

Renovation of a detached single-family house into an energy efficient low energy house

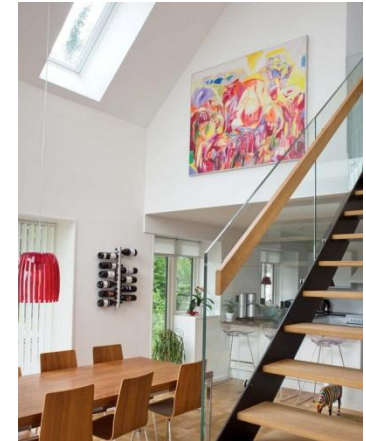
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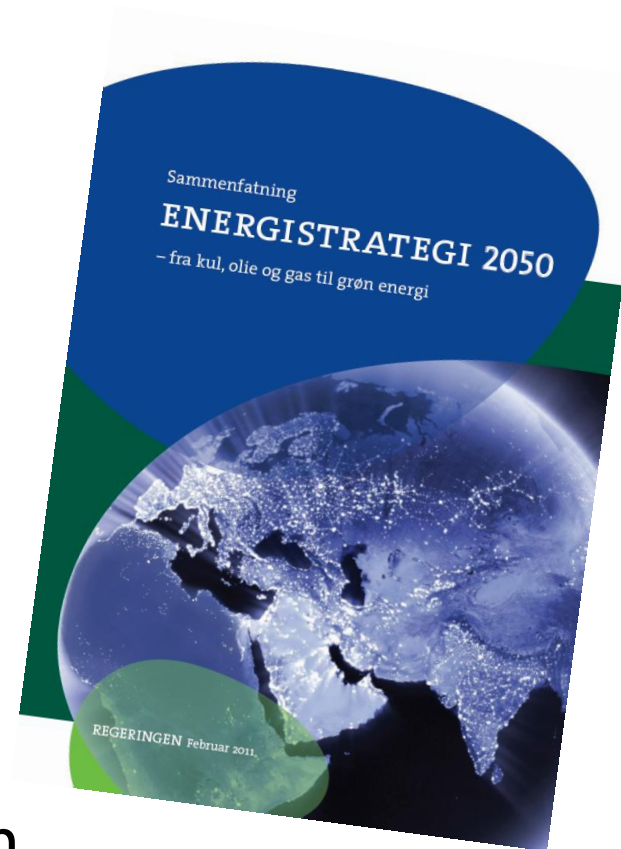
Outline

- Introduction
- Extensive renovation
– how?
- Results



Introduction

- Danish Energy Strategy for 2050 (Feb. 2011)
- From coal, oil and gas to renewable energy, requires
 - Save 50% on the heat consumption in existing buildings
 - Save 75% (compared to 2009 level) on energy consumption in new buildings in 2020



EnergiParcel – New energy for your home



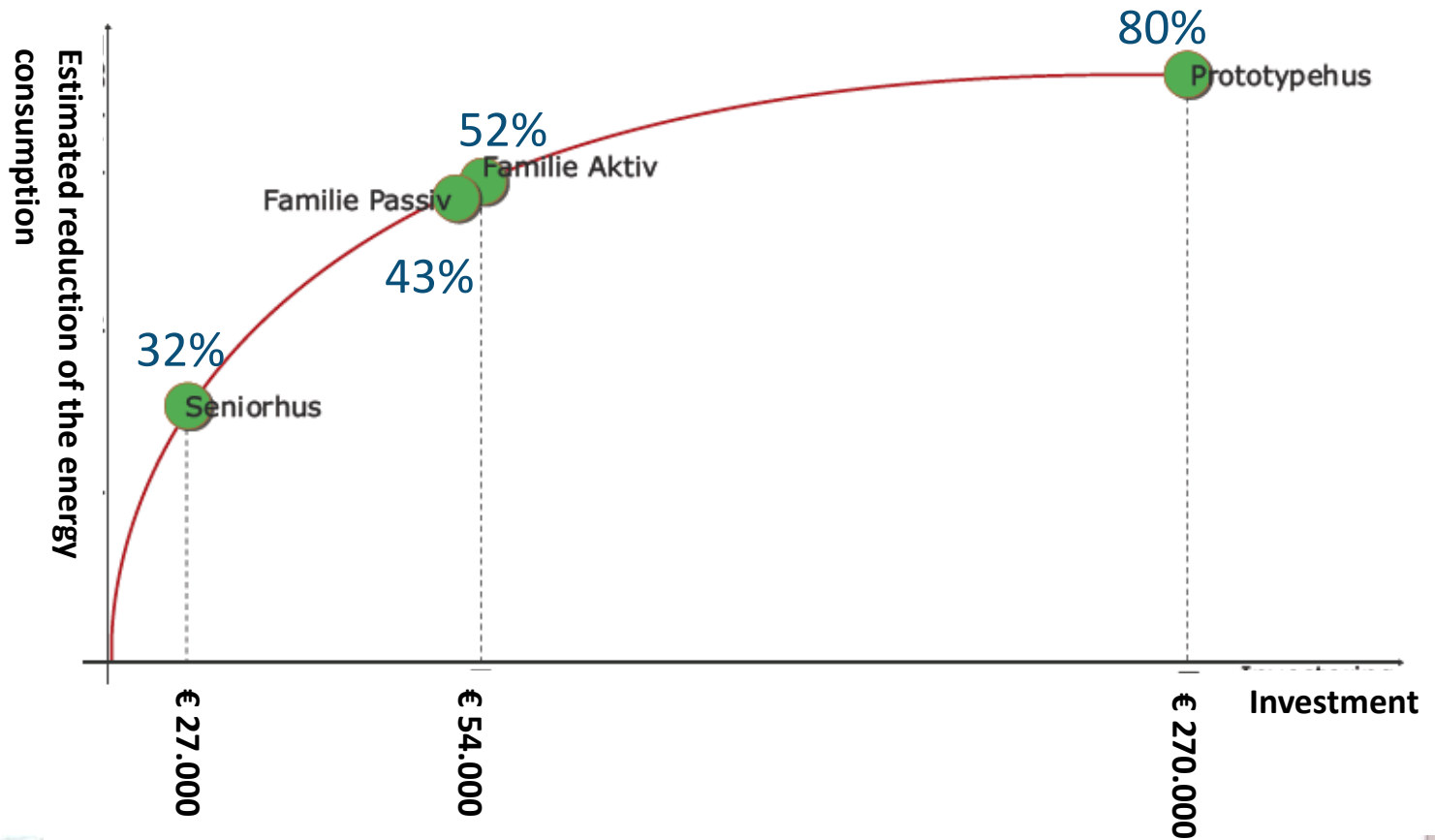
- Energy renovation of four Single family homes in Tilst near Århus
- Measurements of Indoor Environment & Energy consumption before and after renovation
- 2008-2012
- Supported financially by



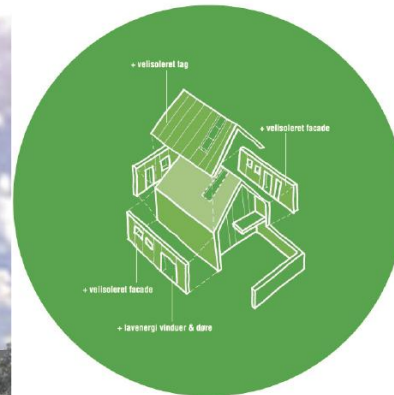
EnergiParcel – New energy for your home



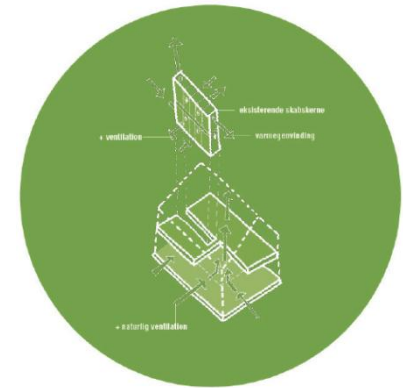
Expected savings



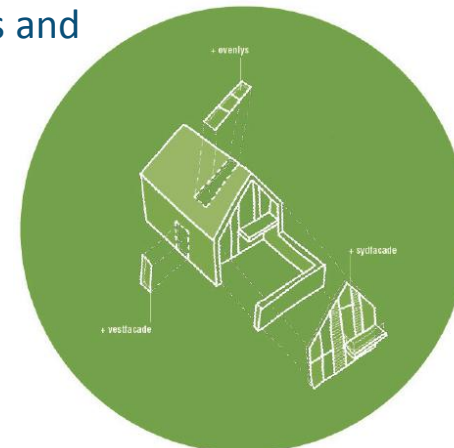
The renovated house



New facades, roof, windows and doors



Combined natural and mechanical ventilation

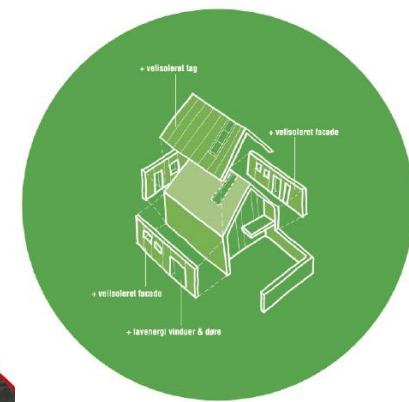


Optimized use of daylight



New facades

- Constructions

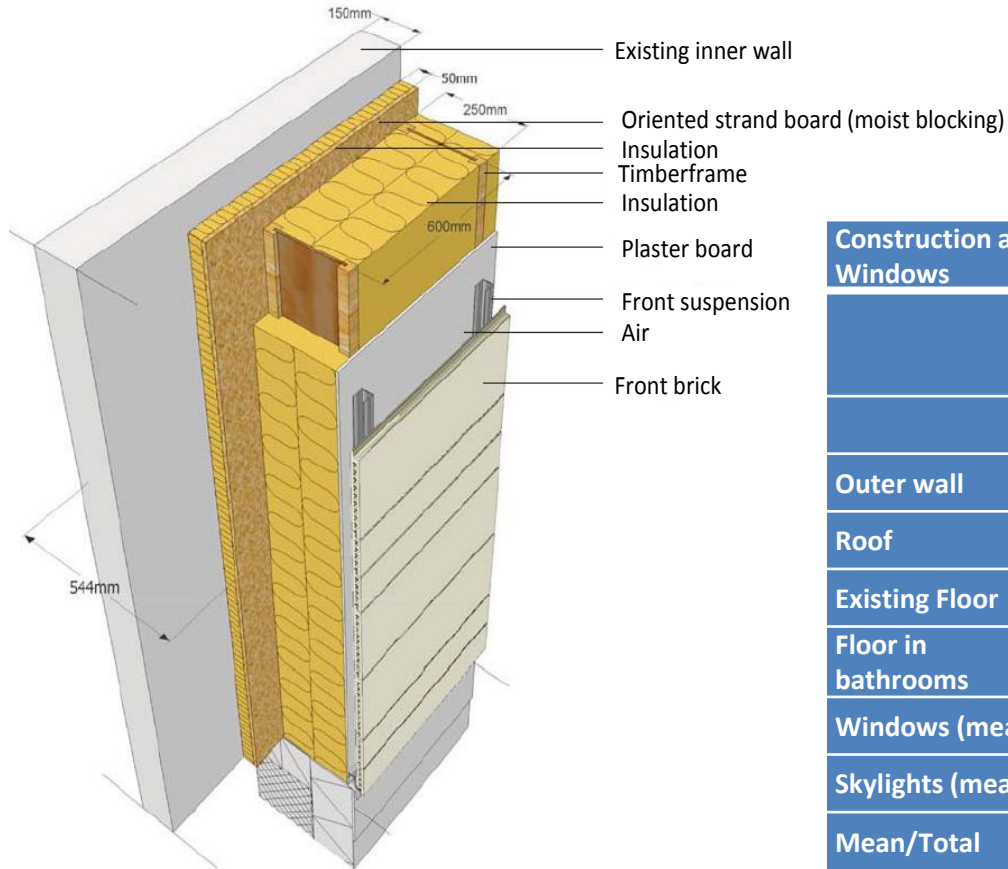
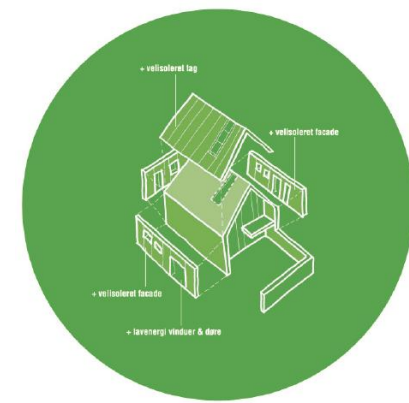


- The outer part of the existing cavity wall was torn down
- New façade was constructed on the outside of the bearing inner wall



New facades

- Constructions



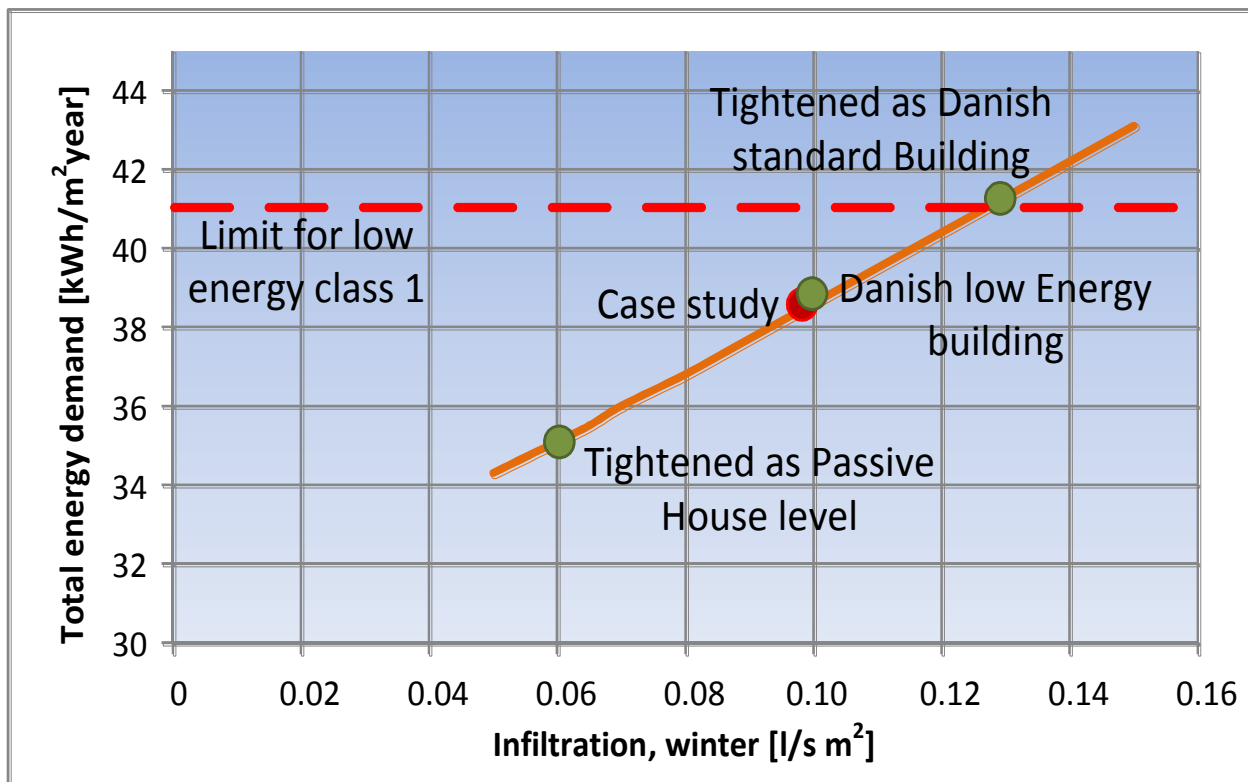
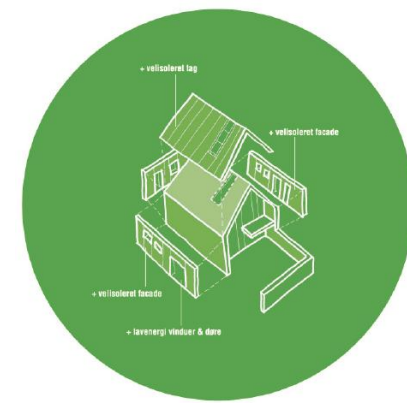
Construction and Windows	Before renovation		After renovation		
	U-value	Heat loss façade	U-value	Heat loss façade	Reduction in heat loss
	W/m ² K	%	W/m ² K	%	%
Outer wall	0.42	17%	0.117	10%	72%
Roof	0.31	14%	0.092	12%	61%
Existing Floor	0.3	9%	0.3	21%	0%
Floor in bathrooms	0.3	1%	0.11	0%	63%
Windows (mean)	2.8	53%	0.96	46%	62%
Skylights (mean)	2.8	6%	1.2	10%	23%
Mean/Total	0.72	100%	0.28	100%	55%



New facades

- Airtightness

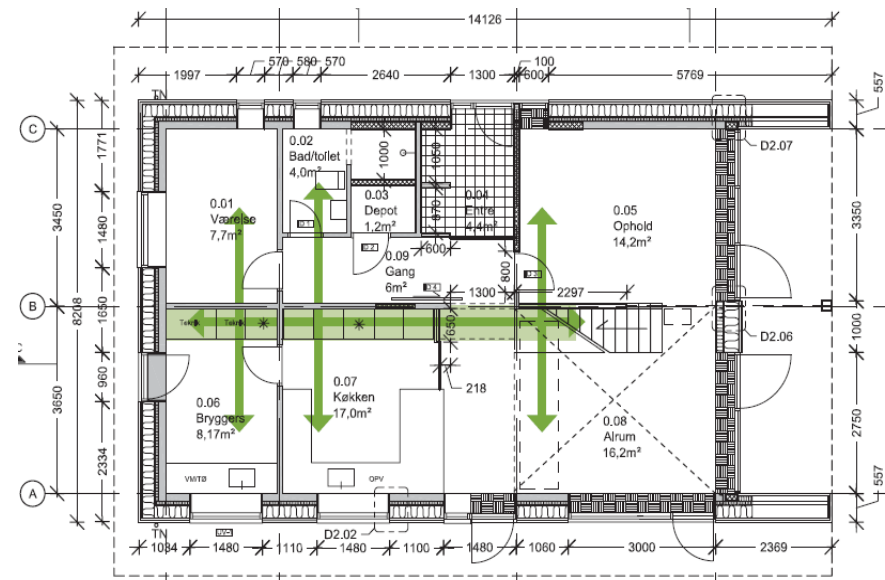
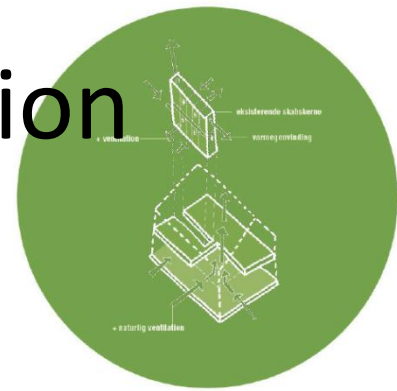
- Test result with 50 Pa: 0.97 l/s per m²



Combined nat. & mech. ventilation

- Installation

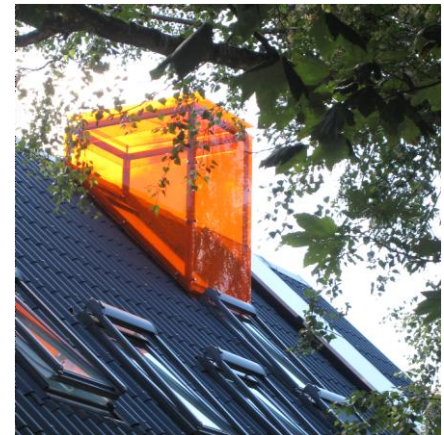
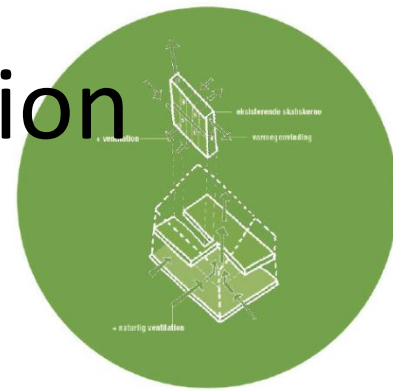
- Great challenge to install mechanical ventilation into an existing building
- Counter flow heat exchanger with a dry efficiency of approx. 90%
- Minimized pressure drop



Combined nat. & mech. ventilation

- Strategy

- Combined mechanical (winter) and natural (summer) ventilation
- “Solar chimney” is used with the natural ventilation

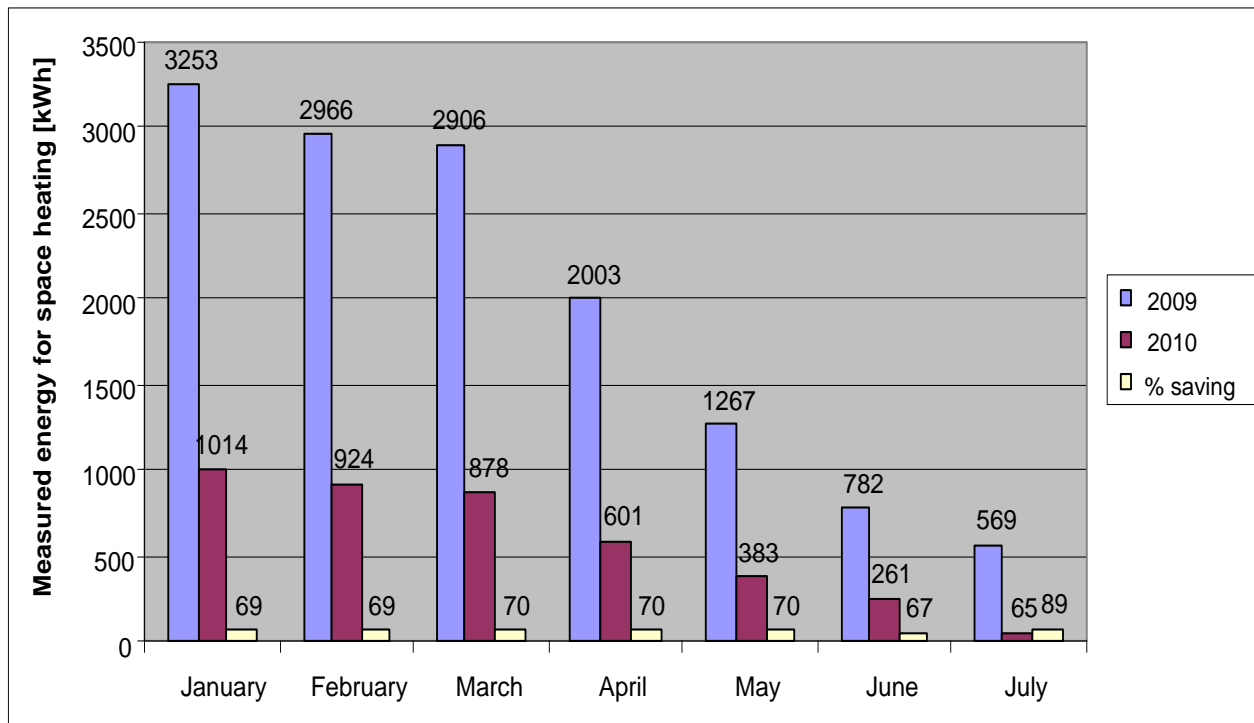


Results

- Energy consumption



Total energy consumption was reduced with 69%

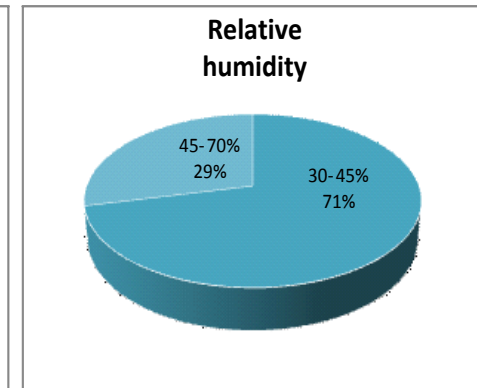
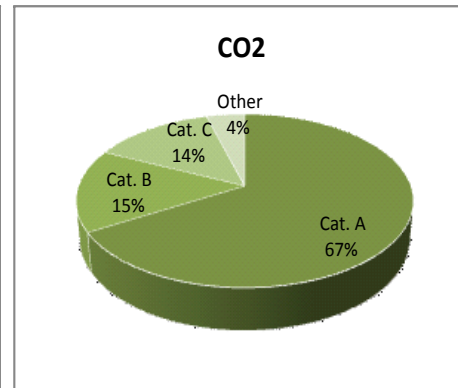
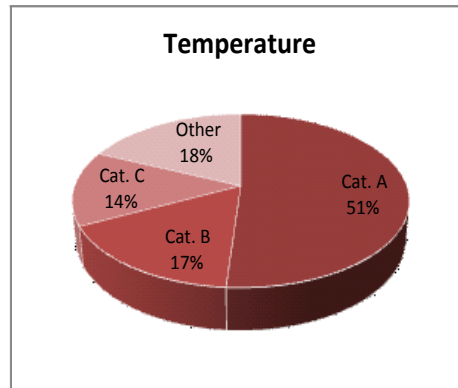


Results

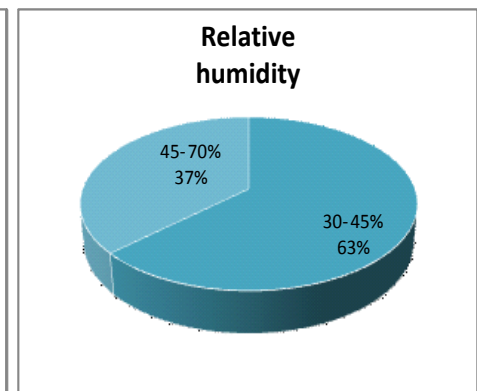
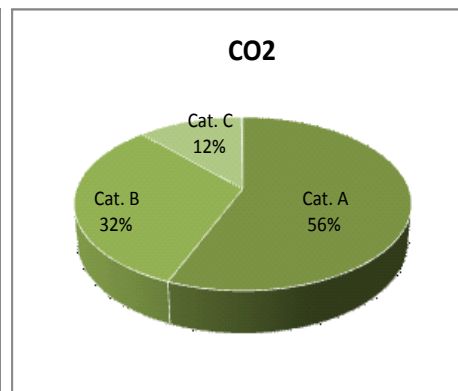
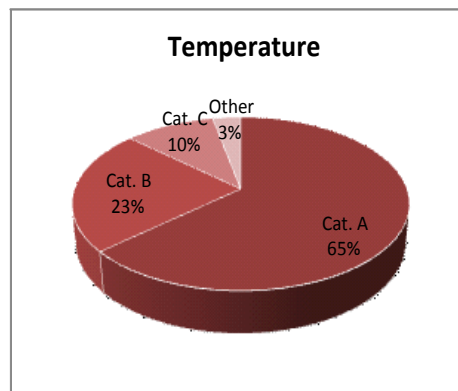
- Indoor environment (based on CR1752)



Before renovation:



After renovation:



Temperature - better
CO₂ - better
RH - unchanged

Summer:

A: 23,5 – 25,5°C; B: 23,0 – 26,0°C; C: 22,0 – 27,0°C A: CO₂ < 830 ppm; B: CO₂ < 1030 ppm; C: CO₂ < 1560 ppm;

Vinter:

A: 21,0 – 23,0°C; B: 20,0 – 24,0°C; C: 19,0 – 25,0°C

Discussions

- We need to have heavy reductions on the energy consumptions for domestic buildings
- The technology is there, but still it is too expensive to make these extensive renovations
- Further development of existing technologies, new technologies and optimized economical solutions for renovation are needed





Questions?

