SMART BUILDING

Saving Energy with KNX

Case study

Saving Energy with KNX
Overview

"Particularly automation functions which present a high degree of energy-saving potential by combining various individual trades can today only be achieved using modern building system technology based on bus and communication systems." The Institute for Building and Energy Systems at Biberach University of Applied Sciences, Germany.

As energy costs continue to escalate, everyone has to keep a close eye on how much it costs to heat buildings. A study conducted by price comparison and switching service uSwitch shows that energy bills could increase up to £445 a year per household. So it has become more than just good sense to take energy efficiency measures seriously.

Managed accommodation is based upon maximising the efficiency of a building to help yield a profitable rental return. A critical element for focus should be the owner/manager's ability to monitor, control and optimise the energy use of the building without disruption to the comfort of the occupants.

Here we consider two case studies, both controlled using KNX - the worlds only open standard for building control, which considers standards such as ASHRAE, ISO and IEC to work as one, globally recognized system.

The KNX system installed managed:
- Lighting Control
- Heating
- Ventilation
- Air-Conditioning
- Alarm systems
- Energy management
- Interfaces to other systems

Case Study-1: Two student accommodation one with KNX controls and other with traditional controls.

Case Study-2: An office block which initially had traditional lighting controls and later a complete KNX lighting control was installed.

Case study 1
Student accommodation

Lighting control

Simple absence control was implemented to allow the system to control the lighting by absence of presence and sufficient natural light. Due to the KNX combined Passive Infrared Sensor (PIR), Lux and Temperature sensor the detector controlled both the lighting and HVAC.

Taking into considering the lighting control aspect of the bar chart (indicated in the red box below). Studies have shown a saving of up to 58% can be achieved by lighting control.

The client kindly provided us with the electricity bill for both the properties. Now even with the property running on higher/kWH charges (0.1436) in comparison to the property with no lighting control (0.1377) taking only the usage during night time as this is when the most of the lights will be used. The figures **indicate 25%-27% savings**.

As a conservative figure lets assume the lighting controls cost £ 2000/flat and average spend of £26,000 per year on electricity with controls and £38,000 without controls. We are looking at a pay back period of 8-10 years.

Heating controls

All Panel Heaters, Ventilation and MVHR units were under the control of the KNX system. Each unit was enabled via the push of a button then disabled via absence detection via a PIR. The HMVR was boosted when presence, humidity and temperature met a certain criteria within the kitchen and bathroom spaces.

The heating in the property was done by electric panels. We are taking into account the same kWH for both the properties, as we did for the lighting. In this instance we take the coldest month (Jan) saw that the property with the controls was 15% more expensive than the one without controls. Though this can be seen as a negative further investigation proved that this was because of the low efficient electric panels. The client has identified this issue and is on course of replacing these.

But what has to be considered is even with a highly inefficient panels the difference was only 15% which indicates that without any controls this could be as high as 50%-60%. Also changing set point with time (as shown in figure 01 opposite) is said to decrease energy usage.

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01 Energy usage and potential saving through use of heating controls
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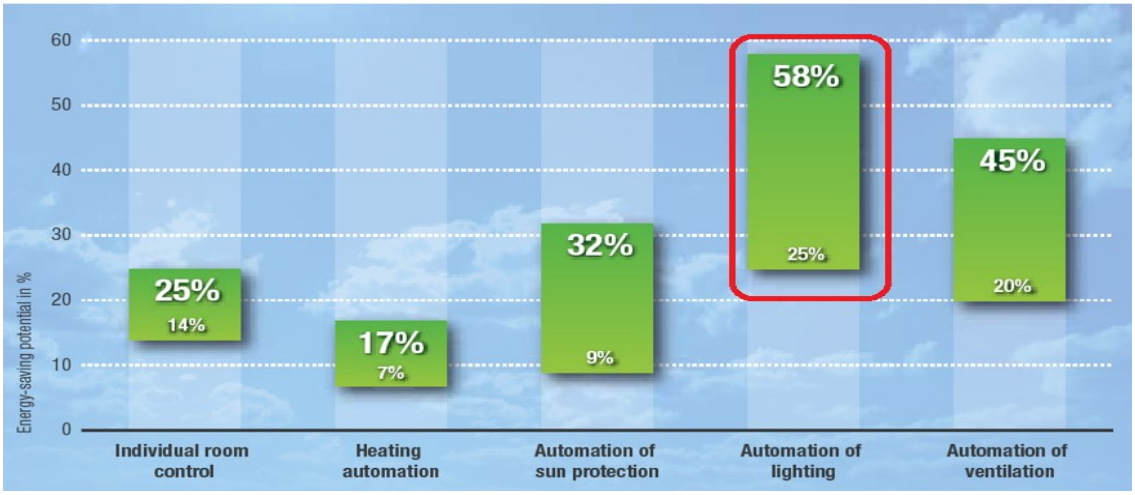
02 Heat only when and where needed



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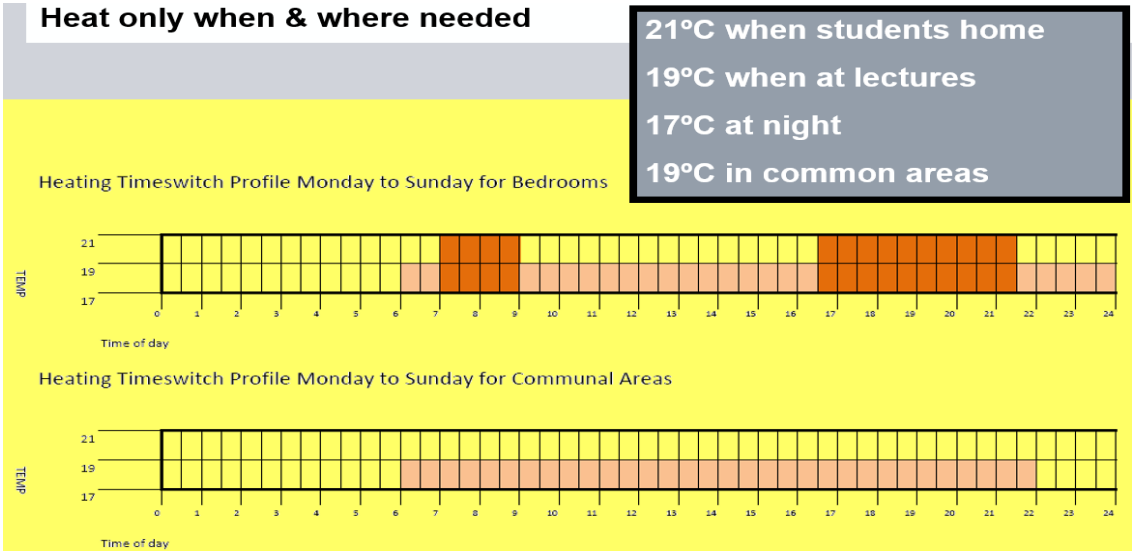

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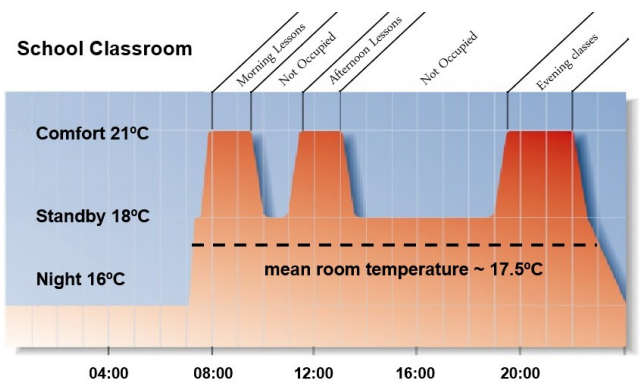
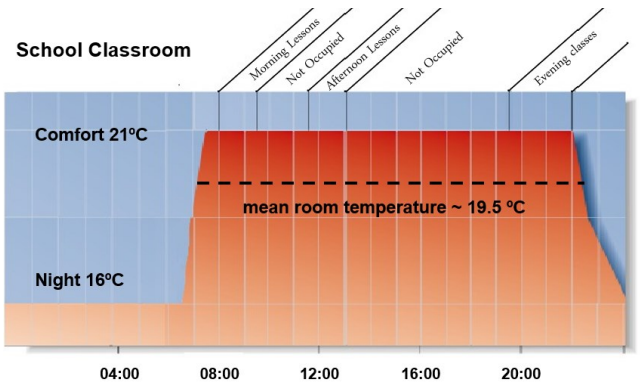
Studies recently done in a school classroom in the UK depict the graph below

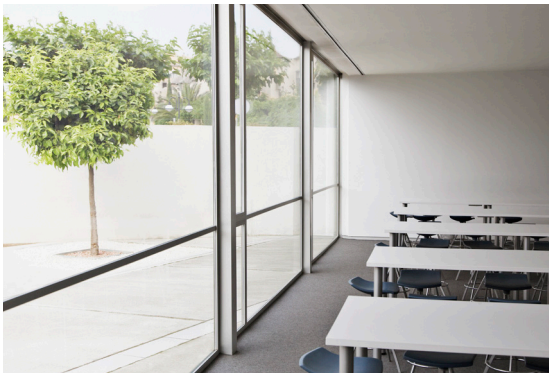




A temperature reduction of 1°C can mean energy saving of 6%.

Case study 1

Student accommodation



Energy management

KNX forms the entire field level control and data provision for the building wide BEMS (Building Energy Management system). All control data on occupancy, lighting levels, internal room temperature and ventilation are all integrated with one another and with the BEMS to influence plant control decisions, building wide KNX control decisions and local room level KNX control decision. All KNX relays for the lighting and panel heaters have built in current transformers so energy usage can be monitored on an individual circuit basis across the site.

Studies have shown that load management is a key part in energy management and one that is often not utilised to its full potential. In addition to reducing energy costs through load balancing, you can also create immediate energy savings through load scheduling, which is the part of energy load management that minimizes demand.

But thanks to KNX systems most of the components come with their own load management facility and this leads to further savings.

01 Load Management with KNX

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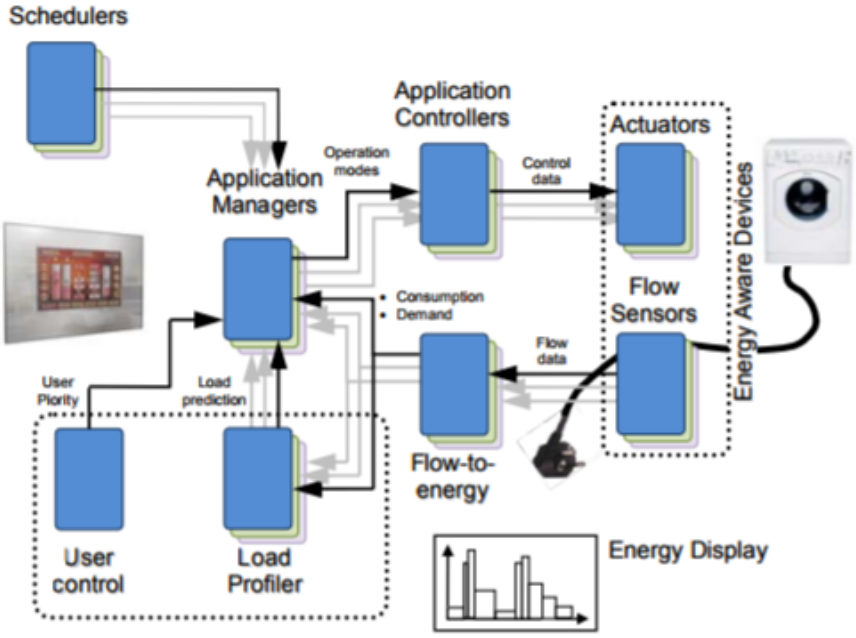
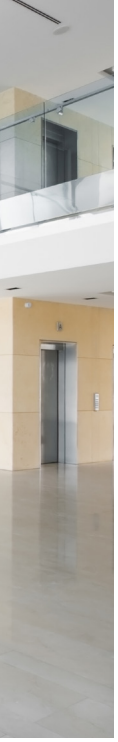


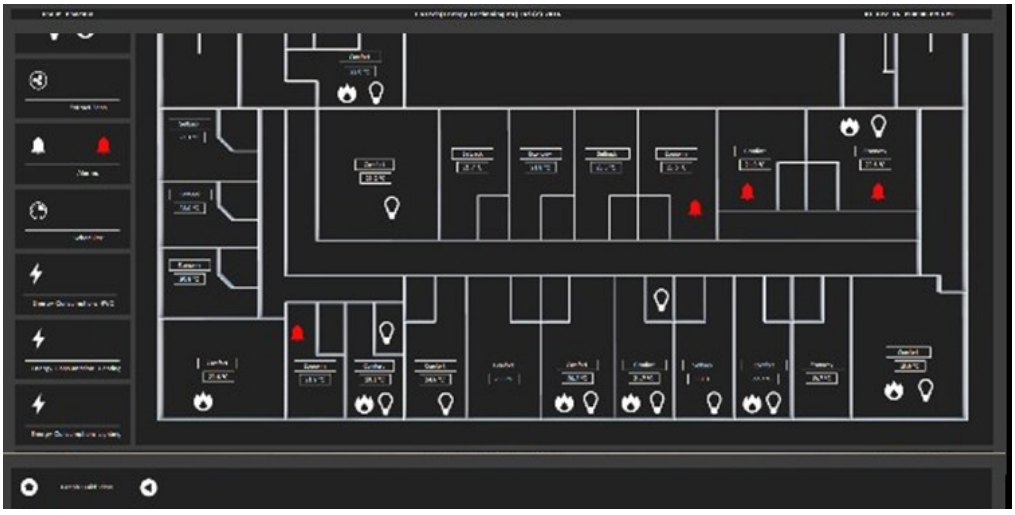


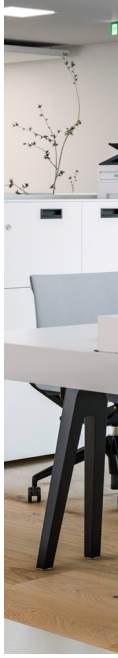
Visualisation

Entire building alarm system, data display and monitoring functions are displayed on one completely integrated building BEMS head end. Control decisions and monitoring of the entire system can be taken from this visualisation, as can alarm handling. A bespoke integration page developed between KNX/BACnet to indicate for each object the value received on the KNX side and the BACnet side to reduce complications of fault detection and rectification between integrated systems without requirement to have engineering knowledge of both protocols.

In this day and age with extensive usage of smart phones and tablets. Visualisation plays a key part in the building management.

Though the savings can not be quantified for this the benefits achieved by visualisation is well experienced by the end user.





Case study 2
Office

Overview
The previous case study was done with information for 6 months, hence we have decided to present you with another case study where ABB had conducted a complete survey of an office building before and after KNX installation in the UK. The study was conducted on lighting and it was done with figures that reflected an entire years usage.

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Before and after KNX installation

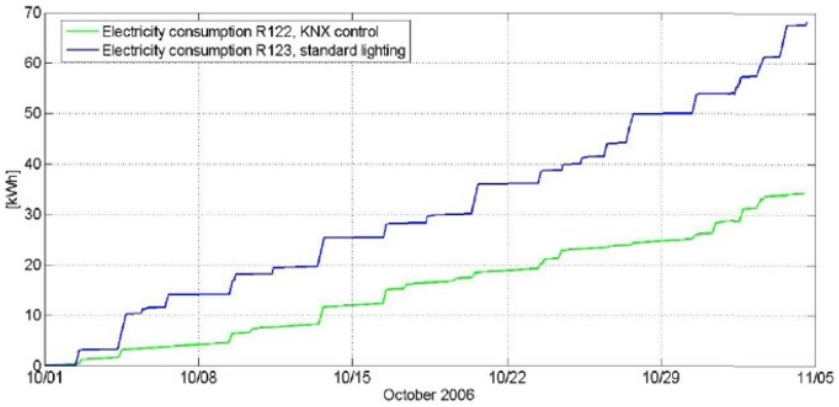
Existing system	
Lamps Load (W)	72
Total No. of Lamps	3,000
Total Load (kW)	261
Hours per day	15
kW/H per day	32400
kW/H per month	64800
kW/H per year	777,600
Cost of Energy (£)	0.07
Cost per Year (£)	54432
Carbon Emission/year (Tonnes)	334.37

New system	
Lamps Load (W)	72
Total No. of Lamps	3,000
Total Load (kW)	261
Hours per day-Reduced	9.5
kW/H per day	2052
kW/H per month	41040
kW/H per year	492,480
10% Dimmed Savings	443,232
PIR/Daylight Savings (35%)	288,100
Revised Cost/Year	20,167
Carbon Emission/year (Tonnes)	334.37

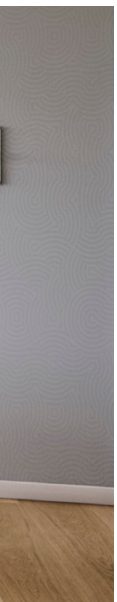
The client was kind enough to give us the cost of installation this includes even the labour for commissioning and programming the system and with these figures we can calculate:

Cost of Installation	£262,563.00
Payback period (yrs)	7.66
Enhanced Capital Allowance	£78,768.90
Revised Capital Cost	£183,794.10
Final Payback period (years)	5.36

One of the key component in the project was the ABB's presence detection which can be enabled for presence, movement, absence and constant light control. The graph below was plotted with comparison of two rooms and how PIR's reduce the energy usage:



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



The client now wishes to integrate the blinds along with the lighting control and thanks to KNX system already present this can be easily achieved and integrated. Once this is achieved we are looking a potential savings of:

Automatic Function	Potential Savings	Positive Factors
Sunlight Automatic (blinds and shutter positioning)	5-8%	Good Natural Lighting levels
Sun Tracing	10-13%	Good Natural Lighting levels in combination

Saving Energy with KNX
Conclusion

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"Energy efficiency is not just about saving energy, it's about tackling economic, environmental and social issues at the same time."
UN's sustainable energy chief
Rachel Kyte

In light of climate change and increasingly scarce natural resources, a buildings energy efficiency is of paramount importance for long term investment.

Essential requirements for this are an energy efficient architectural design, an insulated building exterior and modern installation engineering with a high level of efficiency. Ultimately the consumption of energy for lighting and heating/cooling depends on both building use and user behavior. The variable nature of the user and demand make it hard to estimate, however with a dynamic energy management system this can be optimised and avoid wasted use, ensuring economical use.

Bus devices regulate and controls the heating and cooling system according to demand. Lighting installations are operated more efficiently using sensors and timer programs. The integrated automation system links with day light systems, sun protection, ventilation and other systems whereby further energy savings opportunities can be exploited.

Energy savings with KNX
Up to 40% with KNX shading control
Up to 50% with KNX individual room control
Up to 60% with KNX lighting control
Up to 60% with KNX ventilation control

Intelligent capture of consumption data as well as coupling with intelligent works (Smart Grid system) opens up new possibilities for further optimization and increased energy efficiency for both today and the future.

One thing is clear we control climate change!

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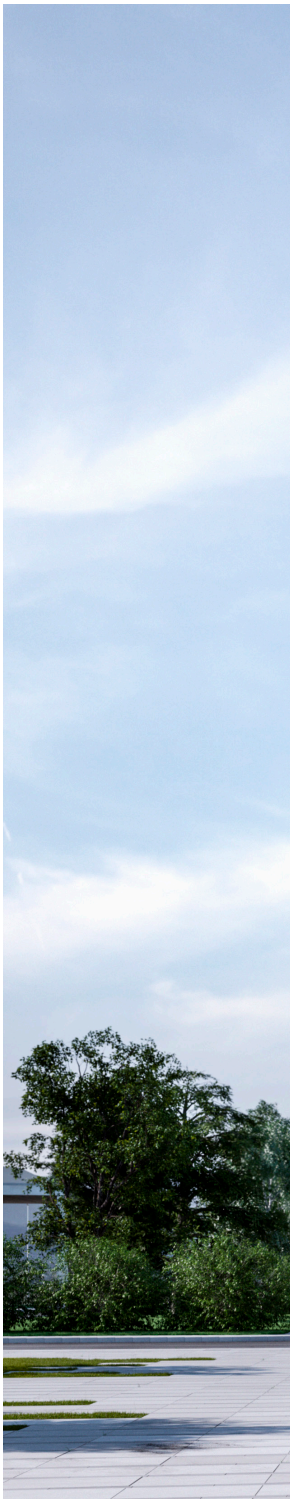

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