A low-energy Building under Arctic Conditions

Experiences After Five years of Operation

Martin Kotol

NSB 2011

9th Nordic Symposium on Building Physics

Agenda

- Introduction
- Construction of the house
- Results
- Problems
- Conclusions

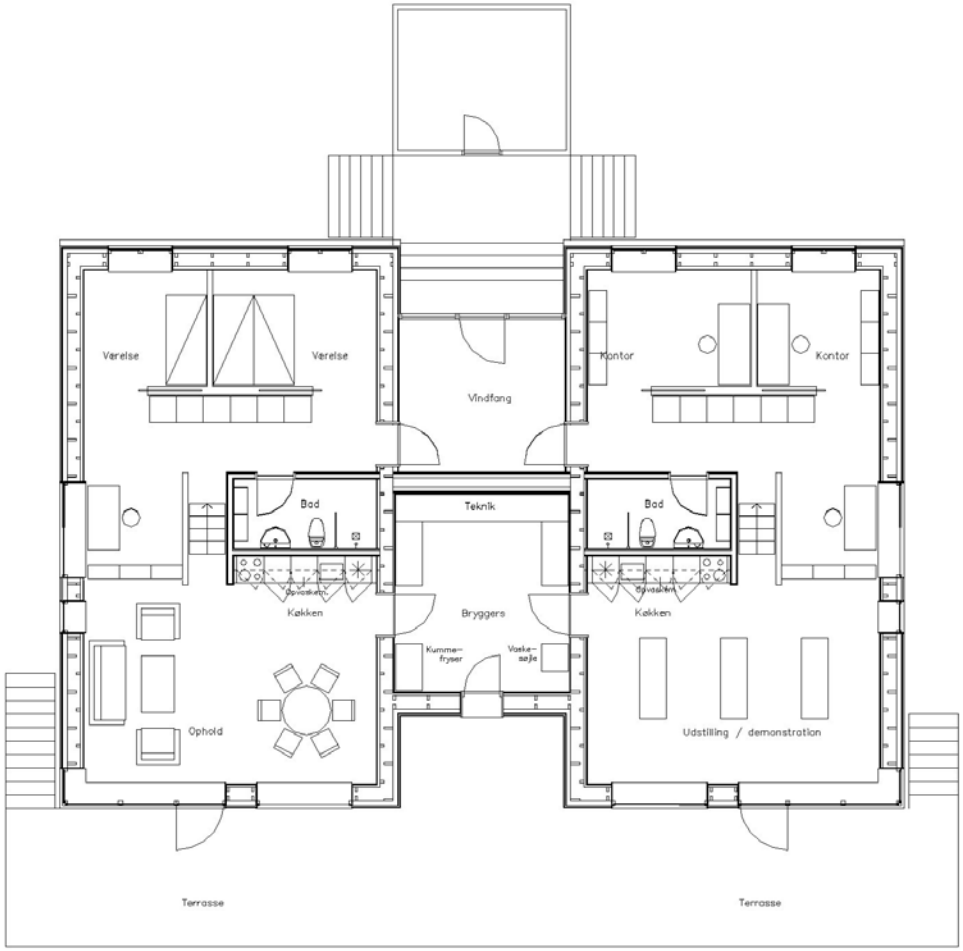
Low Energy House Sisimiut

- Built in 2005 in Sisimiut, Greenland
  (42km north of polar circle)
- Semi detached house
  (197 m^2 total floor area)
- Objectives
  - Low energy consumption
    80 kWh/(m^2·yr)
  - Good IAQ
  - Advanced technologies

A low-energy Building under Arctic Conditions

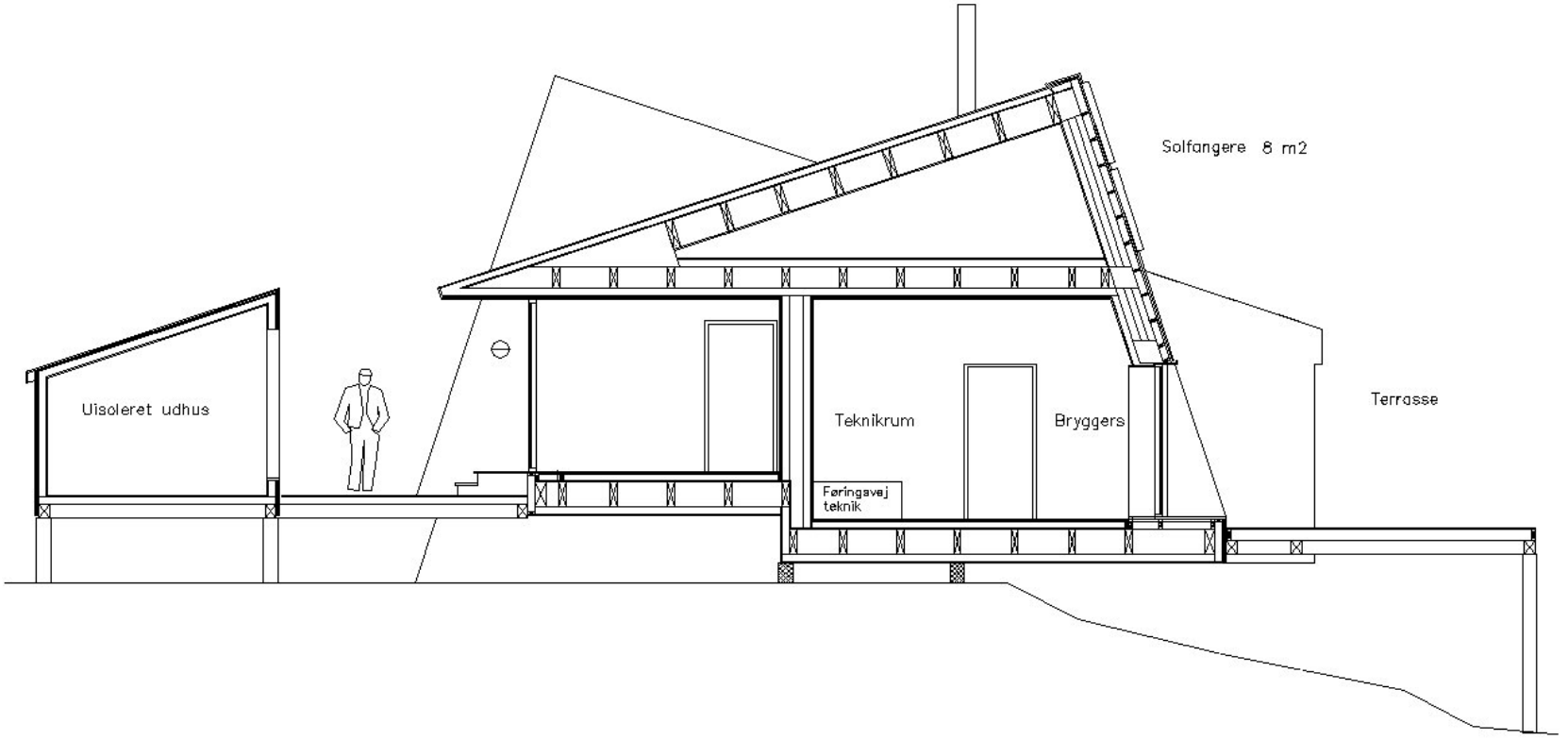
Experiences After Five years of Operation

- Well insulated envelope
- Air tight
  - n_{50}=1
- Minimal thermal bridges
- Three types of windows
  - 1+2 pane
  - 2+1 pane
  - 2+vacuum
- Hydronic floor heating
- Oil furnace
- Solar collectors for DHW
  - 8m²
  - 57%
- Ventilation with heat recovery

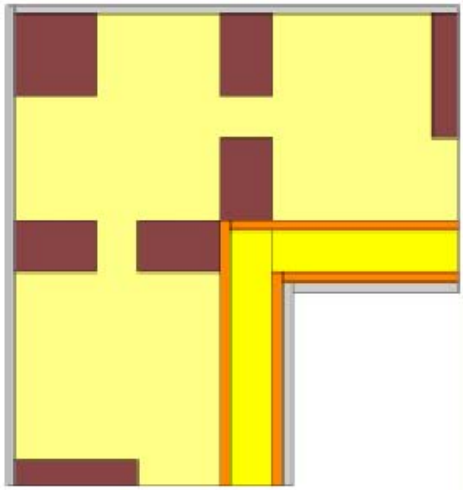


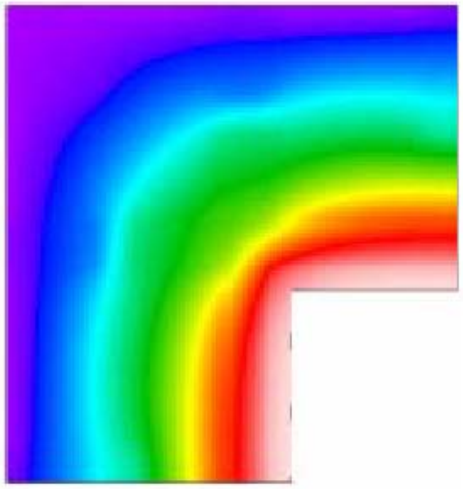
A low-energy Building under Arctic Conditions

Experiences After Five years of Operation



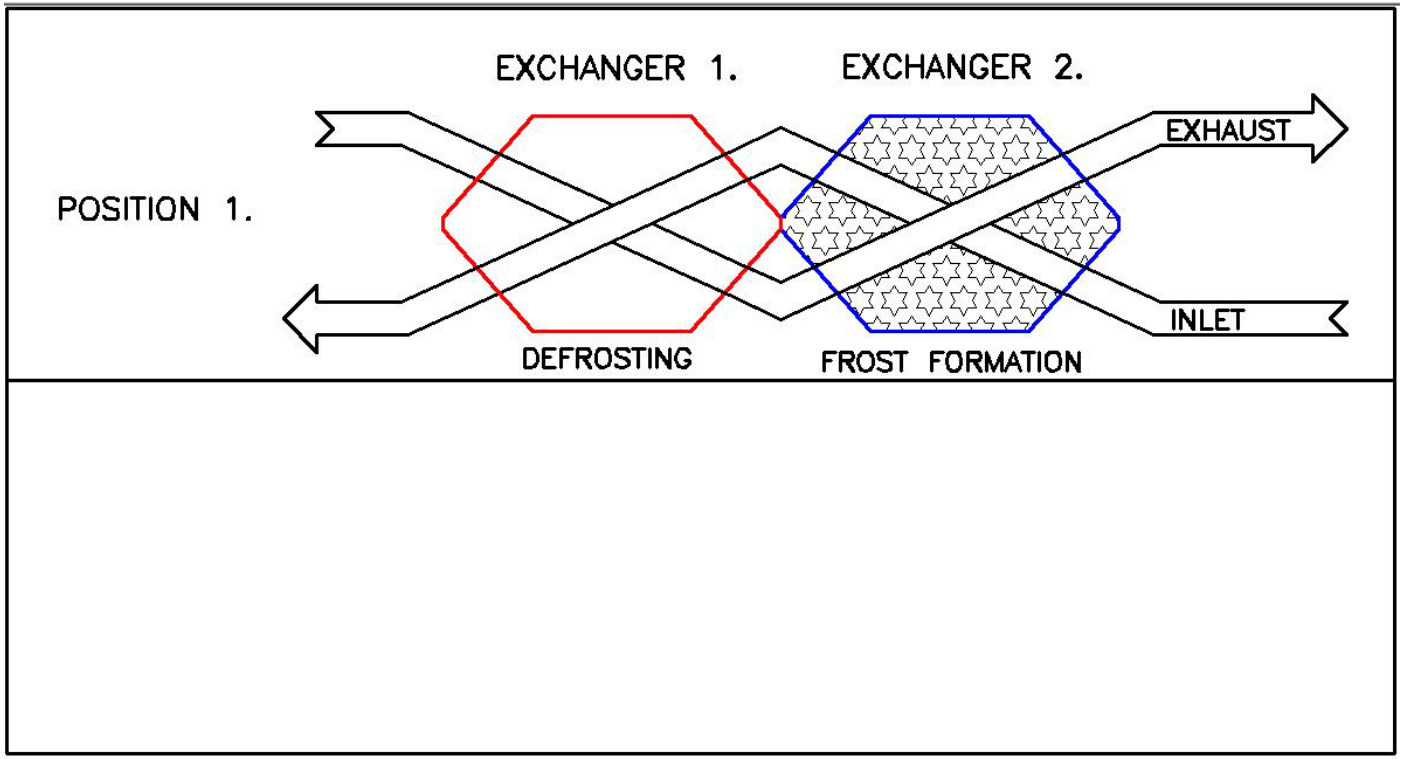
Double wall construction





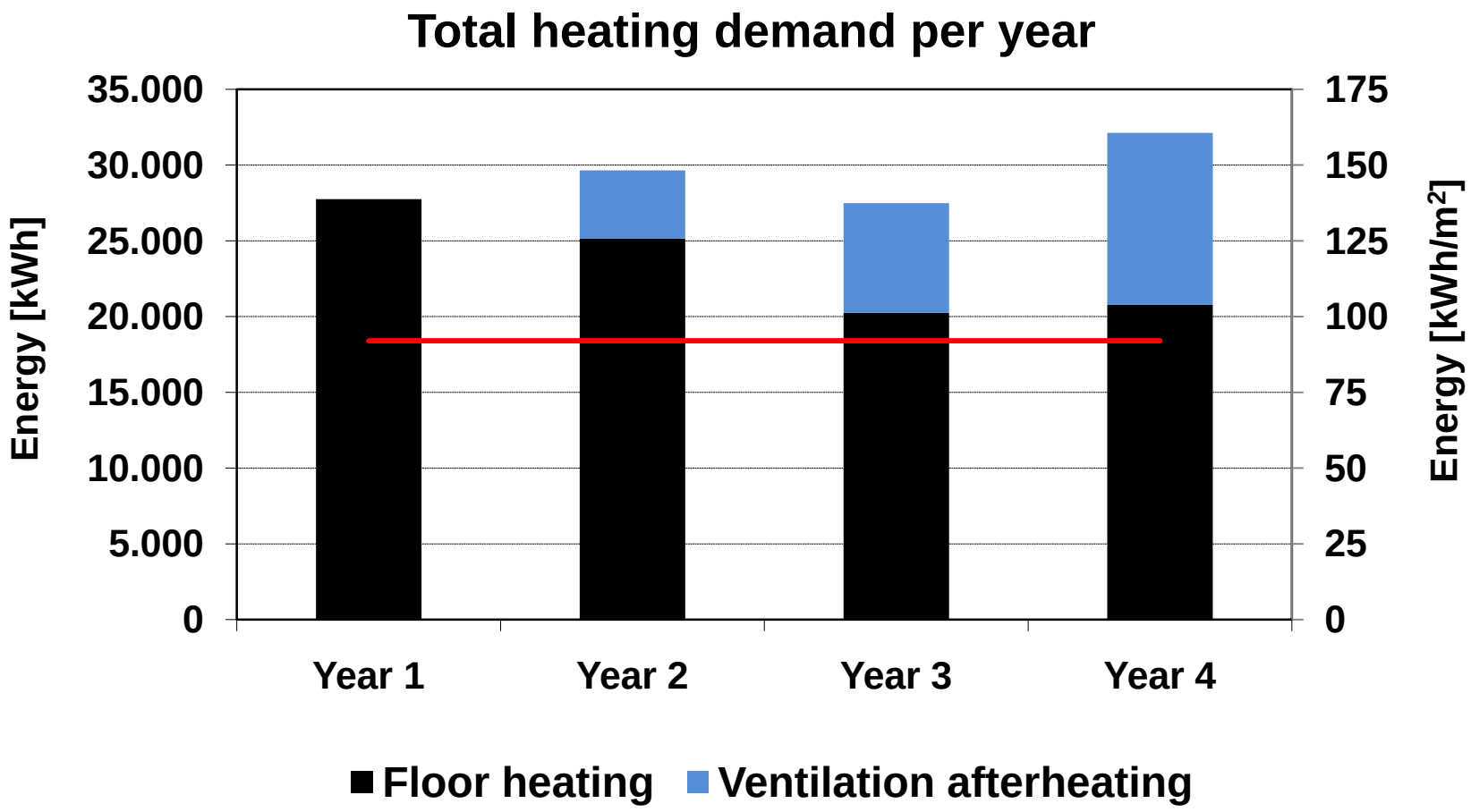
Construction	Insulation thickness [mm]	U-value [W/(m²·K)]
Walls	300	0.15
Ceiling	350	0.13
Floor	350	0.14
Windows		1.0 – 1.1

Unique heat exchanger developed at DTU



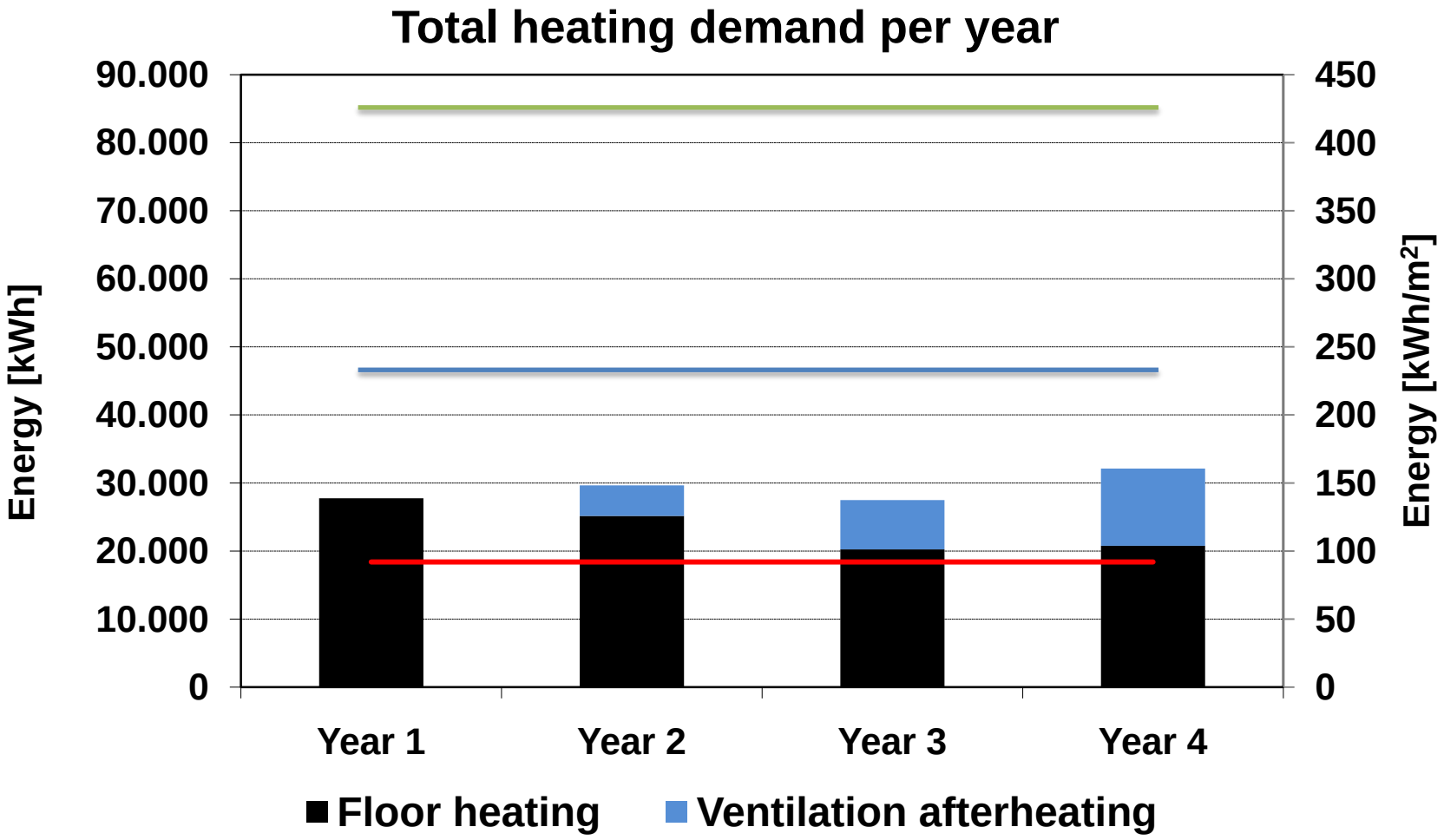
A low-energy Building under Arctic Conditions

Experiences After Five years of Operation



A low-energy Building under Arctic Conditions

Experiences After Five years of Operation



Experienced problems and solutions

- Higher indoor temperature
  - 23°C instead of 21°C
- Heated entrance
- Air tightness
  - n_{50}=1
  - n_{50} in 2009=3,29
  - n_{50} in 2010=2,96
  - n_{50} in 2011 =2,74
  - Explored leakages sealed
- Water leakages around the windows
  - New cladding of the facade, Summer 2010

Experienced problems and solutions

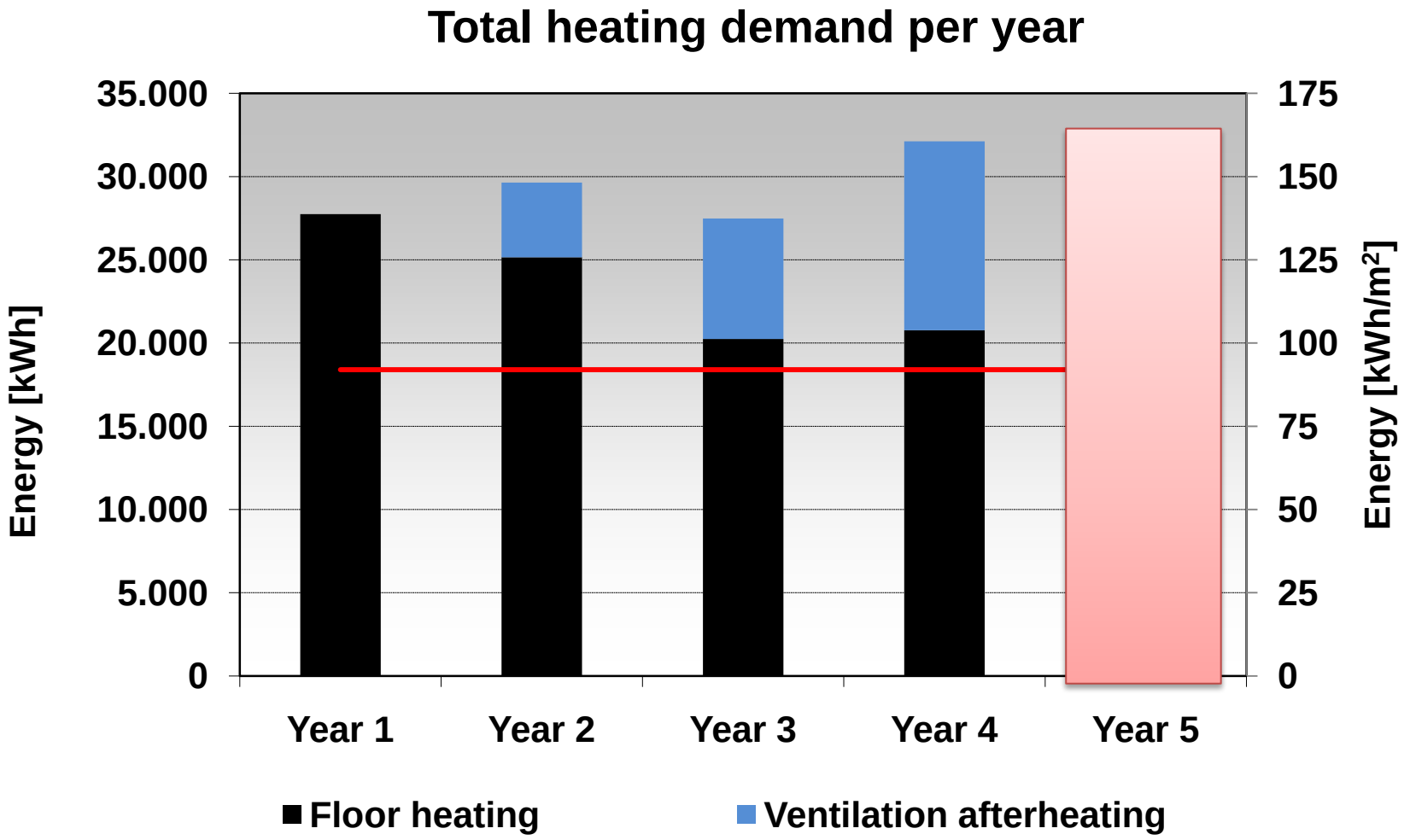
- Excess of the solar heat in the summer
  - Additional heater (cooler) put to the entrance (crawl space)
- Thermosyphoning
  - Electromagnetic valve installed in December 2009
- Incorect setting of the heating coil in the ventilation system
  - Set point of 20°C from December 2010
- High heat loss from ventilation ducts
  - Additional 120 mm of thermal insulation added in Fall 2009
- Malfunction of the switching damper inside HE
  - Mended in December 2009

A low-energy Building under Arctic Conditions

Experiences After Five years of Operation

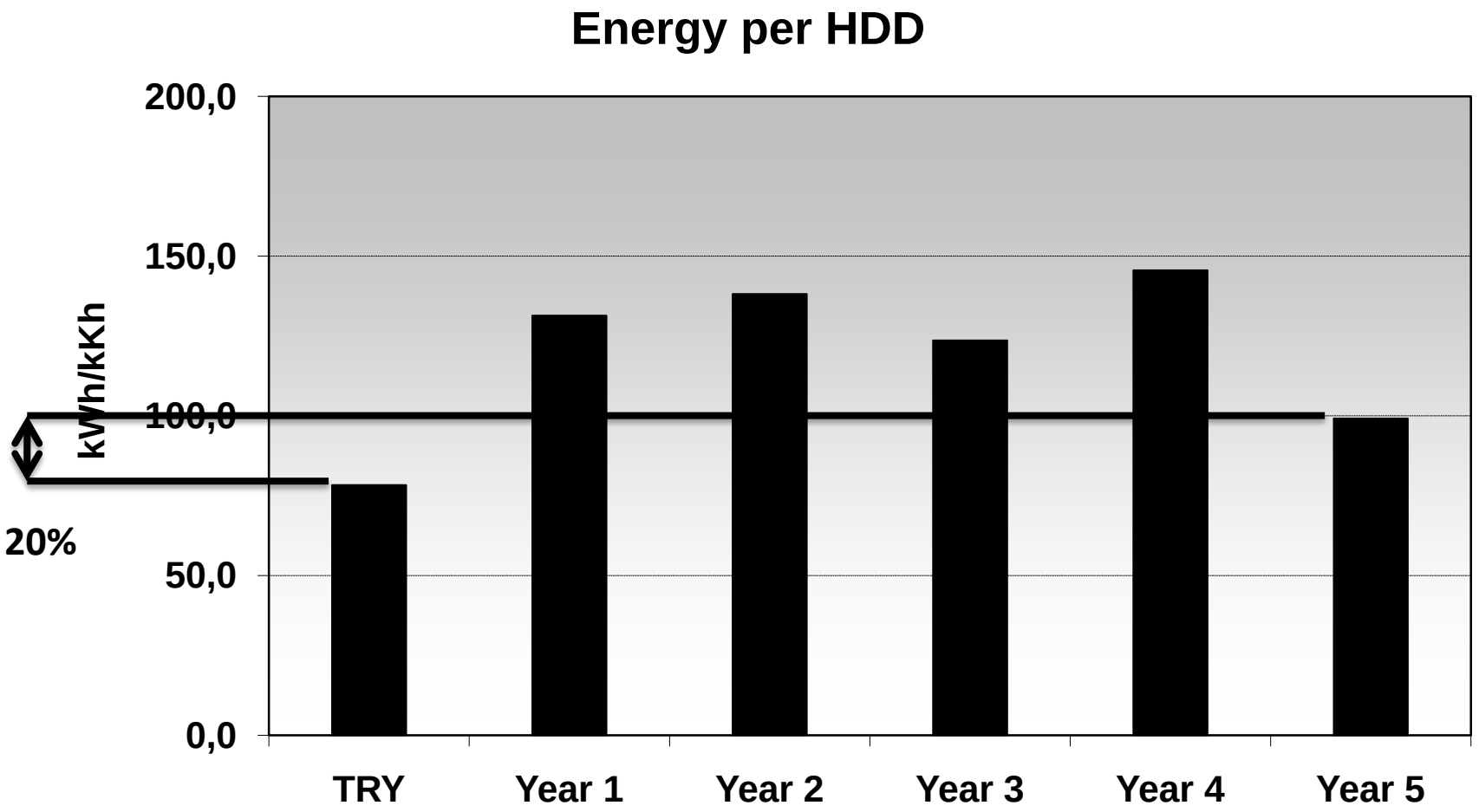
A low-energy Building under Arctic Conditions

Experiences After Five years of Operation



A low-energy Building under Arctic Conditions

Experiences After Five years of Operation



Conclusions

- It is possible to build energy efficient buildings in the arctic regions
- Problems uncommon in milder climates might appear
- Technologies used must be simple and easy to repair in case of malfunction

A low-energy Building under Arctic Conditions

Experiences After Five years of Operation

Thank you for your attention!

Unique heat exchanger from DTU