

# Renovation in Cold Climate

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# Task 37: Advanced Housing Renovation with Solar and Conservation



## 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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May 2010

## Contents

### 1. Introduction

### 2. The housing stock

- 2.1 Swedish housing stock
- 2.2 Norwegian housing stock

### 3. Energy strategies

- 3.1 Basic strategies for renovation
- 3.2 Ambition levels for renovation
- 3.3 Energy calculations

### 4. Costs and profitability assessments

- 4.1 Different concepts for economical analysis
- 4.2 Different approaches results in different outcomes
- 4.3 Which concepts, assumptions and system boundaries should one use

### 5. Whole building concepts for energy and cost efficient renovation

- 5.1 Small wooden houses
- 5.2 Apartment buildings

### 6. Building physics and indoor climate related challenges

- 6.1 Introduction
- 6.2 Ventilation, air tightness and indoor air quality
- 6.3 Thermal comfort
- 6.4 Moisture- and mould proof constructions
- 6.5 Software

### 7. Case studies

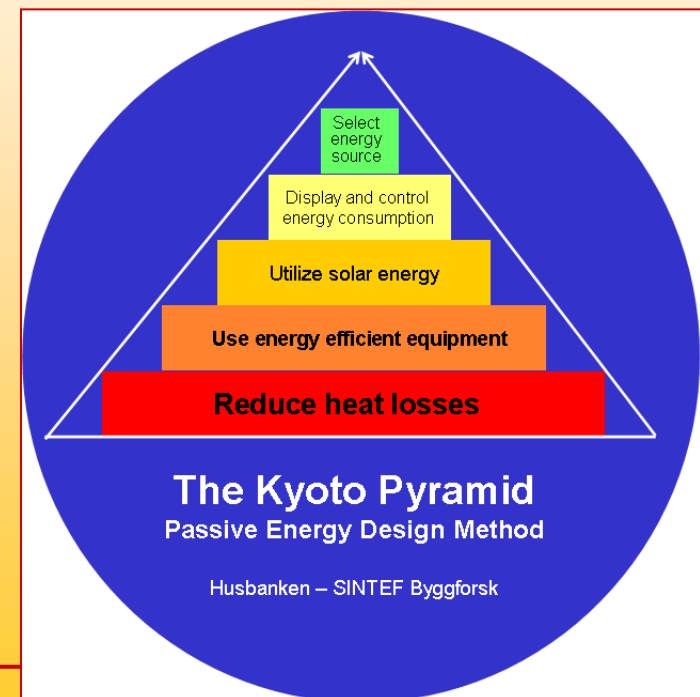
- 7.1 Brogården in Alingsås (Sweden)
- 7.2 Backa Röd (Sweden)
- 7.3 Myhrerenga (Norway)

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

### 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 ( $\eta > 75 \%$ ).
- **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.*







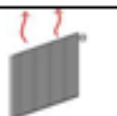
Ambition level for renovation	Space heating demand
Level I: Low energy renovation	45 kWh/m <sup>2</sup> a
Level II: Passive house renovation	25 kWh/m <sup>2</sup> a

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	0.43 W/m <sup>2</sup> K	0.21 W/m <sup>2</sup> K	0.15 W/m <sup>2</sup> K
	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/m <sup>2</sup> K (equiv. 0.22)	0.35 W/m <sup>2</sup> K (equivalent 0.22)	0,35 W/m <sup>2</sup> K (equivalent 0.19)
		5 cm insulation	Unchanged	10 cm added <u>insul.</u> on foundation wall
	U-value roof or attic	0.35 W/m <sup>2</sup> K	0.12 W/m <sup>2</sup> K	0.10 W/m <sup>2</sup> K
		12-13 cm insulation	Up to 30 cm insulation	Up to 35 cm insulation
	U-value windows and doors	2.8 W/m <sup>2</sup> K	1.2 W/m <sup>2</sup> K	0.80 W/m <sup>2</sup> K
	Heat recovery (η) Specific fan power	- 1.5 kW/m <sup>3</sup> /s	80 % 2.0 kW/m <sup>3</sup> /s	80 % 1.5 kW/m <sup>3</sup> /s
		Exhaust system	Balanced ventilation	Balanced ventilation
	Air leakage rate (N50)	5.0 h <sup>-1</sup>	2.0 h <sup>-1</sup>	1.0 h <sup>-1</sup>
			Measures around windows and doors	Additional measures to improve
$\Psi''$	Thermal bridges	0.08 W/m <sup>2</sup> K	0.07 W/m <sup>2</sup> K	0.05 W/m <sup>2</sup> K
			As air leakage	As air leakage
	Net space heating demand	145 – 155 kWh/m <sup>2</sup> är	≤ 45 kWh/m <sup>2</sup> är	≤ 25 kWh/m <sup>2</sup> är
	Local <u>renewables</u>	0 kWh/m <sup>2</sup> är	0 kWh/m <sup>2</sup> är	15 kWh/m <sup>2</sup> är
				Solar collectors cover 50 % DHW

## Key numbers for multi-family 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/m <sup>2</sup> K	0.17 W/m <sup>2</sup> K	0.10 W/m <sup>2</sup> K
	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/m <sup>2</sup> K	0.4 W/m <sup>2</sup> K	<del>U<sub>basementwall</sub>: 0.09 W/m<sup>2</sup>K</del> <del>U<sub>slab</sub>: 0.3 W/m<sup>2</sup>K</del>
		3 cm insulation	Unchanged	28 cm added <del>insul.</del> on basement wall
	U-value roof or attic	0.23 W/m <sup>2</sup> K	0.17 W/m <sup>2</sup> K	0.08 W/m <sup>2</sup> K
		15 cm insulation	Up to 25 cm insulation	Up to 50 cm insulation
	U-value windows and doors	2.1 W/m <sup>2</sup> K	1.2 W/m <sup>2</sup> K	0.85 W/m <sup>2</sup> K
	Heat recovery (η) Specific fan power	- 1.5 kW/m <sup>3</sup> /s	80 % 2.0 kW/m <sup>3</sup> /s	80 % 1.5 kW/m <sup>3</sup> /s
		Exhaust system	Balanced ventilation	Balanced ventilation
	Air leakage rate (N50)	-	1 l/s m <sup>2</sup>	0.3 l/s m <sup>2</sup>
			Additional measures to improve	Additional measures to improve
	Net space heating demand	150 kWh/m <sup>2</sup> år	< 45 kWh/m <sup>2</sup> år	< 25 kWh/m <sup>2</sup> år

## Different concepts for economical analysis described

### ■ Simple payoff

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

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

### ■ Life cycle cost – LCC

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

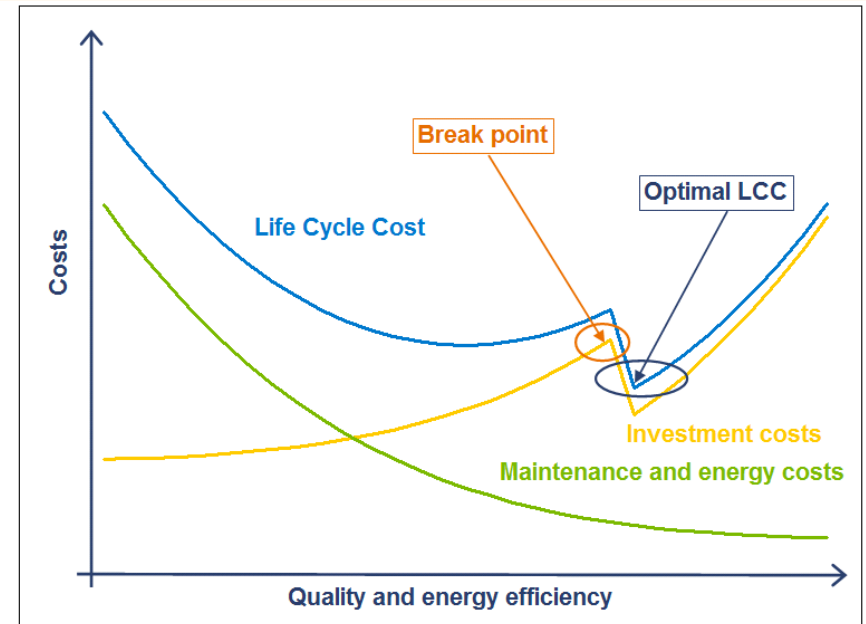
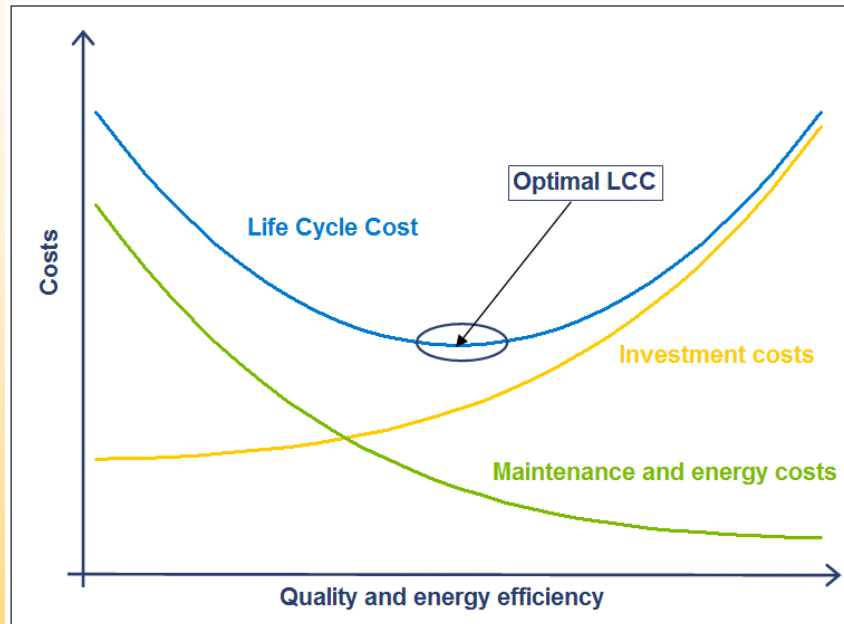
- All future costs are discounted to a present value
- Can be used to optimize replacement cycles
- Good method to compare two or more options

### ■ Life cycle profit, LCP

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

- All future costs discounted to a present value
- Takes the rest value into account

## 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

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](http://www.iea-shc.org/task37)

**Thank you for your attention**

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