# Renovation in Cold Climate

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# Task 37:
# Advanced Housing Renovation with Solar and Conservation

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

TASK 37

Advanced Housing Renovation
by Solar and Conservation

Whole building concepts for Advanced Housing Renovation with Solar and Conservation in Nordic countries.

Subtask C - Internal working document

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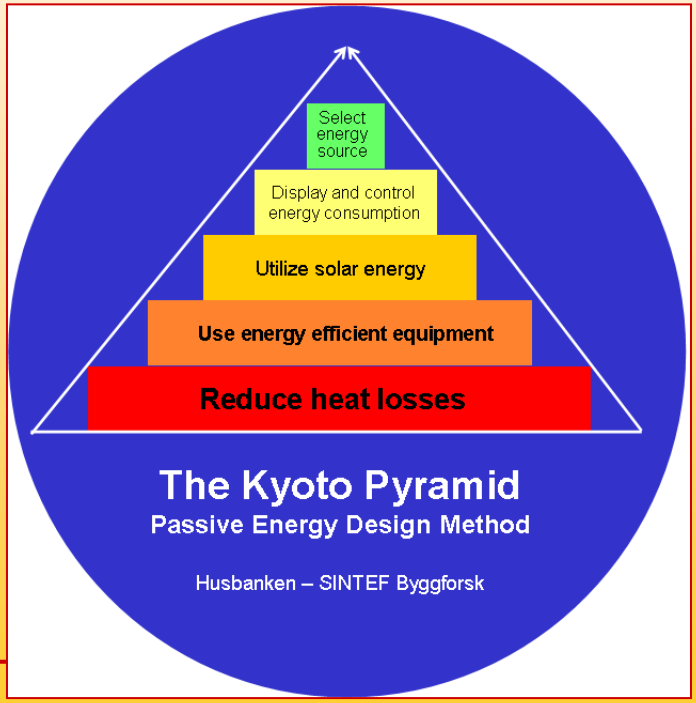
## Contents

# Basic strategies for renovation

The passive design principles includes five steps:

- **Reduce the heat loss** as much as possible by insulating walls, floor and ceiling, new passive house windows, introducing a continuous air tight layer to achieve an air tight building envelope and installing balanced ventilation with high heat recovery efficiency (η > 75 %).
- **Minimize the electricity demand,** by using very efficient fans, pumps, appliances and lighting systems..
- **Utilize solar energy**,
- **Control energy use** and energy behaviour
- **Choose energy source**



# Ambition levels for renovation

- In a lot of renovation projects it is practical or economical hard to achieve the “passive house” renovation level, due to :
  - different façade restrictions limits the insulation in the external wall
  - difficulties to achieve the passive house air tightness,
  - restriction on windows design so passive house windows can not be used,
  - the roof construction gives limitation for the insulation thickness

*Proposed ambition level for ambitious energy renovation.*

| Ambition level for renovation | Space heating demand |
|---|---|
| Level I: Low energy renovation | 45 kWh/m²a |
| Level II: Passive house renovation | 25 kWh/m²a |

| Components: | Typical standard | Renovation level I | Renovation level II |
|---|---|---|---|
| U-value external walls | 0.43 W/m²K | 0.21 W/m²K | 0.15 W/m²K |
| Example | 10 cm insulation | Up to 20 cm insulation | Up to 30 cm insulation |
| U-value slab on ground or basement ceiling | 0.35 W/m²K (equiv. 0.22) | 0.35 W/m²K (equivalent 0.22) | 0,35 W/m²K (equivalent 0.19) |
| | 5 cm insulation | Unchanged | 10 cm added insul. on foundation wall |
| U-value roof or attic | 0.35 W/m²K | 0.12 W/m²K | 0.10 W/m²K |
| | 12-13 cm insulation | Up to 30 cm insulation | Up to 35 cm insulation |
| U-value windows and doors | 2.8 W/m²K | 1.2 W/m²K | 0.80 W/m²K |
| Heat recovery (η) Specific fan power | - 1.5 kW/m³/s | 80 % 2.0 kW/m³/s | 80 % 1.5 kW/m³/s |
| | Exhaust system | Balanced ventilation | Balanced ventilation |
| Air leakage rate (N50) | 5.0 $h^{-1}$ | 2.0 $h^{-1}$ | 1.0 $h^{-1}$ |
| | | Measures around windows and doors | Additional measures to improve |
| Ψ'' Thermal bridges | 0.08 W/m²K | 0.07 W/m²K | 0.05 W/m²K |
| | | As air leakage | As air leakage |
| Net space heating demand | 145 – 155 kWh/m²år | ≤ 45 kWh/m²år | ≤ 25 kWh/m²år |
| Local renewables | 0 kWh/m²år | 0 kWh/m²år | 15 kWh/m²år |
| | | | Solar collectors cover 50 % DHW |

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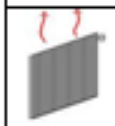
Key numbers for **small houses** before and after renovation with different ambition levels

| Components: | | Typical standard | Renovation level I | Renovation level II |
|---|---|---|---|---|
|  | U-value external walls | 0.41 W/m²K | 0.17 W/m²K | 0.10 W/m²K |
| | Example | 10 cm insulation | Up to 20 cm insulation | Up to 35 cm insulation |
|  | U-value slab on ground or basement | Approx 0.4 W/m²K | 0.4 W/m²K | $U_{basementwall}$: 0.09 W/m²K<br>$U_{slab}$: 0.3 W/m²K |
| | | 3 cm insulation | Unchanged | 28 cm added insul. on basement wall |
|  | U-value roof or attic | 0.23W/m²K | 0.17 W/m²K | 0.08 W/m²K |
| | | 15 cm insulation | Up to 25 cm insulation | Up to 50 cm insulation |
|  | U-value windows and doors | 2.1 W/m²K | 1.2 W/m²K | 0.85 W/m²K |
|  | Heat recovery (η)<br>Specific fan power | -<br>1.5 kW/m³/s | 80 %<br>2.0 kW/m³/s | 80 %<br>1.5 kW/m³/s |
| | | Exhaust system | Balanced ventilation | Balanced ventilation |
|  | Air leakage rate (N50) | - | 1 l/s m² | 0.3 l/s m² |
| | | | Additional measures to improve | Additional measures to improve |
|  | Net space heating demand | 150 kWh/m²år | < 45 kWh/m²år | < 25 kWh/m²år |

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Key numbers for **multi-family houses**

before and after renovation with different ambition levels

# Different concepts for economical analysis described

- **Simple payoff**
  - Very easy to use
  - Method does not take into account increased value of the product, inflation, interest rates

$$PBT = \frac{Capex}{Savings}$$

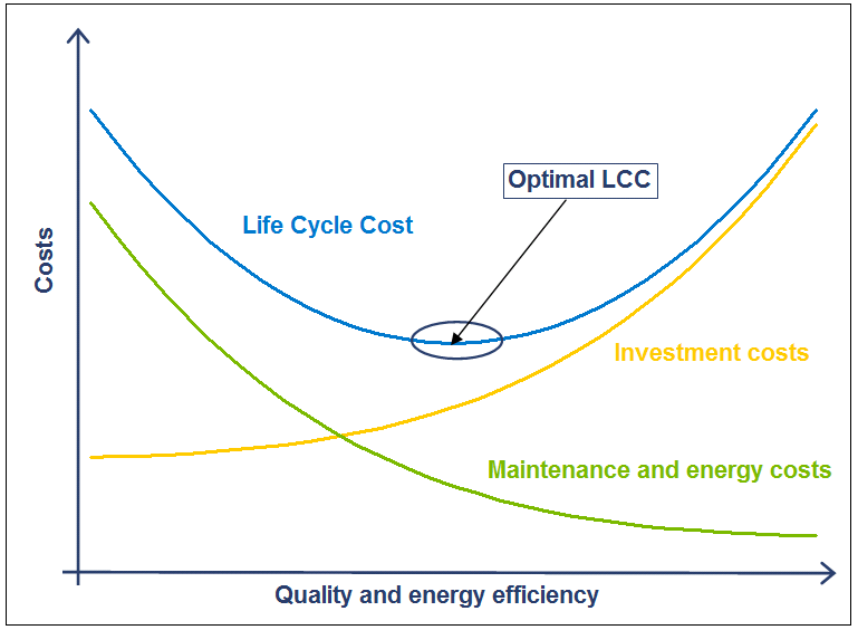
- **Life cycle cost – LCC**
  - All future costs are discounted to a present value
  - Can be used to optimize replacement cycles
  - Good method to compare two or more options

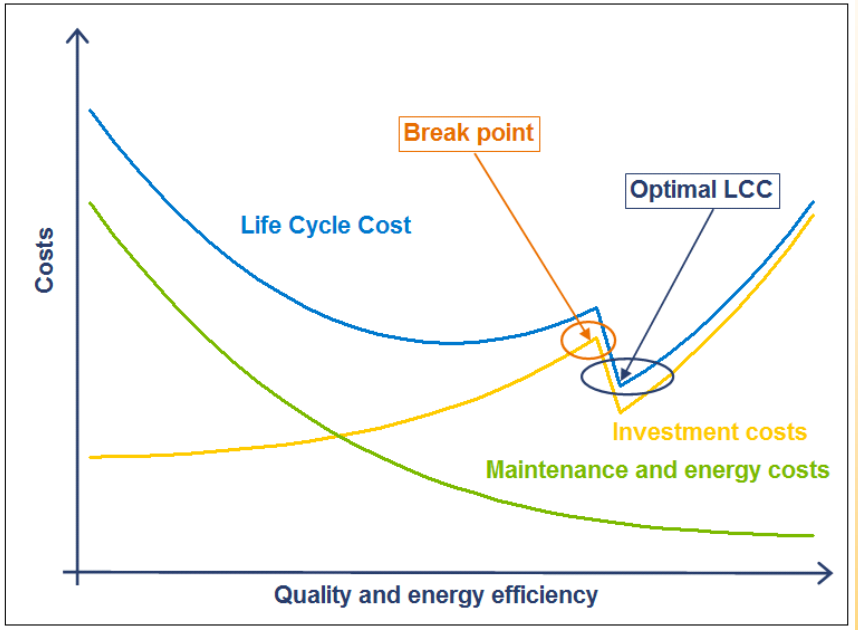
$$LCC_n = \sum_{t=0}^{n} \frac{C_t}{(1+R)^t} + Capex$$

- **Life cycle profit, LCP**
  - All future costs discuounted to apresent value
  - Takes the rest value into account

$$LCP_n = \sum_{t=0}^{n} \left(RI_t - E \cdot \alpha(1+\beta)^t - M_t\right) + \frac{RV}{(1+R)^n} - Capex$$

# COSTS AND PROFITABILITY ASSESSMENTS




- LCC of renovation standards, traditional thinking to the left
- Right figure; building envelope so effective that the heating system can be simplified or eliminated
- => Whole building evaluations are important to find the optimal solution

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## The report

## *Whole building concepts for Advanced Housing Renovation in Nordic countries*

**will be available for downloading early autumn from**

**www.iea-shc.org/task37**

# Thank you for your attention

***www.iea-shc.org/task37***