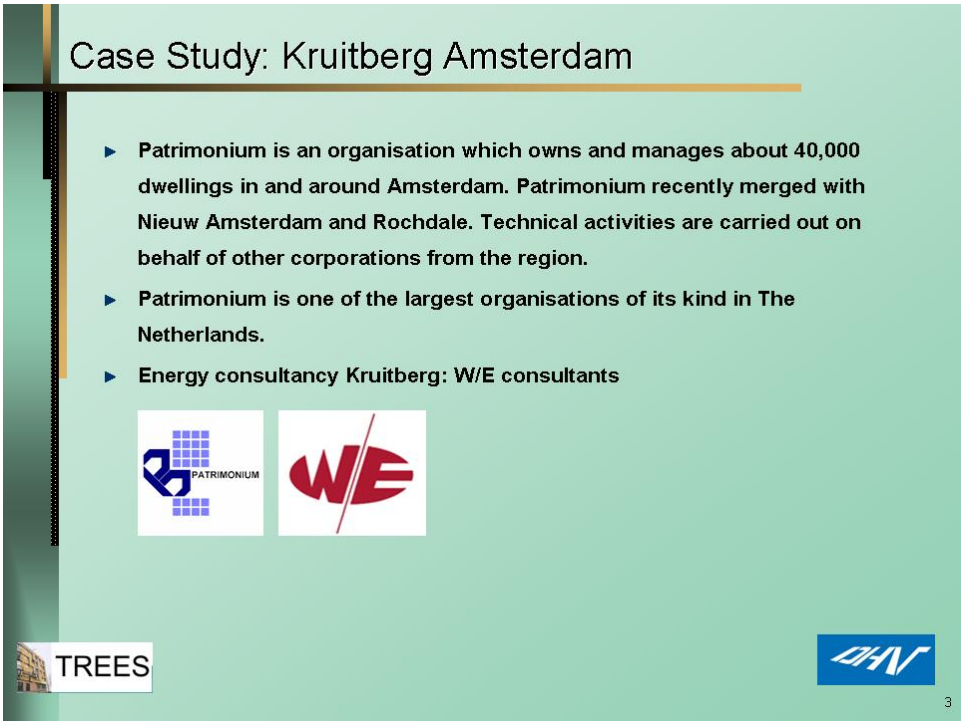
The project is part of a large area (Bijlmermeer) where the total renewal is running from 1992 through 2007 and which has ambitious aims. At the start of the renewal operation several main goals have been set:

- Improving the position of the Bijlmermeer on the housing market (spatial renewal)
- Enhancing the labour participation of the population (social-economical renewal)
- Enforcing the urban life in the Bijlmermeer through more employment and cultural facilities (liveable and management renewal).
- In the second phase for renewal goals for urban renewal have been sharpened further in sub goals:
    - Improving satisfaction of residents about living in high-rise buildings
    - Higher appreciation for the quarter, showed by lower exchange rates
    - More people who want to live in the area

For the renewal operation a program has been determined. Important measures here in are demolition of buildings, new building, improvement of dwellings, repositioning social housing to a different segment of the social housing market or to another market (like owner occupied), and selling social dwellings to present residents. Next to this, the total urban area will be changed
In the centre of the area the original design conditions will remain valid. The project and several other similar high-rise multifamily buildings together form the Bijlmermuseum.

## 1.2 Organisation

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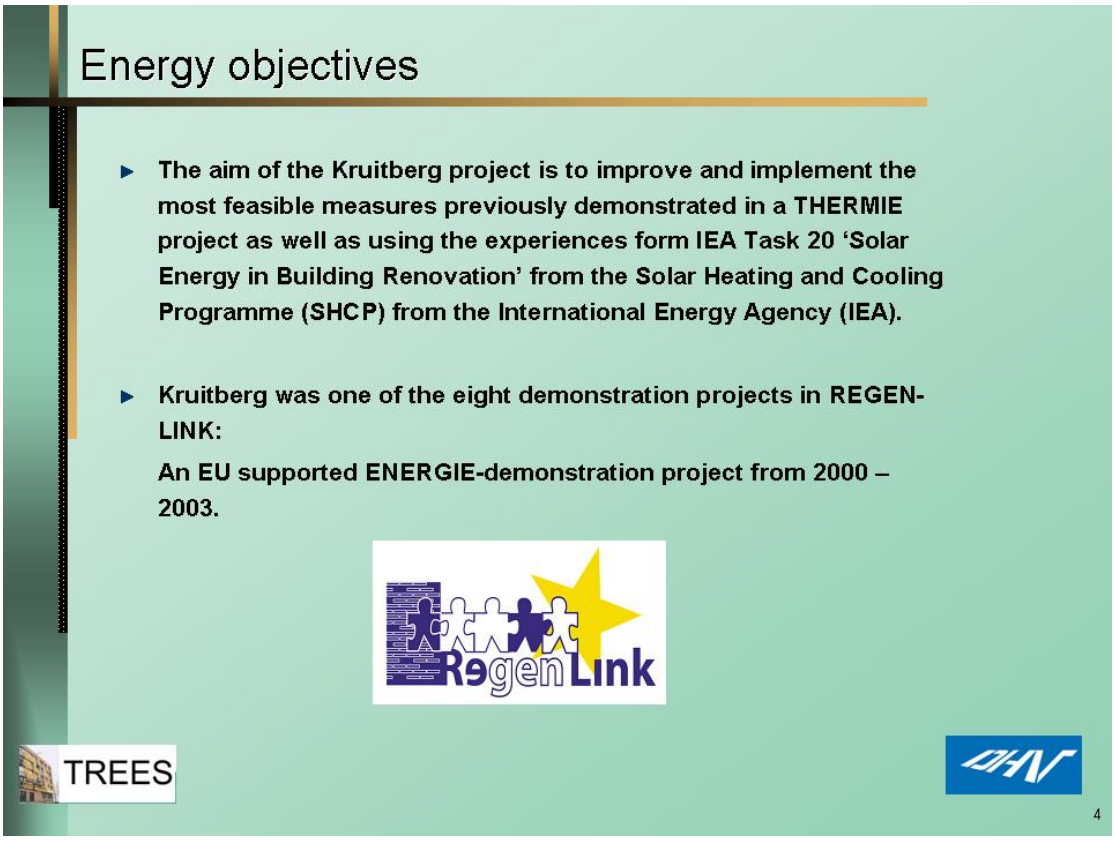
The demonstration project includes the second phase of renewal and exists of 363 apartments of totally 9,000 who are in need of renovation the coming years. The owner, Patrimonium, is a large (40,000) housing company in and around Amsterdam. The project will have great influence on the future renovation strategy of this company, as well as for other national and European similar companies.

Patrimonium is one of the largest organisations of its kind in The Netherlands. In line with Patrimonium's size as a housing corporation, it has an extensive technical apparatus, which must be considered capable of realising the proposed measures. Patrimonium aims to grow to a significant larger housing stock in the near future.
Experience with similar innovative projects and applying novel techniques has been acquired with renovation projects like Brandaris (THERMIE 'SHINE'), Noordwachter and new developments like Banne-Oost.
Social aspects, including an intensive tenants involvement, will be of major interest for this project. Experienced employees from Patrimonium will manage this process.

# 2. Aim of the project




[Powerpoint slide 4]

Advanced renovation of a 10 floor multifamily concrete element building with over 360 apartments and some non-domestic service space. The main focus is to save energy, use renewable energy, improve thermal comfort and indoor air quality. Materials will be chosen taking environmental aspects into account and with respect to the necessity of regular maintenance on both exterior and interior.
Results apply to numerous residential building areas from the 60-70's in The Netherlands and Europe.

Main aim is to improve the attractiveness of apartments, building and area. As the project is at the start of future large scale activities, with over 10 similar closely neighbouring buildings and over 100 similar building in the suburbs nearby, the spin-off is expected to be large.
Participation from tenants is an absolute pre-condition for a good project. Part of the approach is novel facility management of the building, individual metering of heat, DHW and water use. Jobs and public services within the building are created and enhanced.

The aim of the project is to improve and implement the most feasible measures previously demonstrated in a THERMIE project as well as using the experiences form IEA Task 20 'Solar Energy in Building Renovation' from the Solar Heating and Cooling Programme (SHCP) from the International Energy Agency (IEA). This is done with respect to specific features of the new project and taking into account more or less proven measures with additional new insights in technical measures like improved solar collector-systems, (amorphous) PV and heat pumps on ventilation air.

# 3. Before renovation

## 3.1 Side information

The original project comprises an urban residential area, located in the south-eastern part of Amsterdam (NL) and was built during the 60-70's. The area is typical for large-scale high-rise areas in Europe. For the district a renewal plan is made. As a part of this overall renewal it was an important task to demonstrate how this can be done in a sustainable way at affordable costs.

The majority of inhabitants are immigrants, where for this particular building 40 % come from the Surinam and the Dutch Antilles, 20 % are from Dutch origin, while the rest are mainly from underdeveloped countries outside Europe (1-2 generation).

The climate is typical western European and rather moderate with prevailing western winds (average 5 m/s). Average temperatures are about 10 °C, varying from 1.7 (January) to 17 °C (July). Lowest temperatures are about minus 15 °C, while the average in the heating season is 5 °C. Heating degree-days are 2804 (The Bilt) in the heating season, and about 3100 year round. Solar irradiation on a horizontal plane varies from 0.6 (January) to 4.65 (July) kWh/(m2day) with a total of circa 1,000 kWh/(m2a). Hours of sunshine are 1460 a year.

The project is a high-rise multi-family building of 10 apartment-floors with 363 dwellings. At ground level some facilities as well as the individual boxes are situated. At the first floor, dwellings are located as well as some other, non-domestic spaces. The ground floor and first floor are broader then the other 8 floors. The apartments consist of 3 main types, 1-2 (26), 3 (141) and 4-5 rooms (196), with an average floor area of 85 m2.
The building consists of 3 wings, with two central installation-spaces at the bend of two wings. The height of the building is 31 meters, the total length 360 meters. At the one side, balconies are located, at the other a gallery.

## 3.2 Building information

The insulation is relatively low compared to current standards. Especially the parapets and some panels at the facades have only a few centimeters insulation. All windows have normal double-glazing. The overall U-value was 3.47 with, and 3.6 W/m2K without glazing.
The ventilation had a collective mechanical exhaust without heat recovery. The fan extracts a constant flow. Air was supplied by natural way by cracks, joints and openable windows.
Radiators in the apartment were supplied by the original collective, not individually metered, gas based, heating system (70/90 °C). Later a district heating plant (CHP) was connected to the original one at the substation at ground level.
The DHW was also collective, not individually metered, and uses the same installation as space heating. At each tap an amount of over 16 liters per minute at a temperature of over 60 °C is available (unmetered!)
District heating, gas, collective electricity, heat flows for collective heating and DHW and cold DW were only measured at building level. Tenants pay an equal part of this (proportional per apartment).
Gas for cooking and electricity used by the households themselves are metered individually.

# 4. Renovation

## 4.1 Technical measures

The applied techniques can be divided into 3 categories of energy efficiency and include:

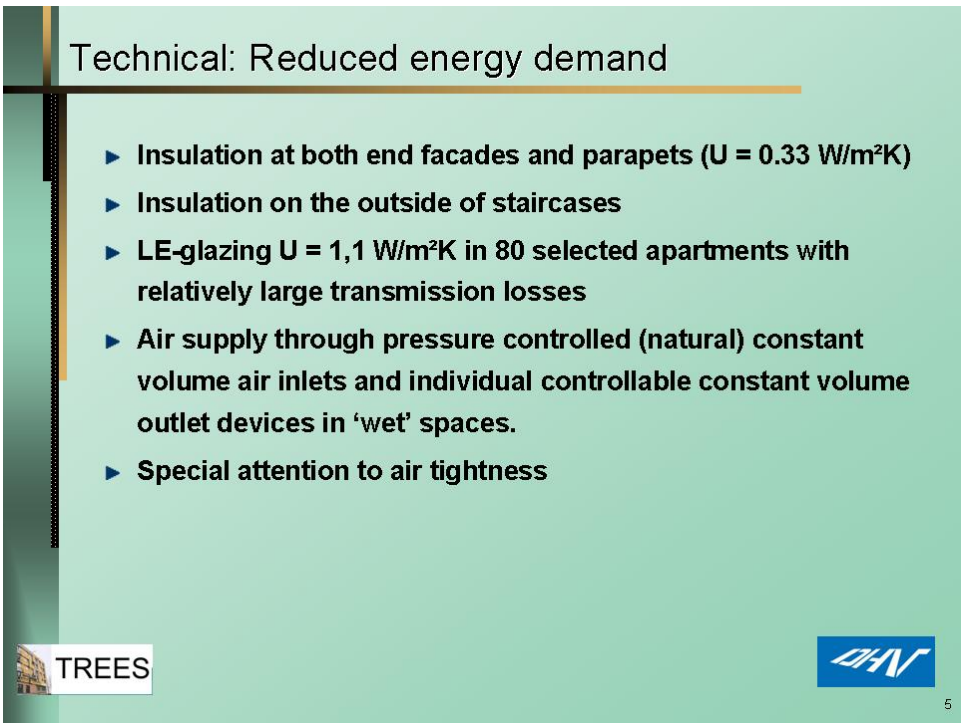
Reduced energy demand:
- Improved insulation
- Advanced glazing
- Ventilation strategies

Renewable energy sources
- Passive solar measures
- Glazed balconies
- Double envelope
- Active solar measures
- Collector integration
- PV
- Heat pump

Energy efficient energy
- District heating
- Small scale CHP
- Condensing gas boiler
- Individual metering

Furthermore, water measures were taken in the project.

The key measures installed in the project are listed following the three categories.




[Powerpoint slide 5]

## Reduced Energy Demand

- Insulation at both end facades and parapets (Rc = 3m²K/W)
- Insulation on the outside of staircases
- LE-glazing 1,1 W/m²K in 80 selected apartments with relatively large transmission losses
- Air supply through pressure controlled (natural) constant volume air inlets and individual controllable constant volume outlet devices in 'wet' spaces.
- Special attention to air tightness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## Renewable Energy Sources

- 33 glazed balconies
- 5 Crystalline PV in parapets
- 1 end façade got crystalline and amorphous panels with 12 kWp
- Air heat is extracted from ventilation exhaust with an electrical compression heat pump (20 kW) to preheat DHW (using 10% of the air).
- 720 m² thermal solar system with a performance of 1,74 GJ/m² primarily for DHW, and secondary for space heating.

## Technical: Renewable energy supply

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- 5 Crystalline PV in parapets
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*PV on end facades before and after renovation (artist impression)*

*construction 720 m2 collector (left) and framework (right)*

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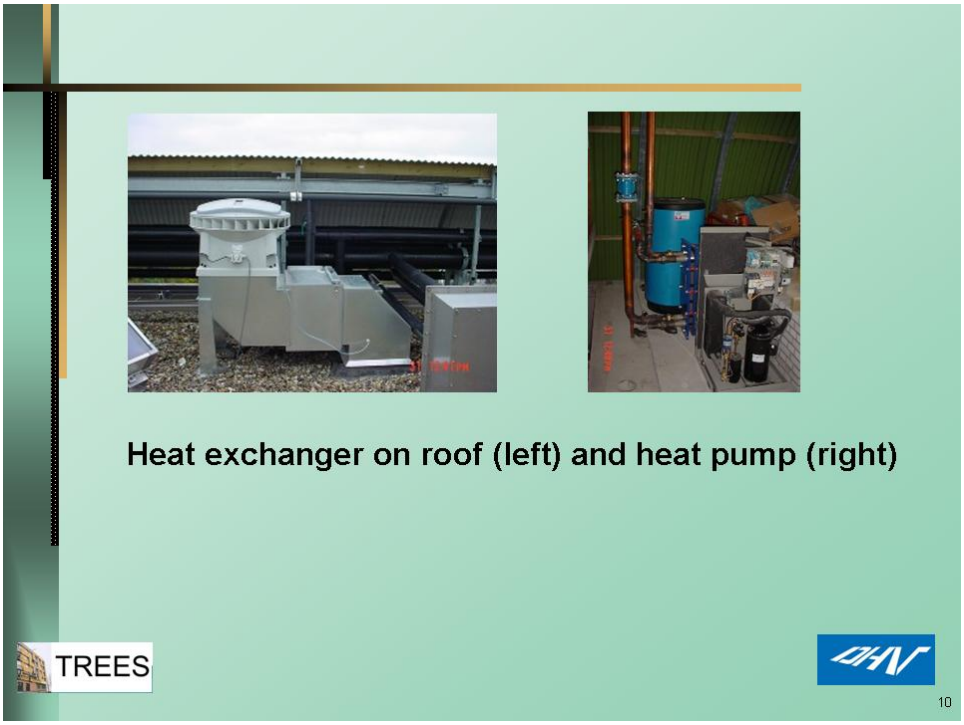


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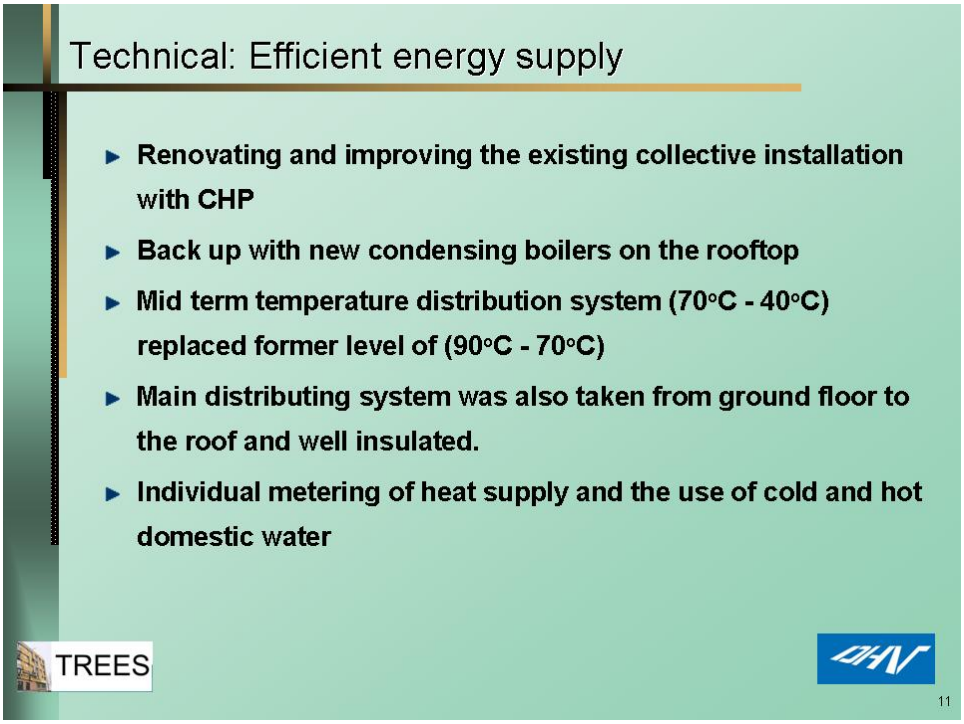


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| Efficient Energy Supply |
|---|
| – Renovating and improving the existing collective installation with CHP |
| – Back up with new condensing boilers on the rooftop |
| – Mid term temperature distribution system (70°C-40 °C) replaced former level of (90°C-70 °C) |
| – Main distributing system was also taken from ground floor to the roof and well insulated. |
| – Individual metering of heat supply and the use of cold and hot DW |

| Various |
|---|
| – Metering and reduction of tap flows from 20 litres per minute to a conventional 8 litres. |


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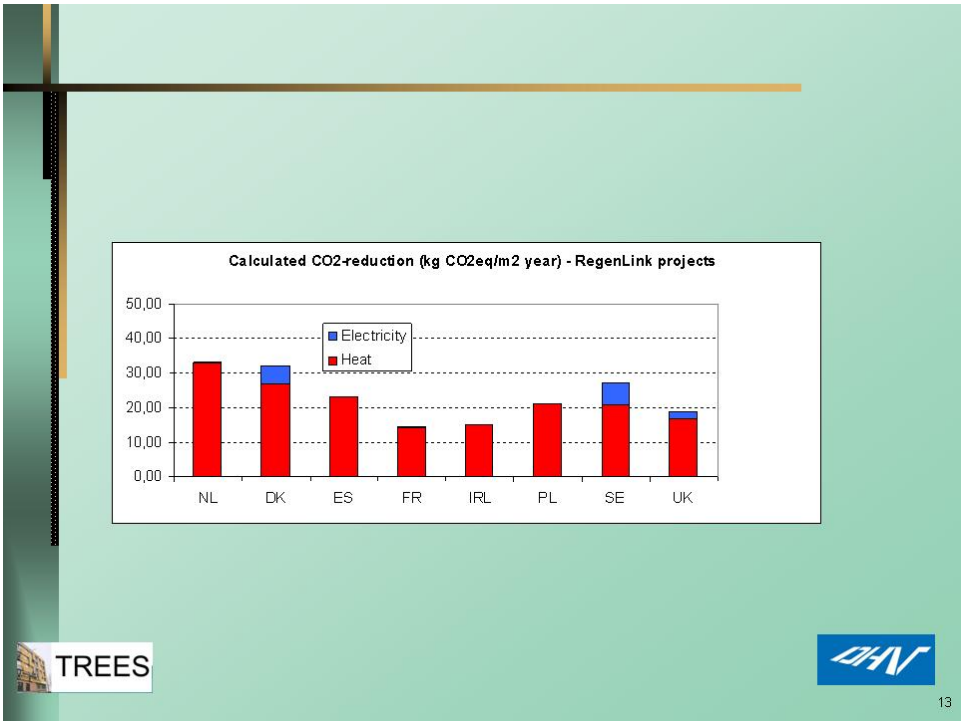
# 5. Results

## 5.1 General performance

The Regen-Link projects demonstrate how energy-efficiency and renewable energy can be integrated in rehabilitation projects in typical social housing areas throughout Europe. Kruitberg can be considered as successful.

Kruitberg has finalised careful and extensive commissioning and generally, the building performs reasonably well, with no serious malfunctions and the tenants are very pleased with the quality of living in the apartments. An important side effect is that the renovation project has improved the image of the housing area

## 5.2 Energy savings

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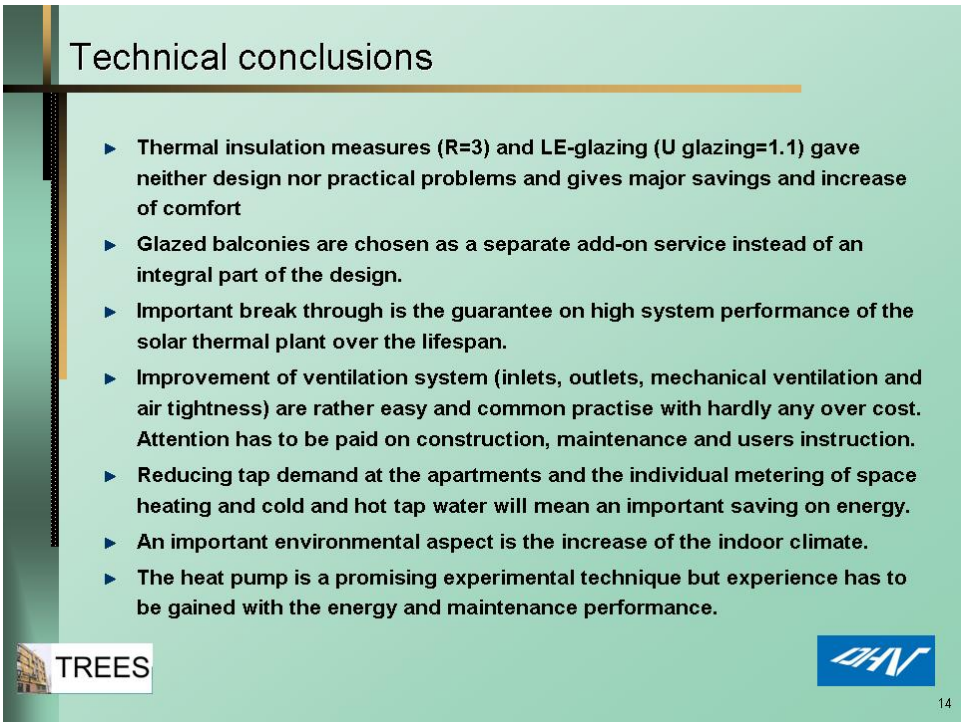
By all measures building related CO2 emission are over 50%.

## 5.3 Technical conclusions

Technical measures are part of the architectural design.

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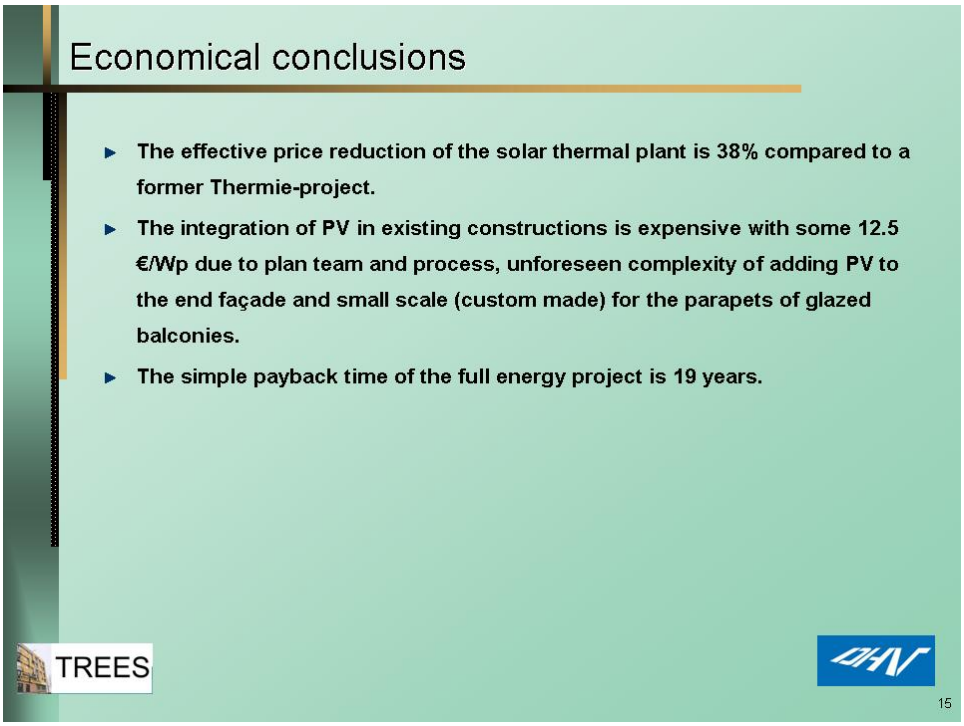
| Technical successes/failures |
|---|
| - Thermal insulation measures (R=3) and LE-glazing (U glazing=1.1) gave neither design nor practical problems and gives major savings and increase of comfort<br>- Glazed balconies are chosen as a separate add-on service instead of an integral part of the design.<br>- Important break through is the guarantee on high system performance of the solar thermal plant over the lifespan.<br>- Improvement of ventilation system (inlets, outlets, mechanical ventilation and air tightness) are rather easy and common practise with hardly any over cost. Attention has to be paid on construction, maintenance and users instruction.<br>- Reducing tap demand at the apartments and the individual metering of space heating and cold and hot tap water will mean an important saving on energy.<br>- An important environmental aspect is the increase of the indoor climate.<br>- The heat pump is a promising experimental technique but experience has to be gained with the energy and maintenance performance. |

## 5.4 Economical conclusions

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| Economical successes/failures |
|---|
| - The effective price reduction of the solar thermal plant is 38% compared to a former Thermie-project.<br>- The integration of PV in existing constructions is expensive with some 12.5 €/Wp due to plan team and process, unforeseen complexity of adding PV to the end façade and small scale (custom made) for the parapets of glazed balconies. |