

Energy efficiency in educational buildings using KNX/EIB

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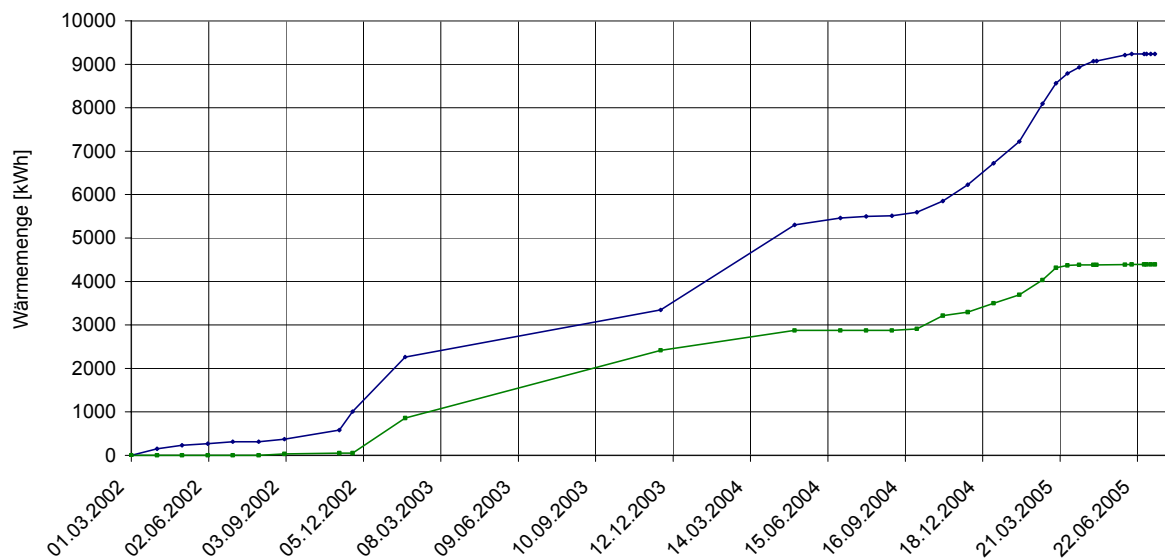
Motivation

Rooms and buildings that are used for educational purposes typically offer a large potential for improving energy efficiency. Relatively large rooms with high user fluctuation and lack of personal responsibility (contrary to office rooms) often result in exceedingly high consumption of heating energy as well as electricity. Technical solutions such as single room control via a building network are necessary and appropriate to realise the large energy savings that are possible in these cases.

Application

There appears to be a lack of examples in practice where energy savings are proven and quantified by accompanying measurements. At Bremen University of Applied Sciences (Hochschule Bremen) two similar, adjacent classrooms of more or less identical usage, one with and the other without KNX/EIB-based single room control, are now compared energetically. The KNX/EIB system of the controlled room features room temperature control and magnetic window contacts shutting the radiator valves.

After approximately three years of operation the heating energy consumption measured by heat meters installed for each room turns out to be halved (!) in the controlled room. The figure below shows the readings of both heat meters since March 2002.



The work presented here aims at exploring the energy savings achievable by KNX/EIB-network technology and making the results transferable to other buildings of similar type.

Setup

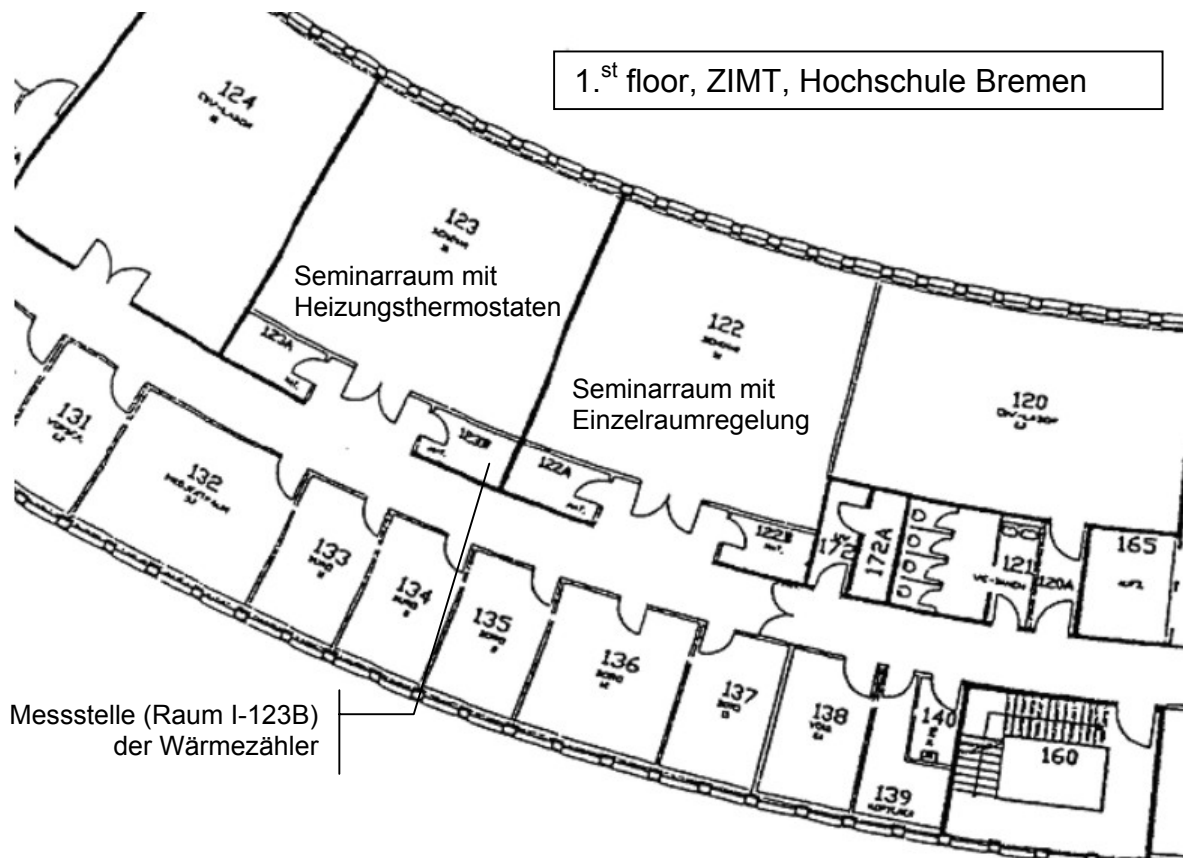
An EIB-based measurement system has been set up to validate the promising preliminary results with respect to questions like:

- Are the savings merely a result of too low room temperatures? (However, there is no evidence for this up till now.)
- Is there heat transfer to the controlled room from adjacent rooms?
- Which control action contributes how much to the overall savings?

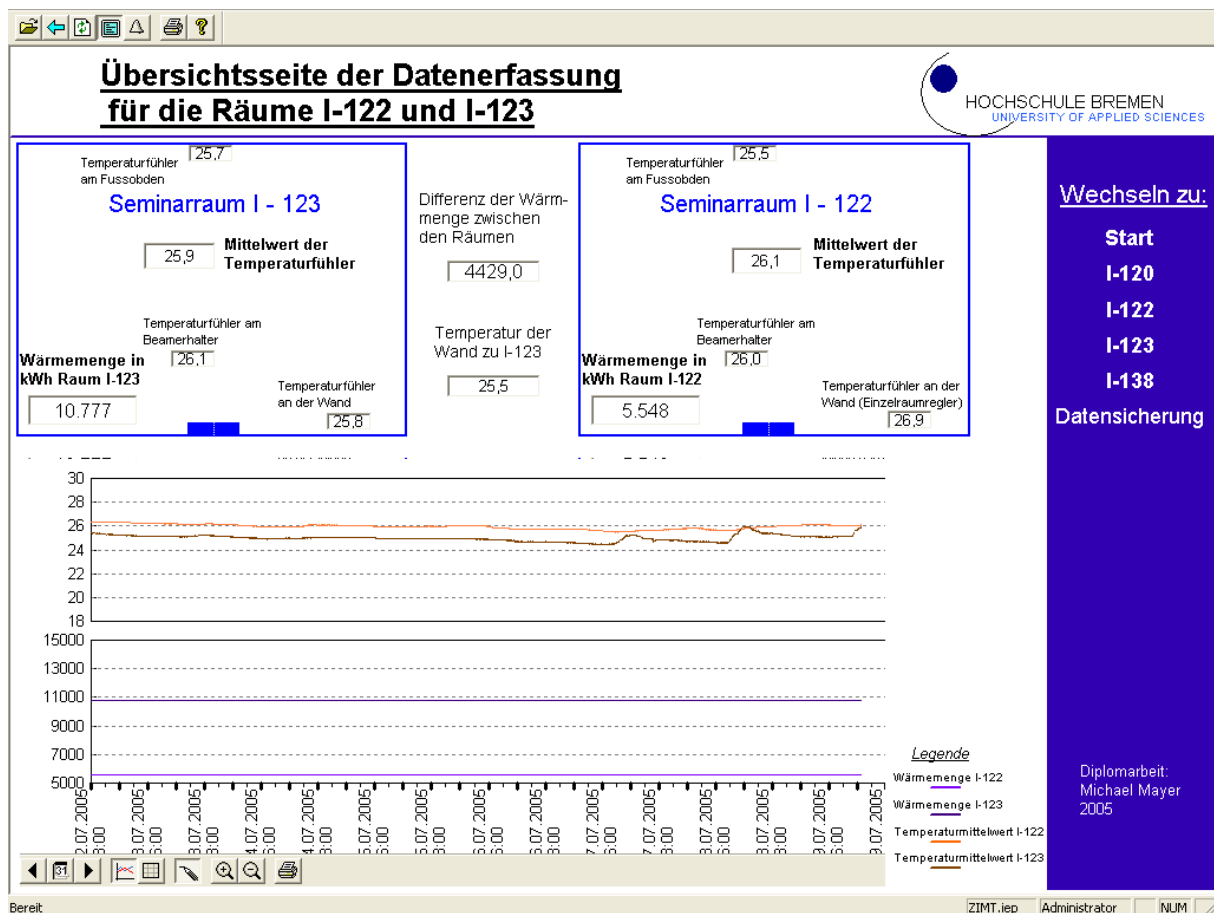
To this end, the existing KNX/EIB room temperature control system with M-bus heat meters (photo) was enhanced. The measurements of the heat meters were made available within the EIB network by a M-bus-EIB gateway, temperature sensors were installed using two 4-Channel-Pt1000 interfaces (Siemens N128), and a PC-based system for continuous measurement data acquisition based on the ELVIS software (IT-GmbH) was set up. The drawing below shows the



two rooms, 122 with EIB-room temperature control and 123 with conventional thermostats. Both rooms were equipped with 3 PT-1000 temperature sensors. One was adjusted to the wall on the side of the windows near the floor between the radiators, one at the ceiling in the middle of each room. In 123 one sensor was placed near the entrance, were 122 was already equipped with the room temperature controller. Finally one sensor was placed on the partition wall between 122 and 123. This sensor will yield information about heat transfer between the two rooms.



The measurement data acquisition runs on a PC-Server connected to the EIB network via a serial interface. The ELVIS software allows for visualisation and control as well as data acquisition and report generation. The screenshot below shows the overview panel of the ELVIS project set up in this case [1].



With the present system all measurements are acquired at a rate of 5 sec and archived daily in Excel-spreadsheets. The system has been tested and is up and running continuously since mid July 2005. More results will be available in spring 2006 after the next heating period.

Future Work

As a next step, the system will be enhanced by light sensors, dimmers and electricity meters, and new control schemes for room heating and daylight dependent light control will be investigated. This way, heating as well as electricity energy efficiency will be optimised by automation via the KNX/EIB-network and the results will be documented as a reference for other educational building projects.

References

- [1] Mayer, M.: "Energetische Optimierung durch Einzelraumregelung mit KNX/EIB in Bildungseinrichtungen", Diploma Thesis, Hochschule Bremen, 2005