

KNX-based Energy Efficient Heating and Lighting in Educational Buildings^(*)

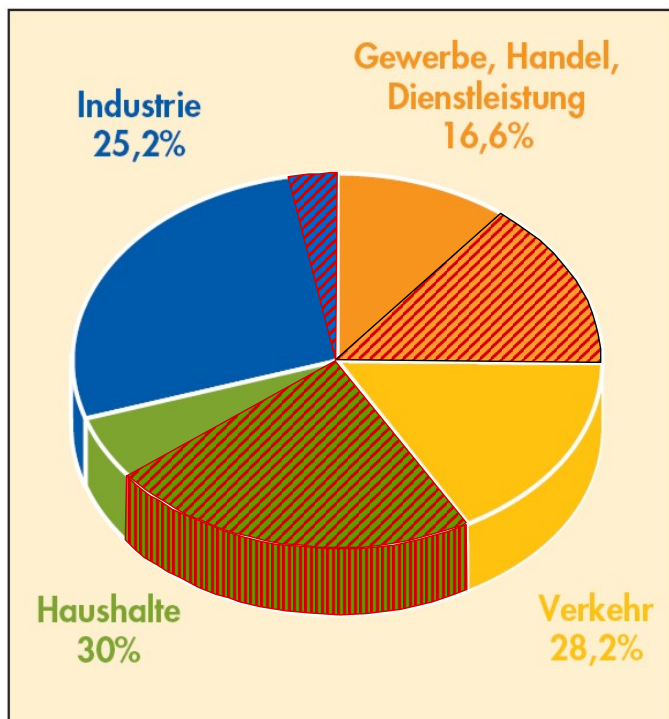
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Hochschule Bremen, University of Applied Sciences
IIA – Institute for Informatics and Automation

- Energy Savings Potential
- Measurement System
- Heating Control
- Daylight Responsive Lighting

(*) funded by Bremer Energie-Konsens GmbH

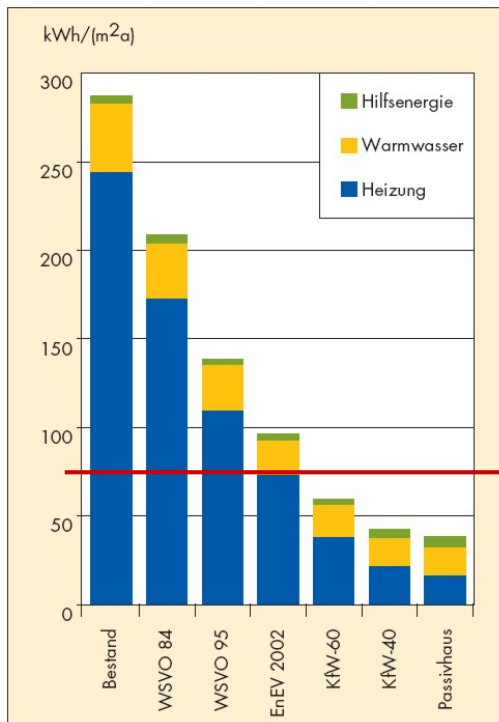


Energy consumption in buildings



33 % of final energy consumption in Germany is due to heating of residential and commercial buildings

Building standards and energy efficiency



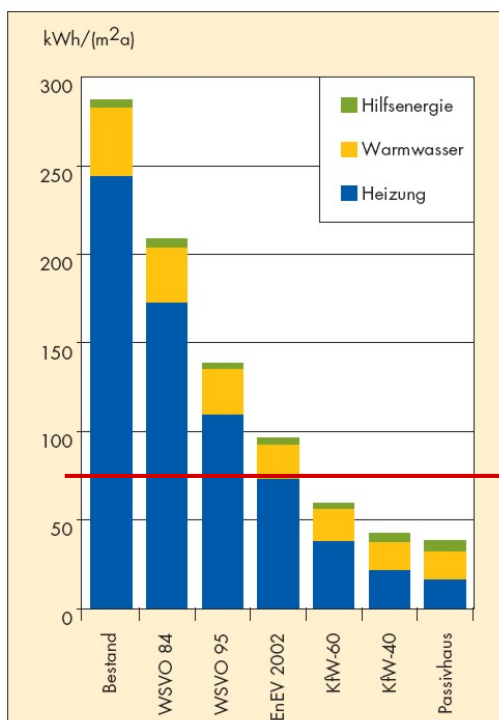
Heating energy savings by thermal protection and state-of-the-art furnaces

Further reduction of energy consumption can **not** efficiently be done **without intelligent automatic control**

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New informatics building at HS Bremen



Hochschule Bremen, **ZIMT** built 2002, standard installation, KNX system only in the area of the sensors&actuators lab



Specific energy consumption:
60 – 75 kWh/m²a

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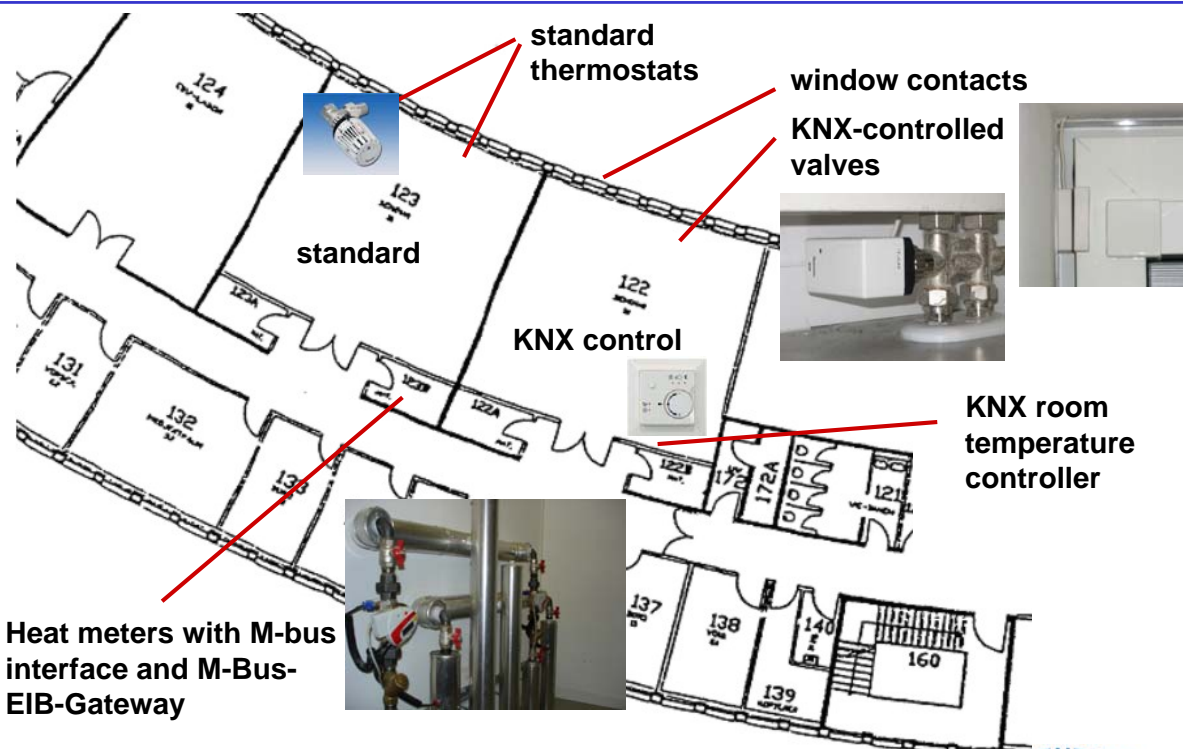
Typical classroom



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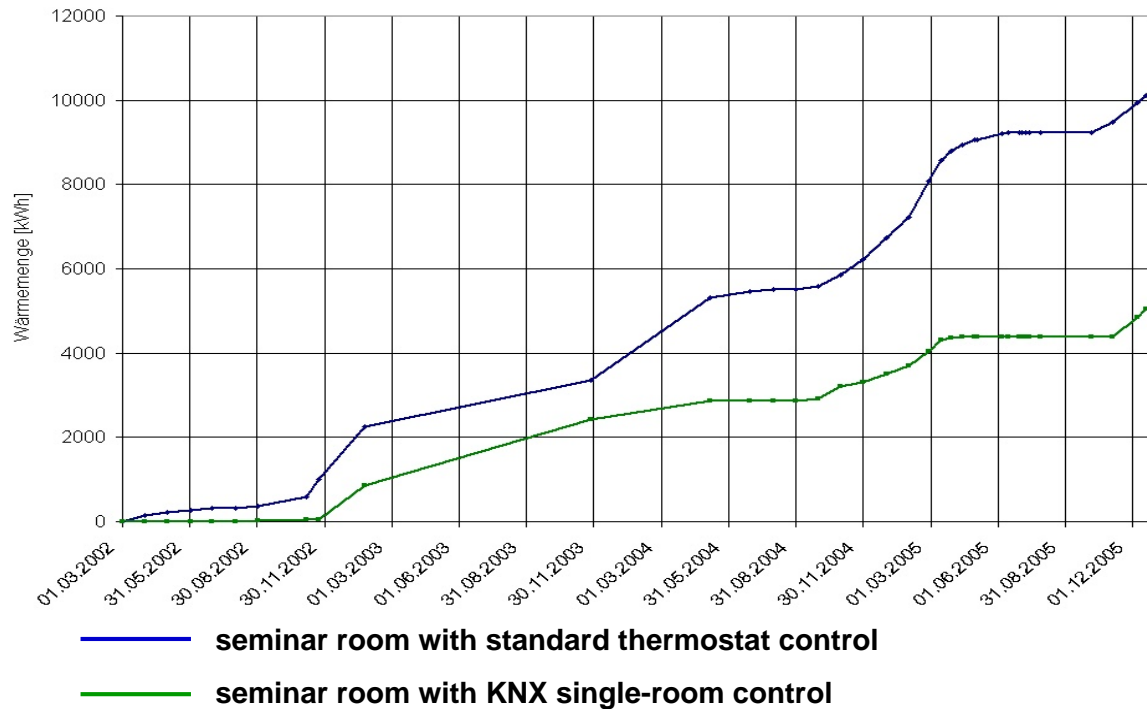
Seminar rooms, ZIMT, 1st floor



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Heating Energy Consumption I



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KNX measurement system

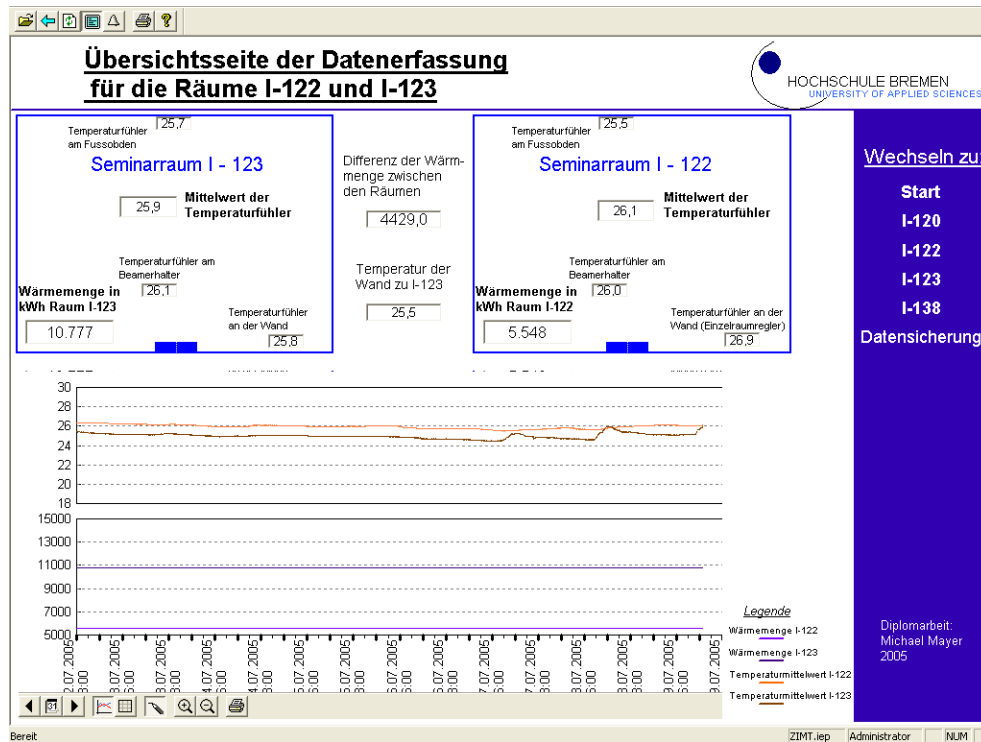
- 2 x 4-Channel Pt-1000 Temperature measurement
- Heat meters with M-bus interface
- M-bus-EIB - Gateway



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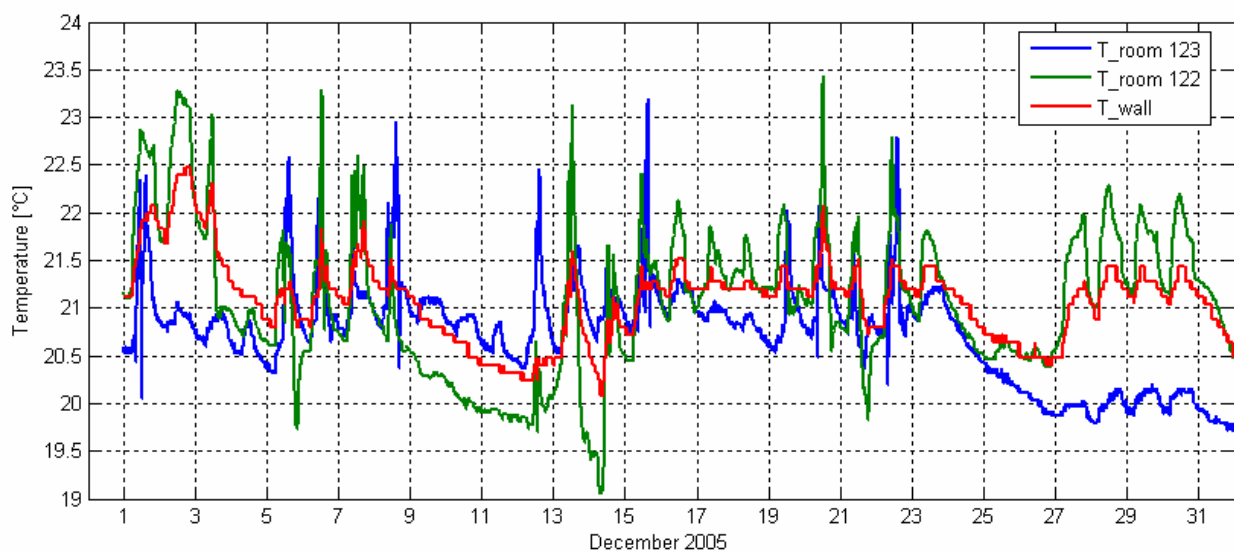
PC-based data acquisition using ELVIS



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Temperature Measurements (December 2005)



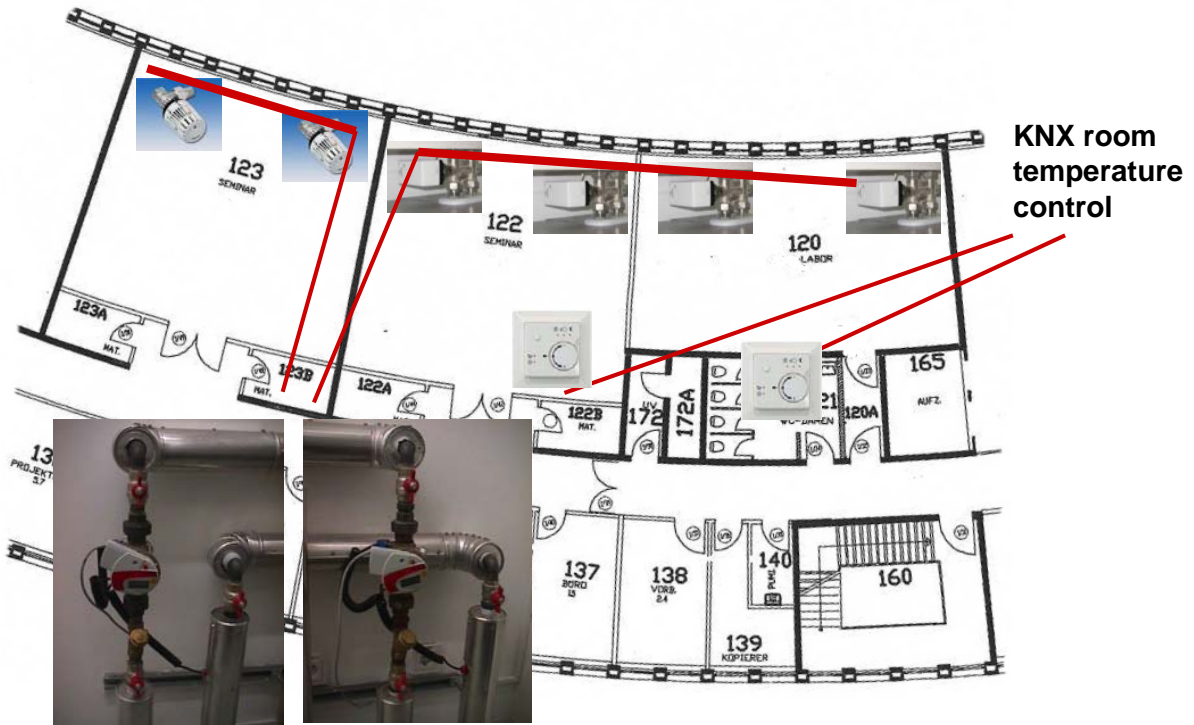
Mean temperatures:

- 21 °C in room 123 (standard installation)
- 21,3 °C in room 122 (KNX network)

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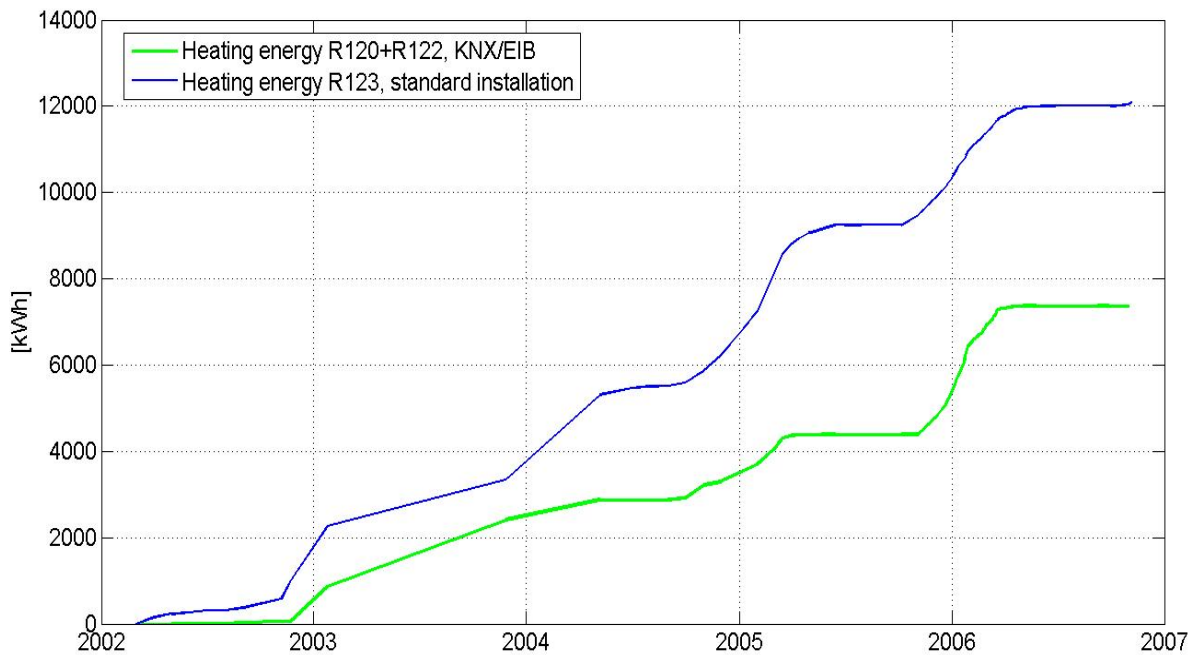
Seminar rooms and laboratory



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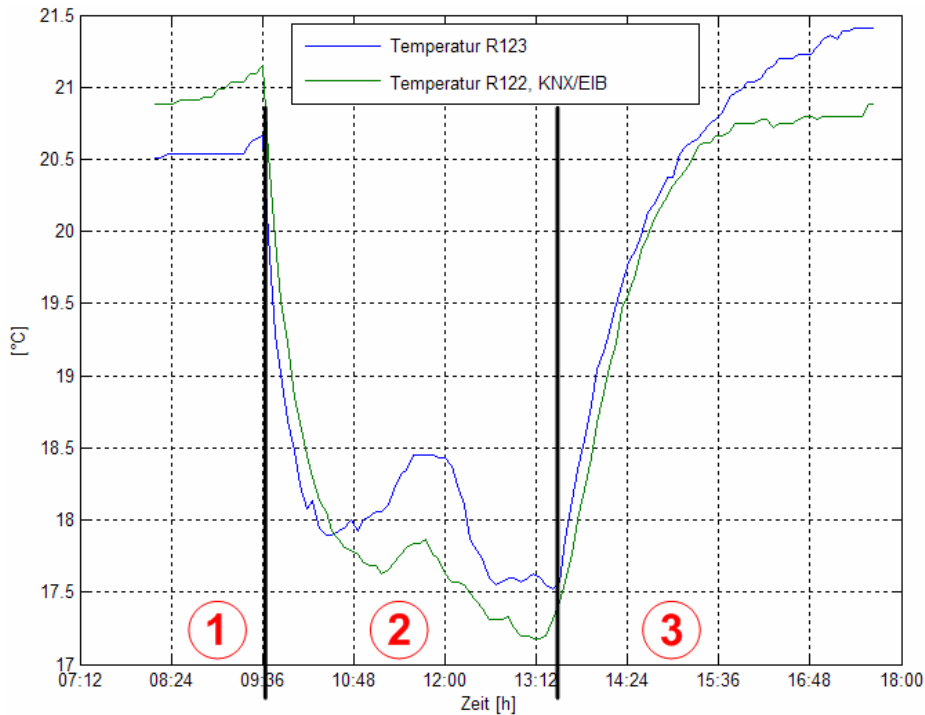
Heating Energy Consumption II



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Room temperature dynamics



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Heating based on time-tables

Etvis - Belegungsplan

Raum I-122 Belegungsplan

belegungsplanabhängiges Heizen Ein

von 18.04.2006 bis 07.07.2006

	Mo	Di	Mi	Do	Fr
08:00-09:30				■	■
09:45-11:15	■	■	■	■	■
11:30-13:00	■	■	■	■	
13:30-15:00	■	■		■	
15:15-16:45		■		■	
17:00-18:30			■		

Sonderstunden:

1)	von	18.05.2006	08:00:00	bis	18.05.2006	16:00:00
2)	von	20.05.2006	16:00:00	bis	20.05.2006	17:00:00
3)	von	21.05.2006	15:00:00	bis	21.05.2006	15:30:00

Nacht-Betrieb ausgeschaltet.

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

Wechseln zu:

- Start
- I-120
- I-122 Belegungsplan
- I-123
- I-138
- Datensicherung

Diplomarbeit:
Christian Eder
2006

Bereit

ZIMT.lep administrator NUM

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Lighting - share of total electricity demand (2002)

- Industries 5.1% (10,7 TWh)
- Residential 8.3% (11,5 TWh)
- Commercial and public 19.6% (26,0 TWh)



Electricity demand: ~ **500 MWh/a**

- 100 x consumption of average household!
- Exceeds heating energy demand (435 – 485 MWh/a)

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Lighting regardless of daylight



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Automatic lighting control

should take into account

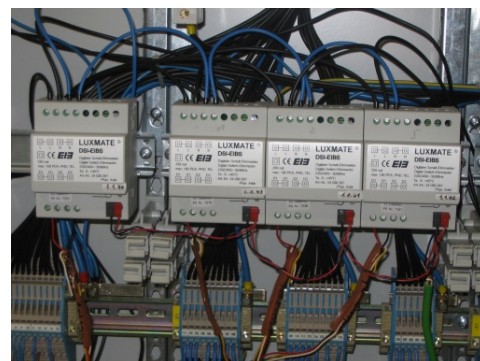
- Human presence
- Daylight level
- Blinds, if present
- Illuminance required on student's desk

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KNX lighting control devices

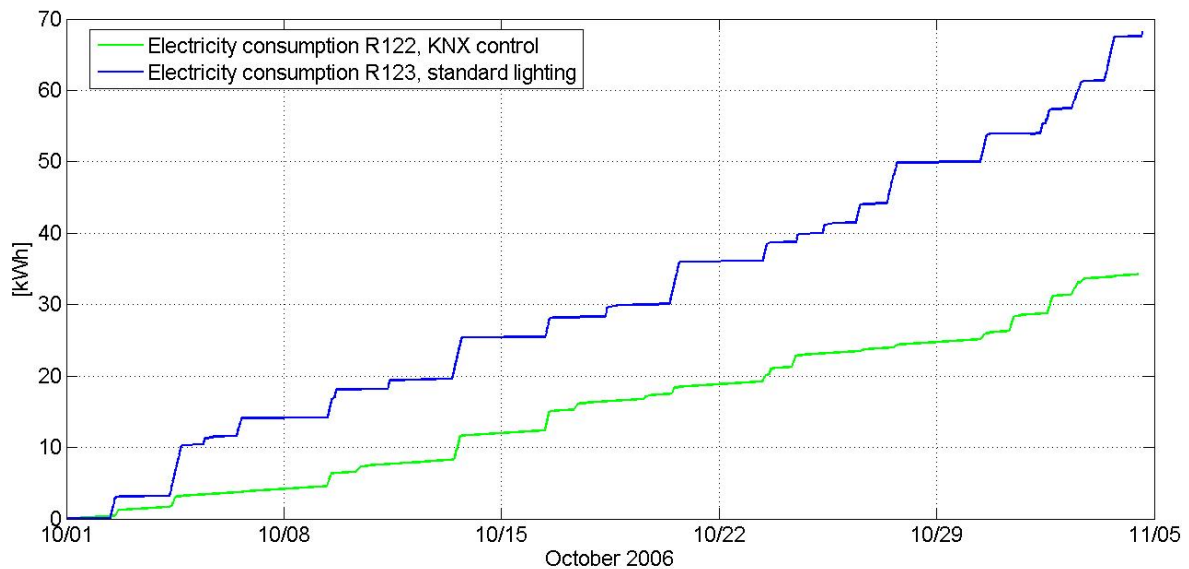
- Presence detection
- Illuminance sensor
- Dimming actuators



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Comparison of electricity demand



Daylight dependent light control with presence detection and two dedicated illuminance sensors for two groups of lamps

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Results

- **A combi-sensor with presence detection is an economically attractive solution, but may not yield illuminance levels as exact as dedicated lux-sensors due to influences by incoming sunlight and other light sources.**
- **An installation with two dedicated lux-sensors is currently installed and yields promising results. Yet, this is a rather expensive solution.**
- **There seems to be a lack of good, standardized setup guidelines for daylight responsive lighting. Discontentment with installations is reported more often by practitioners than satisfactory solutions.**

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