

Paper No. 8-144-19

How to implement energy management in a university organization

M.Sc. Energy consultant

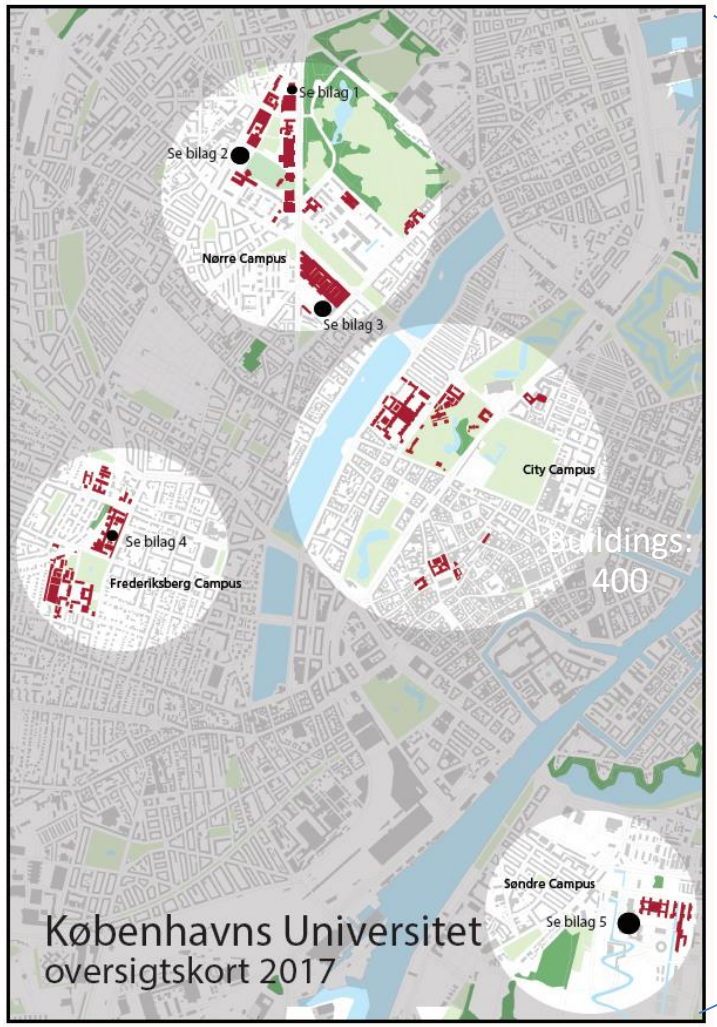
Anne Svendsen, Viegand Maagoe, Denmark

Agenda

1. Presentation of University of Copenhagen
2. Sustainability Strategy for University of Copenhagen
3. Energy Management at the University of Copenhagen
4. Example of energy optimisation

UNIVERSITY OF COPENHAGEN

University of Copenhagen





Established: 1479

Buildings: approx. 400

Students: 38 500 , Employees: 9 000

Total area: 900 000 m^2

Heated area: 400 000 m^2

2008:

1. Energy plan: 2008-2013: 20% (to 2006)

2014:

2. Energy plan: 2014-2020. Goal: 50% (to 2006)

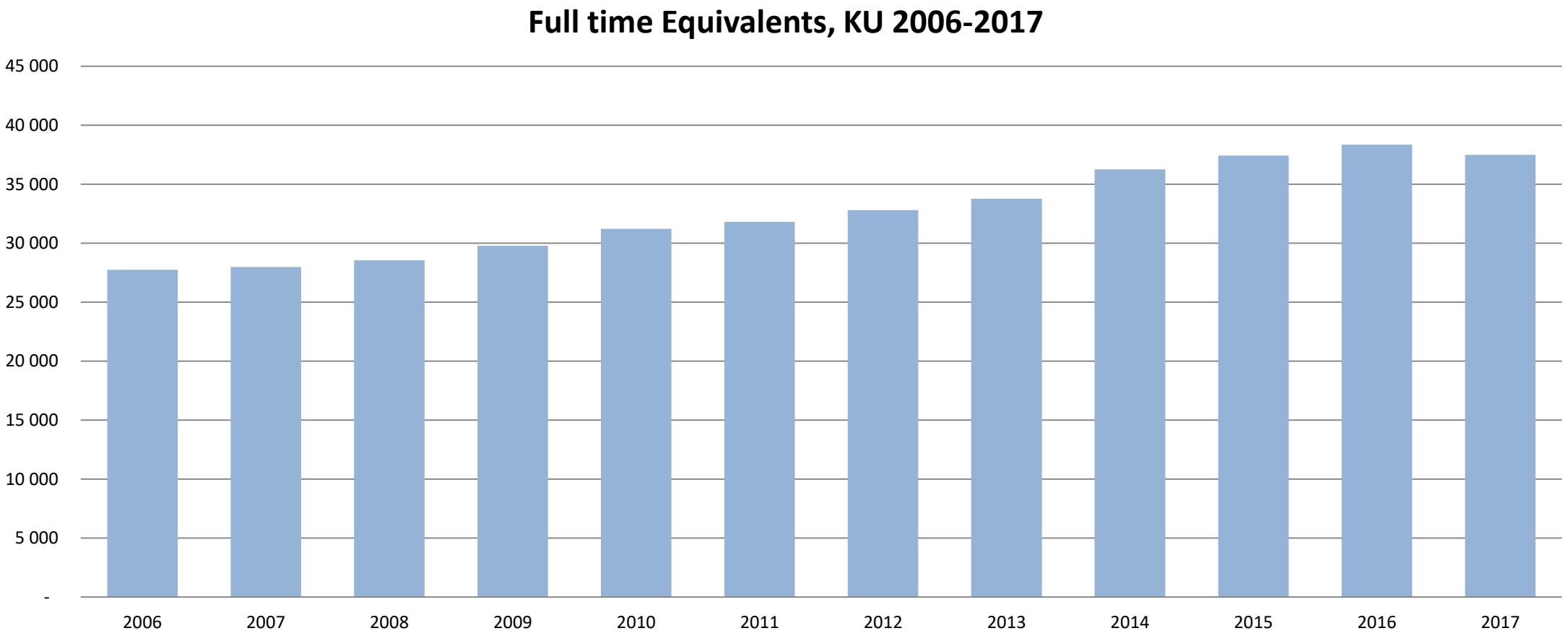




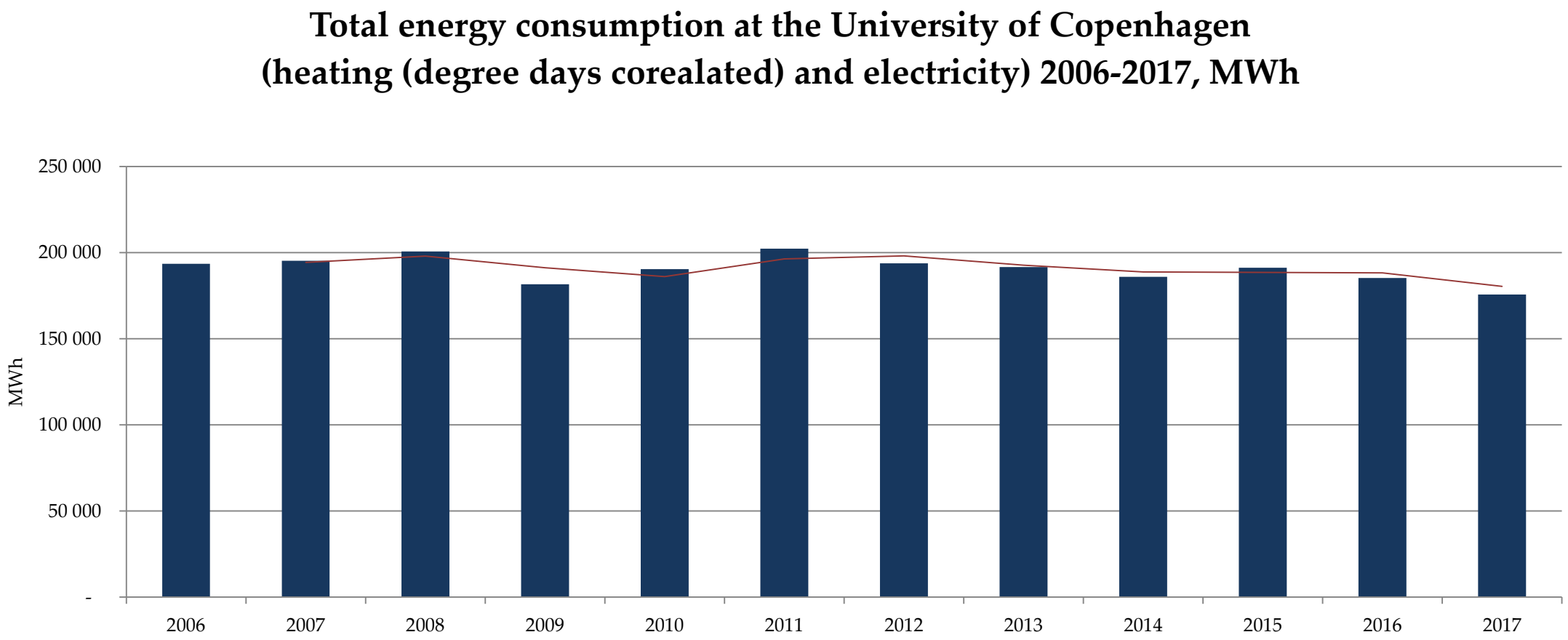


The University consists of many different types of building types

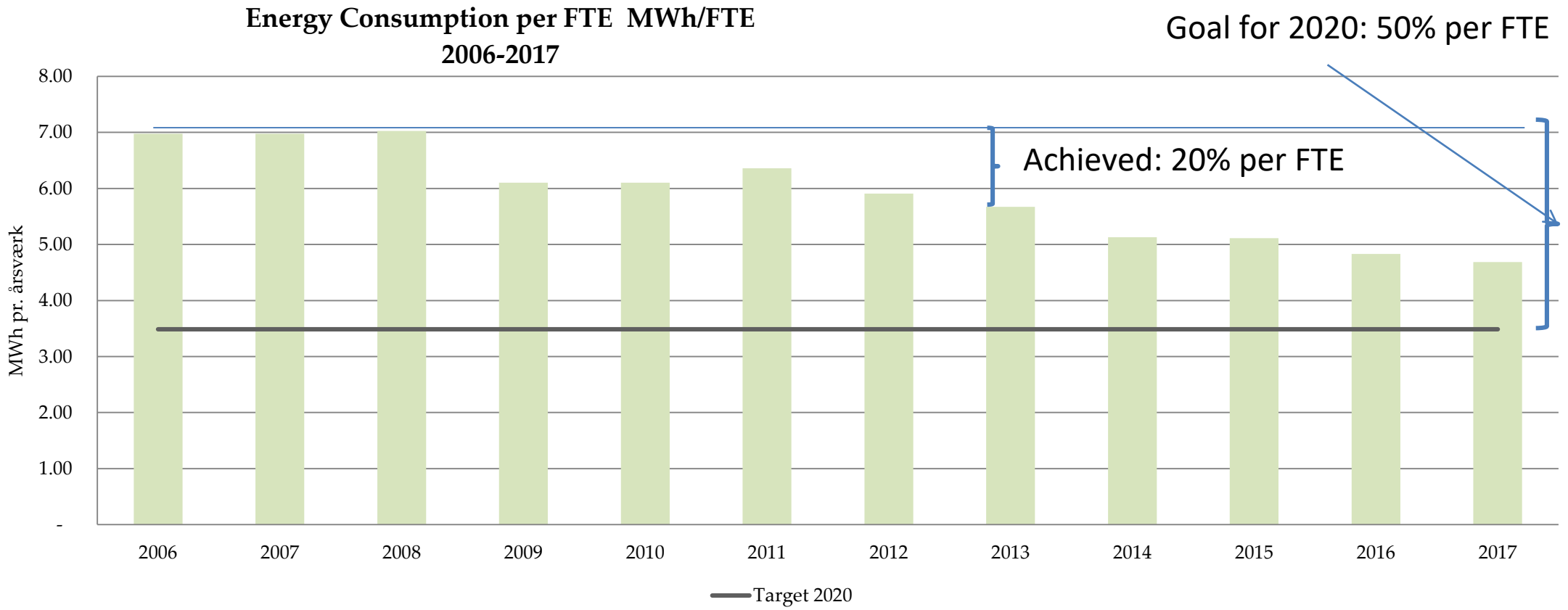
The development in the number of full time equivalents (FTE)



Energy consumption



Energy consumption per fultime equivalent



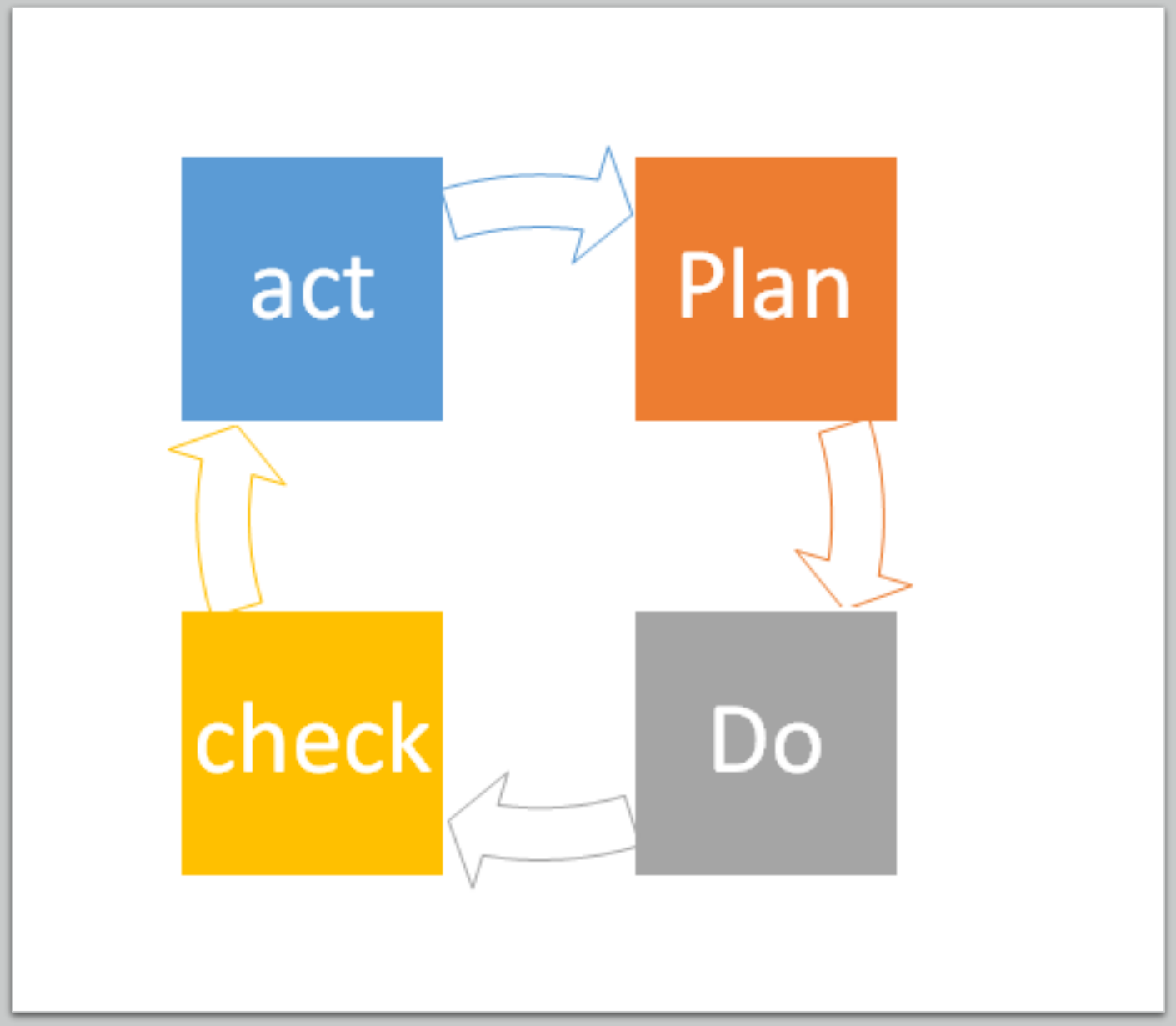
Mile-stones for sustainability and energy efficiency





Energy managment

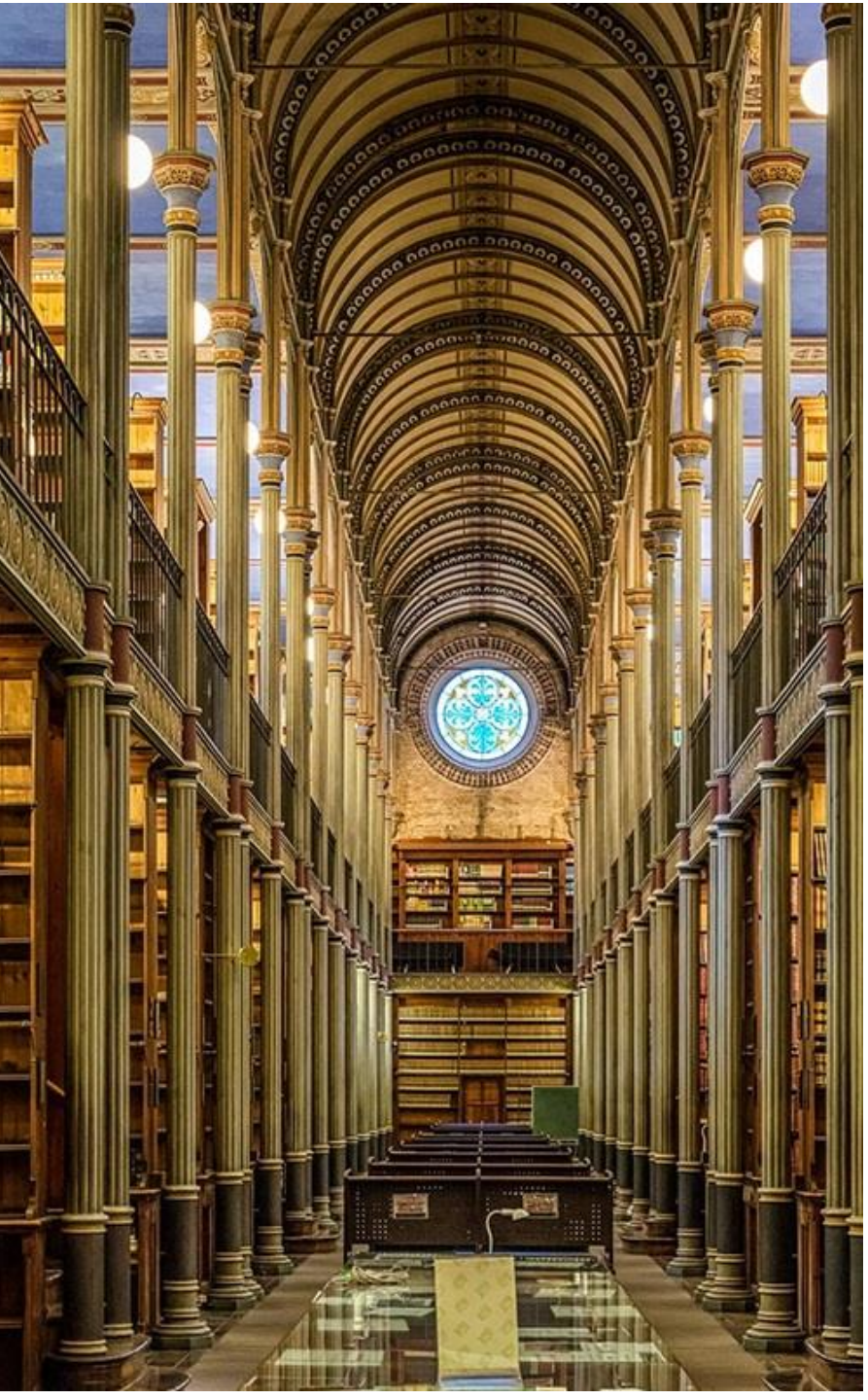
- In 2016 a strategic process on energy managment was initiated based on the principles from iso 50.001.





Proces for energy managment

- **Organization**
- **Energy baseline (EB)**
- **Analysis and evaluation of energy saving potential**
- **Use of KPI’s and data**
- **Action plan**
- **Follow up**
- **Planning**



Challenges :

1: Management and organization

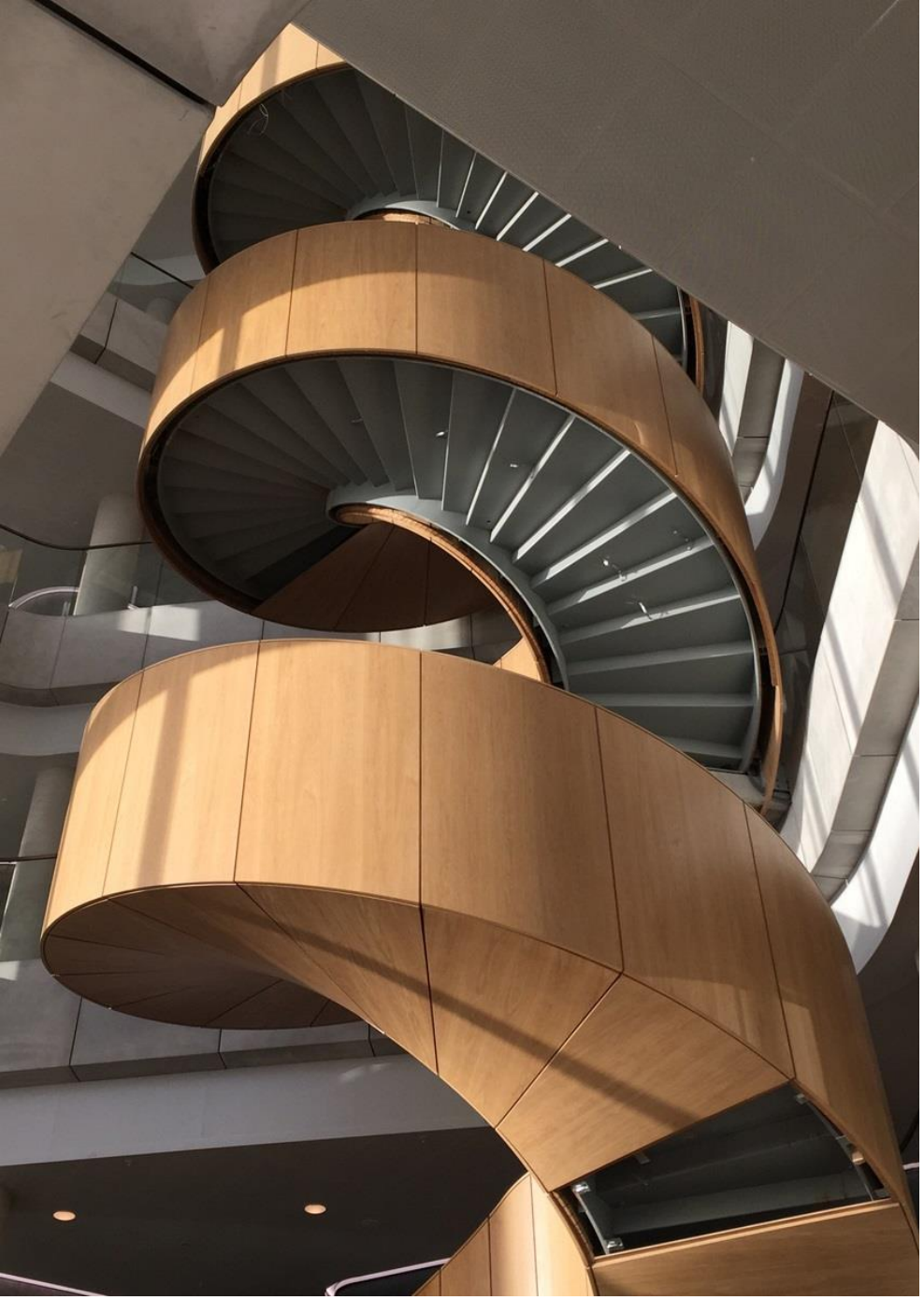
2: Baseline

3: Financing



Where are the energy saving potentials :

- Heating, cooling
- Lighting
- Ventilation
- Lab equipment (ULT freezers etc)
- Pressurized air
- Pumps
- *Insulation of roofs and walls*
- *Replacement of windows and doors*



Action plan:

Focusing on ventilation

- It is assessed that about 20-25 % of the total energy is used for ventilation (both heating and electricity).
- Two types of ventilation; comfort ventilation and process ventilation/laboratory ventilation
  - **Comfort ventilation:** offices, education rooms and auditoriums:
  - **Process ventilation:** mostly laboratories

The optimal situation is when the two systems are clearly separated, and the operation times are according to the function of the room and the actual needs. Otherwise, if the ventilation systems are on 24 h. per. day the result is a very large energy consumption.



Optimisation of ventilation:

- Split heating/cooling and ventilation
- Ventilate according to the function and the use of the rooms:
  - **Comfort ventilation:** according to occupancy
  - **Process ventilation:** according to presence of e.g. chemicals



Approach:

Further investigation when:

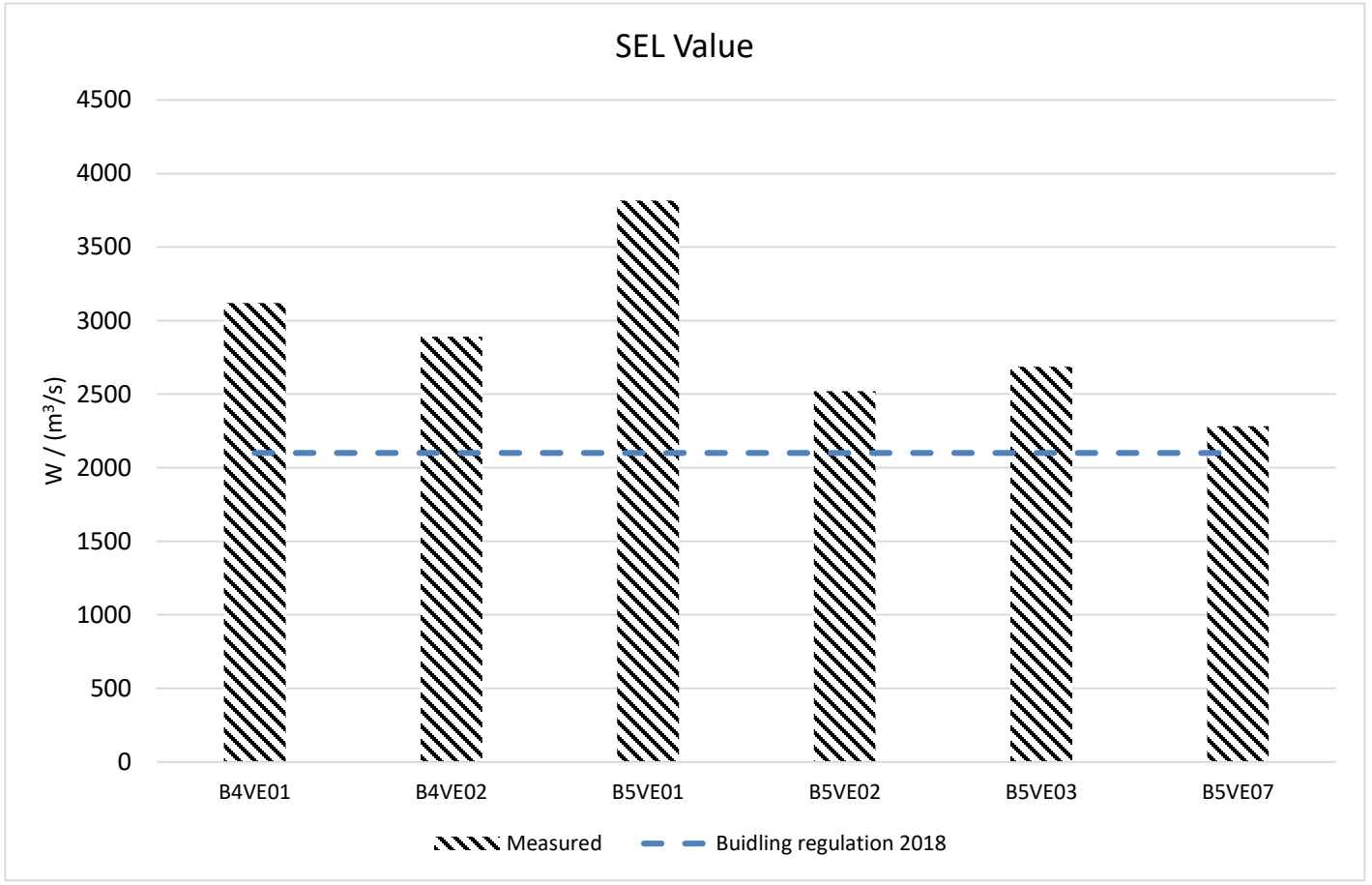
- the ventilation system is more than 10 years old
- there is no heat recovery, or the efficiency of heat recovery is low
- the energy consumption per air volume (SEL factor) is high or has increased over a period
- the function of the rooms supplied from the ventilation system has changed
- the ventilators have a low efficiency (old fans with low efficiency / belt driven fans / ac fans)
- it is not possible to control the ventilation according to occupancy
- the occupancy pattern has changed (e.g. from classrooms to office locations or laboratory)
- The ventilation system operation time is very high
- When the energy consumption is high



Example, analysis of five ventilation systems:

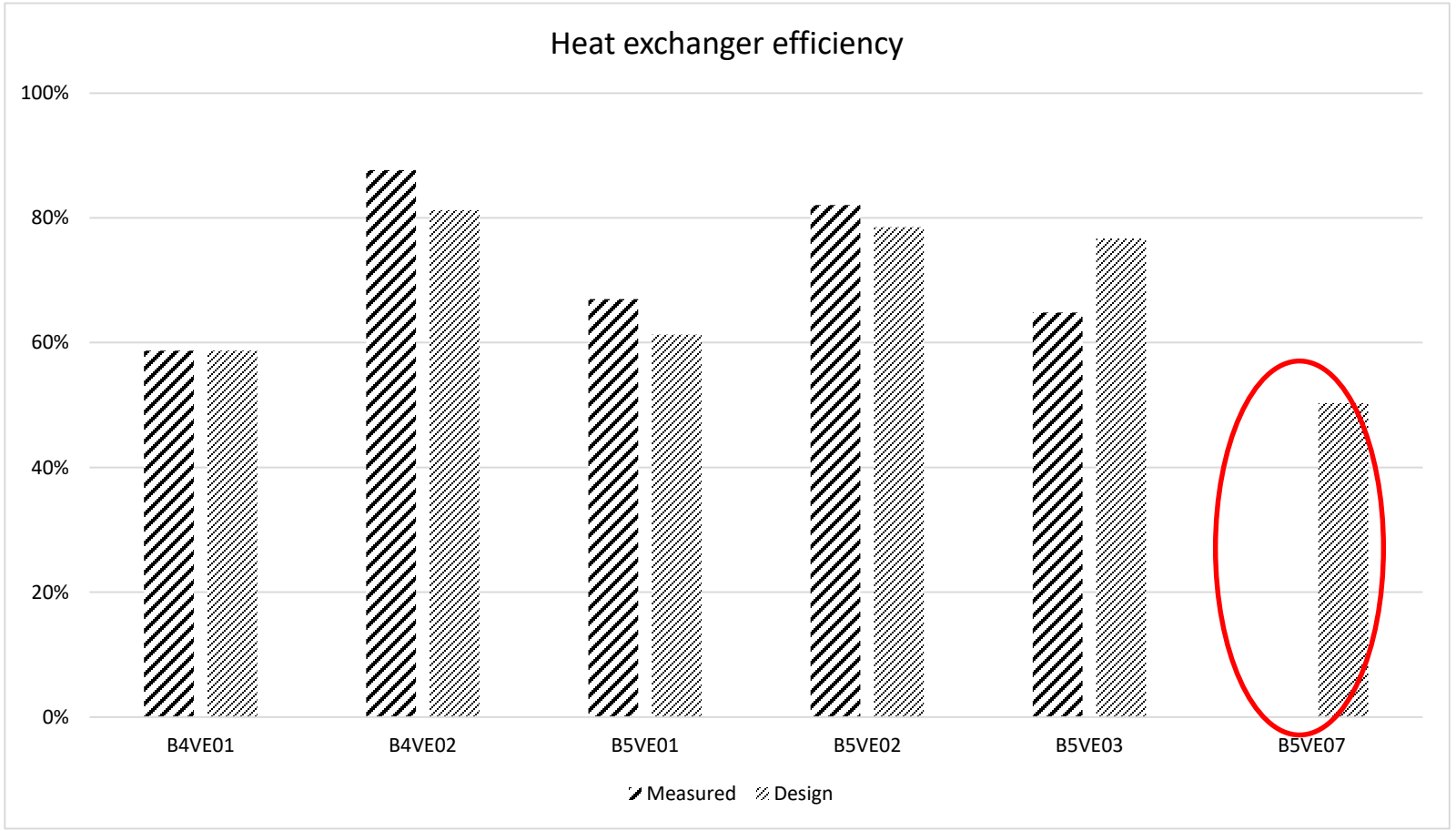
- *Are there faults in the system*
- *What are the actual needs*
- *What are the ventilated air rates*
- *What is the overall efficiency of the ventilation system, the heat exchanger*
- *Is the pressure in the ducts sufficient or too high?*
- *Are the correct filter types being used?*
- *Is heat recovery system installed. Is it possible to measure the efficiency of the heat recovery system?*
- *Can meters, instrumentation and controls be improved? is there a need for increased monitoring / meters?*
- *Is everything registered correct in the BEMS and are the regulations functioning as expected?*

Overall system efficiency



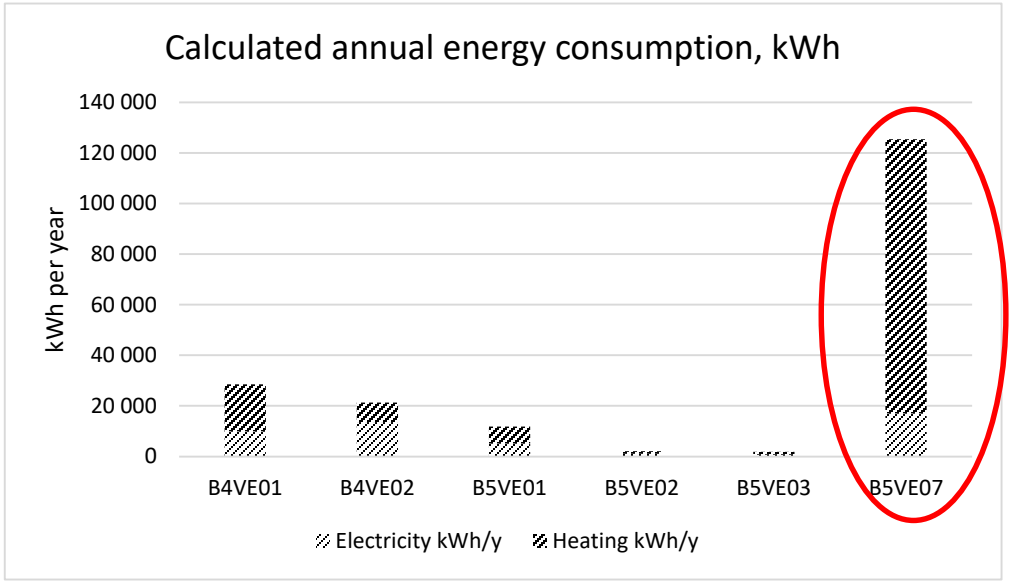
$$SEL = \frac{\dot{P}_{in} + \dot{P}_{out}}{\max(\dot{V}_{in+}\dot{V}_{out})}$$

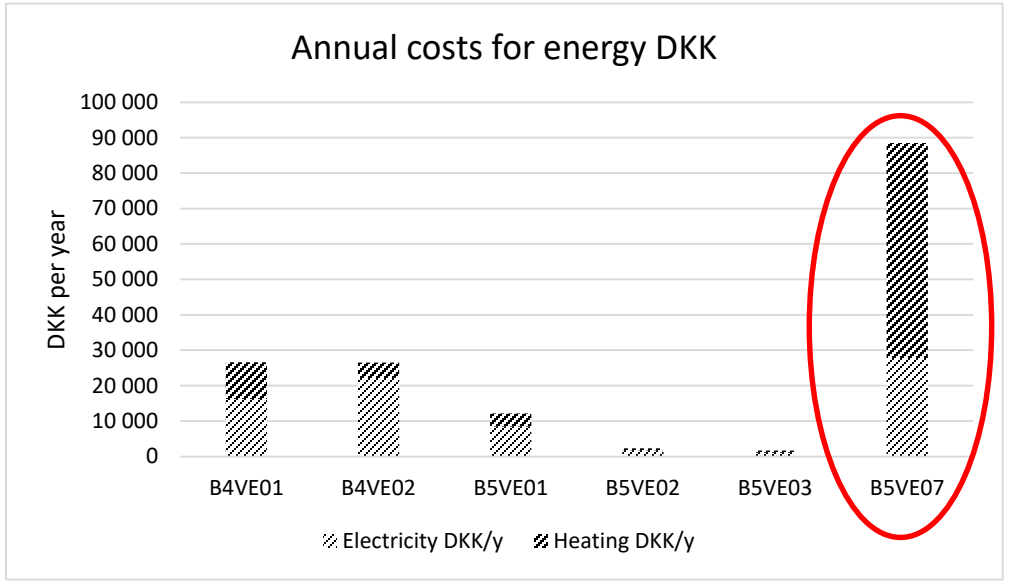
Efficiency of the heat exchangers



$$\eta_{heat\ exchange} = \frac{T_{in} - T_{out\ door\ air}}{T_{out} - T_{out\ door\ air}}$$

Annual energy consumption and costs





Action: repair the pump for the heat exchanger.
Payback period very low, less than one year.
Annual savings of approx. 11.400

Thank you for your attention

- Questions?

Anne Svendsen
info@viegandmaagoe.dk
Tel: +45 33 34 90 00

viegand maagøe
energy people

- Anne Svendsen
- Civil engineer, M.Sc. Energy Efficiency, +25 years of experience
- Working for consulting company Viegand Maagoe, Copenhagen
- Consultants for the University of Copenhagen on energy management

viegand
maagøe
energy people