Innovative retrofit to improve energy efficiency in public buildings

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- Information about the EU project BRITA in PuBs
- Demonstration building: Borgen Community Centre, Norway
- Demonstration building: Prøvehallen, Denmark
- Discussion

ecobuildings

- EU's Sixth Framework Programme announced calls for proposals within the field of Sustainable Energy Systems – Ecobuildings

- Four projects awarded finance:
  BRITA in PuBs, Sara, Eco-Culture, Demohouse

- The four projects include a great number demo-buildings

BRITA in PuBs | SARA | ECO-Culture | demohouse

Bringing Retrofit Innovation to Application in Public Buildings

Purpose

- The aim is to increase the market penetration of innovative and effective retrofit solutions to improve energy conservation and implement renewable energy sources, with moderate additional costs
- Public buildings of different types are chosen to reach groups of differing age and social origin. Public buildings are used as engines to heighten awareness on energy efficiency

Structure: 3 main pillars

BRITA in PuBs

Demonstration buildings:

- College
- Cultural centre
- Nursery home
- Community centre
- Church
- Library, etc.

Research work:

- Project planning needs and financing strategies
- Design guidelines
- Internet-based knowledge tool
- Quality control tool-box

Dissemination:

- Training of users and maintenance personnel
- Training of students
- Publishing the work to different target groups

Participating Countries and Demonstration Buildings

Norway: Hol

Church Hol Commune

Denmark: Copenhagen

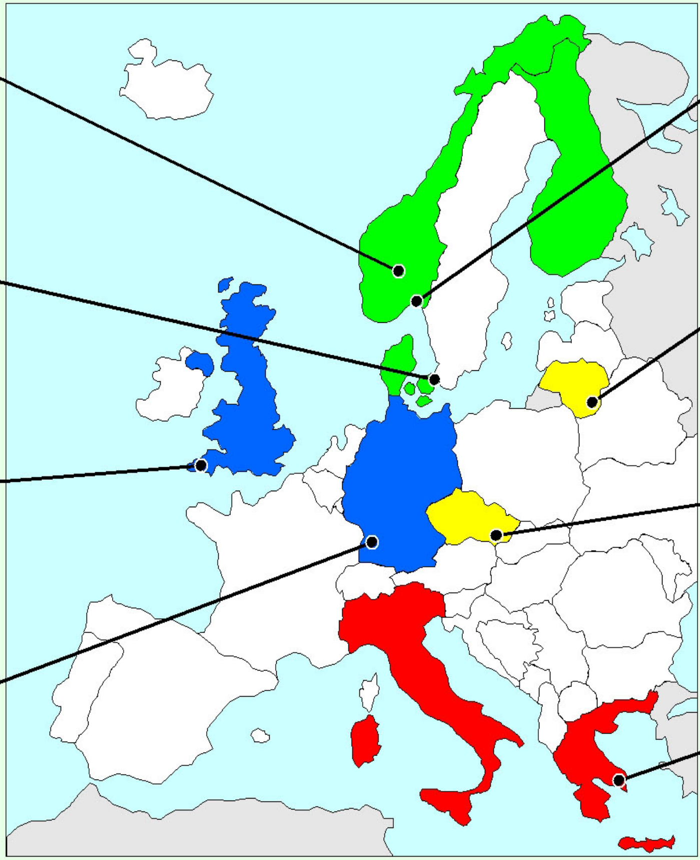
Cultural Centre Proeve-hallen

Great Britain: Plymouth

City College Plymouth

Germany: Stuttgart

Nursing Home Filderhof



Central | North | South | East

Norway: Asker

Borgen Community Centre

Lithuania: Vilnius

Main Building Vilnius Gediminas University

Czech Republic: Brno

Students Social and Cultural Centre "Brewery"

Greece: Athens

Evonymos Ecological Library

Borgen Community Centre

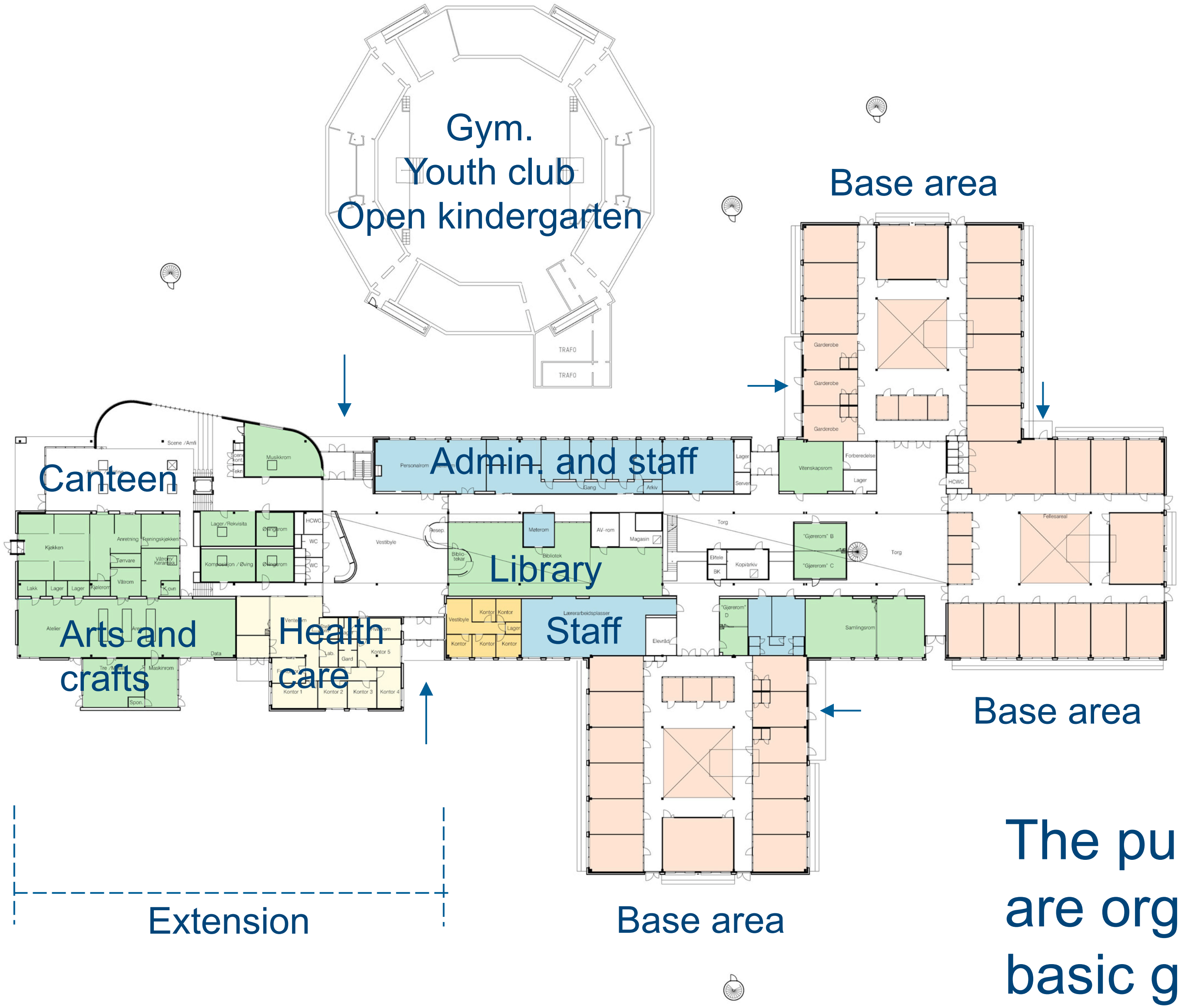
1970
The old Borgen School

2005
Borgen community Centre. HUS sivilarkitekter

Most visible features:

- Daylight openings on the roof and new façades
- Decentralised hybrid ventilation systems

Transformation
from school to community centre

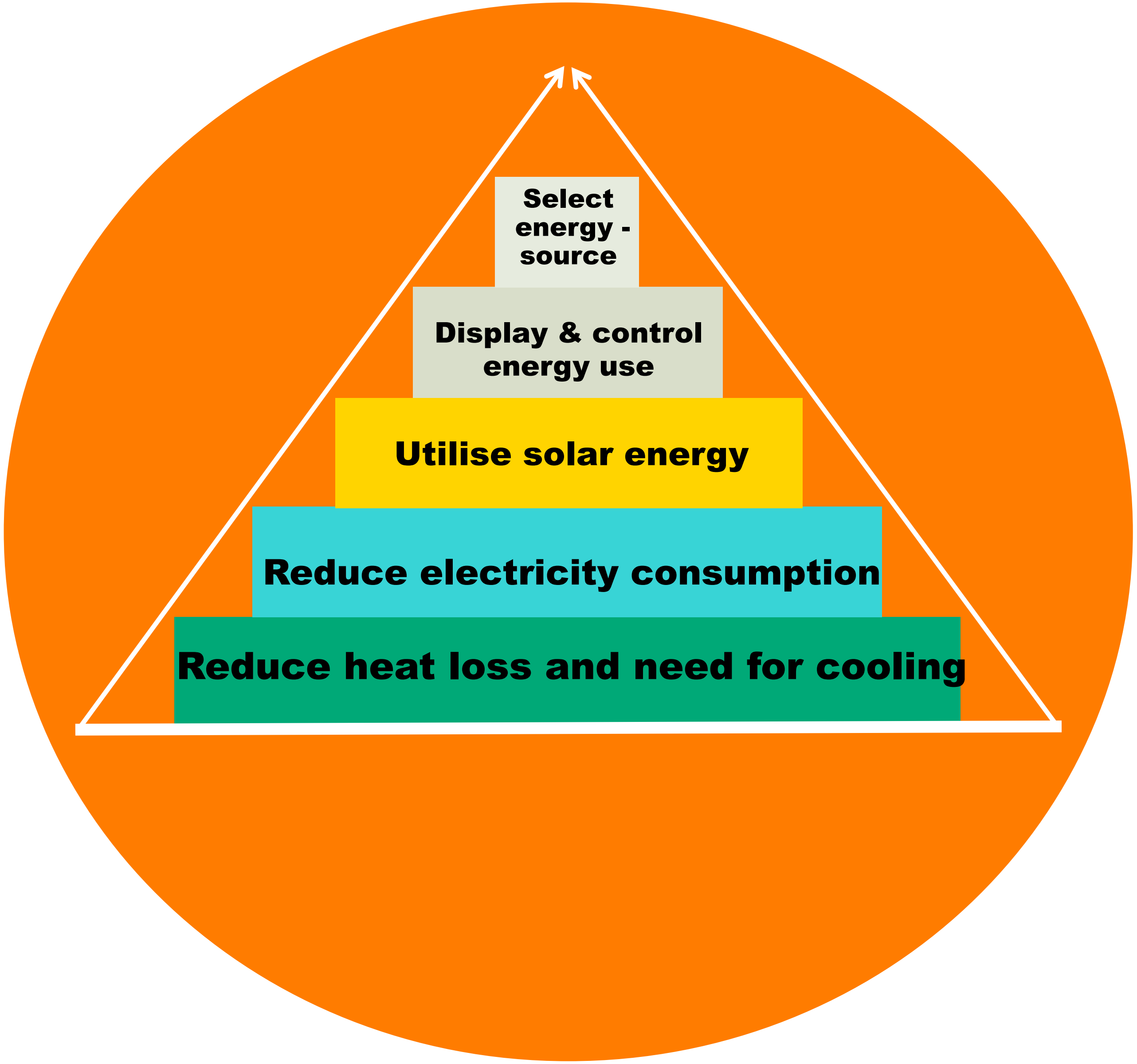


The pupils
are organised in
basic groups of 15

Common space in a home base area


Pupils’ «office»

Design strategy for energy efficiency



Design strategy. Step 1

1. **Reduce heat losses**

   Building shape, zoning of room categories, area efficiency. Well insulated and tight building envelope without cold bridges. Efficient heat recovery of ventilation air.

2. **Reduce electricity consumption**
3. **Utilise solar energy**
4. **Display and control energy use**
5. **Select energy source**

Borgen:

Envelope insulation, windows replacement, heat recovery

Design strategy. Step 2

1. Reduce heat losses

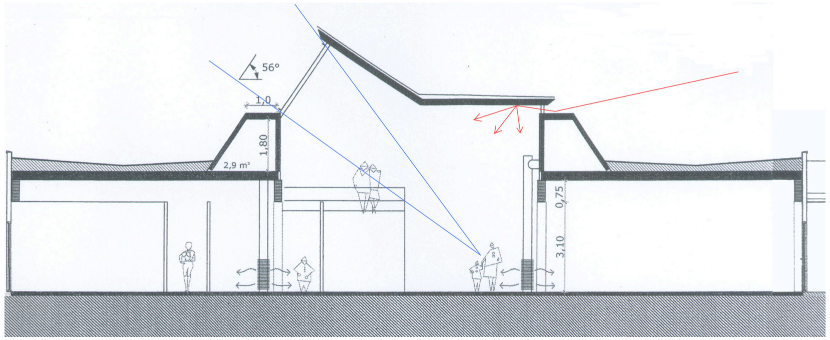
2. **Reduce electricity consumption**
   Exploitation of daylight.
   Low pressure drops in the ventilation system.
   Reduce the need for cooling by utilising thermal mass in combination with night cooling and efficient solar shading.
   Energy efficient lighting and equipment.

Borgen:

New daylighting openings, new hybrid and natural ventilation systems, solar shading, efficient lighting

Daylighting

Communication area



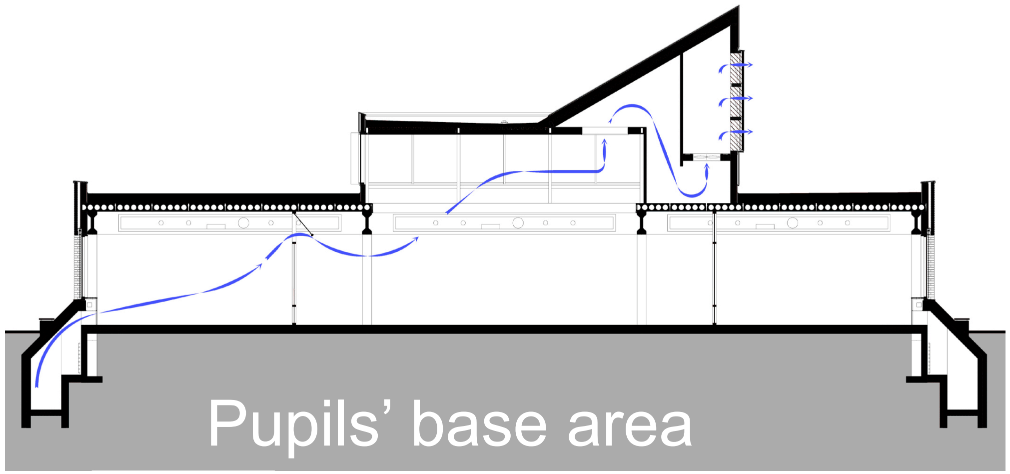
1970
2005

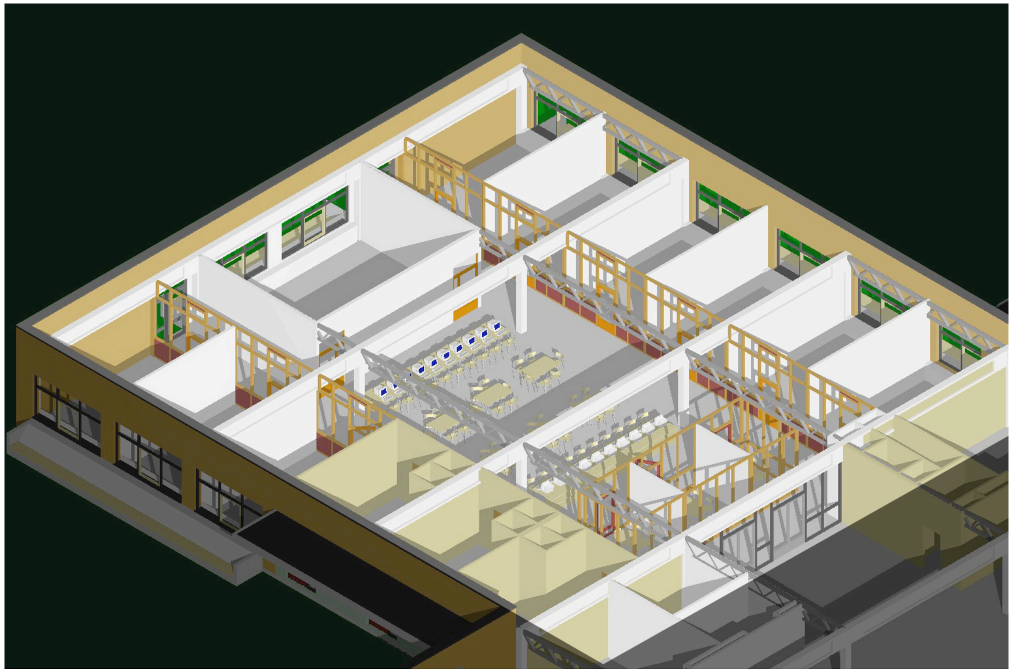

Daylighting and solar shading
Home base area

Ventilation
5 separated systems

Hybrid ventilation in pupils' base areas:

- Inlet air via culverts
- Displacement ventilation
- Outlet air via heat recovery units placed on roof top





Design strategy. Step 3

1. Reduce heat losses
2. Reduce electricity consumption

3. **Utilise solar energy**
   Optimum window orientation, thermal mass activation, solar collectors, photovoltaic

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Borgen:

Materials with high thermal mass capacity in walls (bricks) and floors (concrete)

Design strategy. Step 4

1. Reduce heat losses
2. Reduce electricity consumption
3. Utilise solar energy

4. **Display and control energy use**
   Feedback on consumption. Smart house technologies; i.e. demand control of heating, ventilation, lighting and equipment.

Borgen:

Feedback, reminders and BEMS.
Demand control of heating, ventilation and lighting

Design strategy. Step 5

1. Reduce heat losses
2. Reduce electricity consumption
3. Utilise solar energy
4. Display and control energy use

5. **Select energy source**

   Heat pump, district heating, firewood, gas, electricity …

Borgen:

Heat pump. The old oil burners are now used only for back up

Energy savings

The purchased energy consumption is calculated to 50% of new, existing Norwegian school buildings.

	National Benchmark
Purchased energy consumption	220 kWh/m^2/a

	Budget for Borgen	
	Energy kWh/m^2/a	Power W/m^2
Space heating	29	30
Heating ventilation air	20	41
Water heating	13	10
Fans and pumps	15	6
Lighting	23	14
Equipment	11	8
Cooling	0	0
Total	**111**	

Measured before retrofit: 280 kWh/m^2 a

Measured 2007 (normalised): 102 kWh/m^2 a

Costs

Pay-back time for extra costs
compared to conventional building: 7 years

Prøvehallen, Copenhagen, Denmark

Energy saving measures
- heating, cooling and ventilation

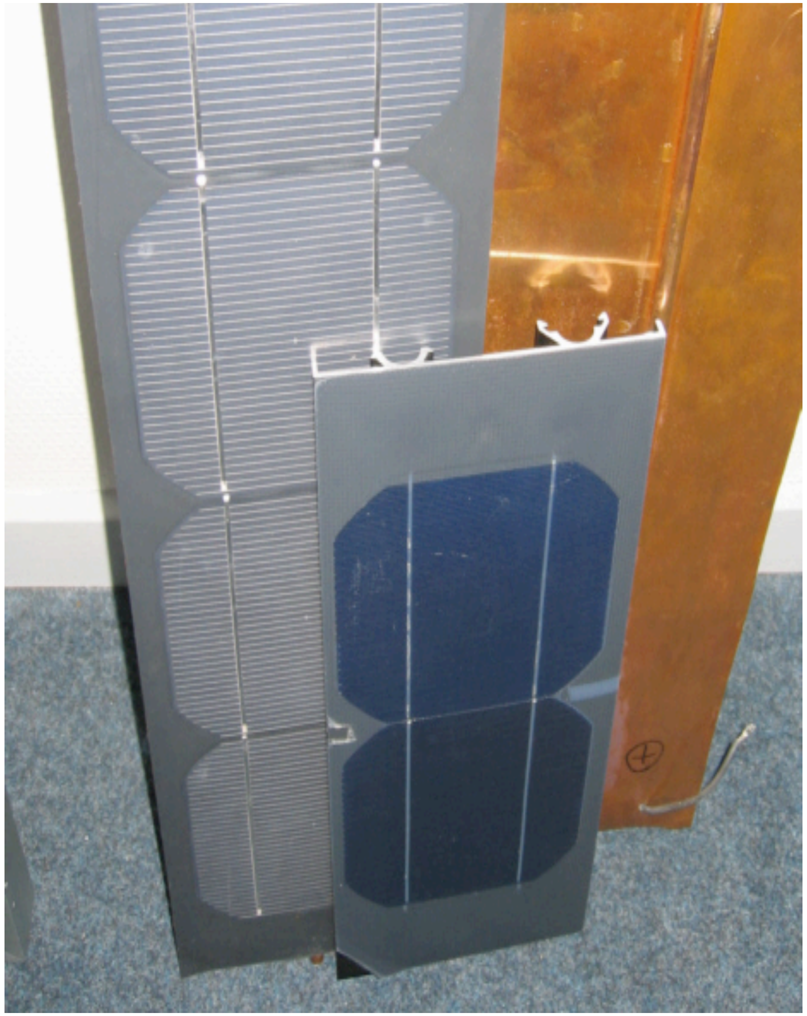
High efficient ventilation
Improved insulation of façade and roof
Low-e windows
Heating energy savings (lower water use)
BEMS
Combined PV and Thermal heating system

Energy saving measures - electricity

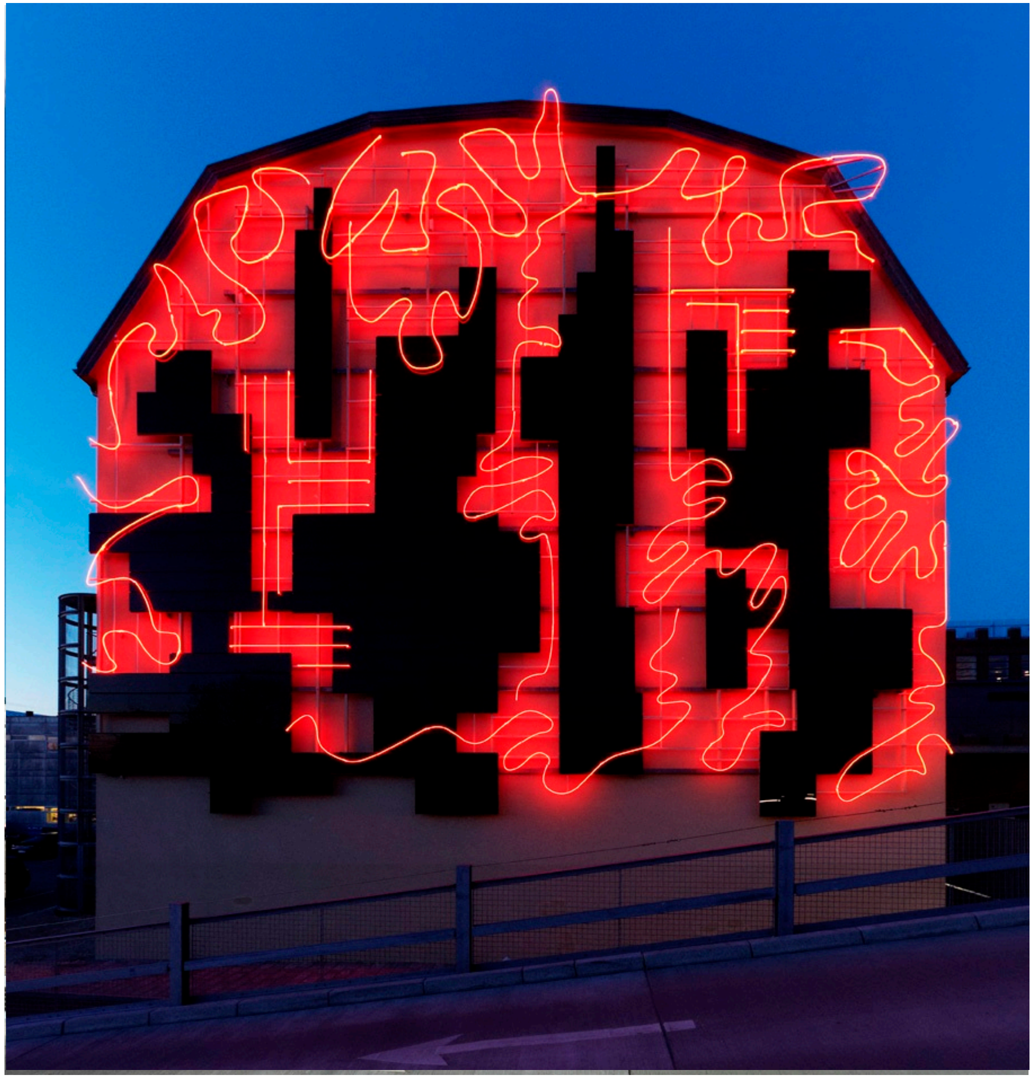
High efficient fans in the ventilation
BEMS
Electrical output of PV/T cells
PV-cells, 19 kWp

Natural ventilation in the gym – windows and roof windows

PV/T solar collectors



The PV on the gable wall



The bottom line

Space heating requirement:

- Reference: 132 kWh/m²/year (BR 95)
- Target: A 50% reduction: 66 kWh/m²/year
- Result: 53 kWh/m²/year (normalised)

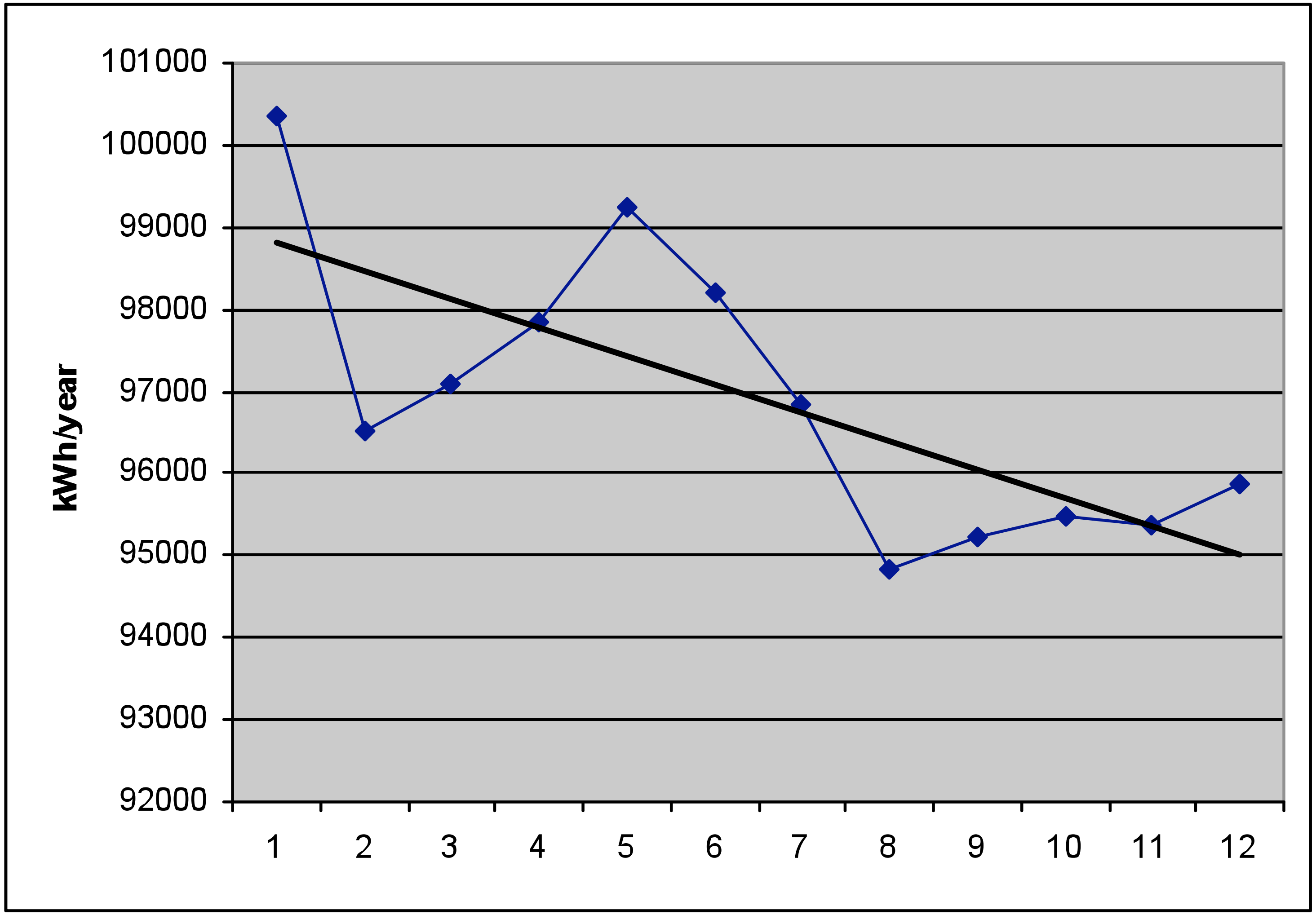
Electricity requirements:

- Higher than expected!!!

Life cycle assessment

- Energy Payback Time: 1.3 /year
- Emission Payback Time: 1.1 /year

Monitored yearly energy consumption for space heating shown for the last 12 months



More information:

Bringing Retrofit Innovation to Application in Public Buildings

BRITA in PuBs

www.brita-in-pubs.eu

Discussion: Barriers and drivers?

Three main phases in sustainable building:

1. Introduction	2. Growth	3. Volume
International intensification cooperation	Regional demonstration	Regulation step by step

1. **Needs in national and international R&D work?**
2. **Economics? Incentives?**
3. **Knowledge building? Regulations?**