ENERGY SAVINGS FROM INTELLIGENT METERING AND BEHAVIOURAL CHANGE: CASE STUDY ASV, HORSENS, DENMARK

This case study examines the benefits to a Danish education centre of monitoring its water and energy consumption, the latter as used for heating and electricity, using an automatic metering and monitoring system.

General description

Description of the building

The educational centre is in Vejle County, Denmark. The centre serves around 900 people in the local area and has around 40 full time staff.

The buildings themselves where erected in 1976 although extensive renovation was carried out in 1992. Additional buildings were erected for increasing classrooms in 2001-2002 and a new kitchen erected in 2004. The overall area of the centre is 12,000m^2 area with 4,000m^2 of built up area. The larger area includes outdoor space, i.e. for sports facilities and the other figure is the heated area.

The environmental aims and regulations of the county have a focus on a sustainable development in the region. This has resulted in increased awareness of energy use in buildings and also of waste and recycling issues. The Intelligent Metering project has been a welcoming project, since it fitted in so well with the overall plan to be certified with the 'green flag' as it is called in Denmark. Previous to this project, the energy and water consumption was read manually by the management and not analysed but handed in to the council.

Location

The centre is situated in Horsens town, with a population of just under 60,000. It is located at a latitude of 55^o 51N and longitude of 9^o 50 E.

Horsens is one of the bigger towns within Denmark and is steadily growing larger. It is situated at the mouth of a fjord.

Levels of energy consumption

The exact benchmark figures for this type of building use are difficult to establish, as the facilities are larger for this type of centre than an ordinary school. However, the high school figures have been used, as it is also a day-time facility only and with sports facilities etc.

	Good practice	Typical	Poor practice
	kWh/m^2/ annum	kWh/m^2/ annum	kWh/m^2/ annum
Electricity	18.6	30.3	46.1
District Heating	69	104.8	147
	m^3/m^2/ annum	m^3/m^2/ annum	m^3/m^2/ annum
Water	0.14	0.24	0.34

Table 1: DK benchmark for energy consumption in high schools

Energy consumption for 2005

Electricity	100,665 kWh	25 kWh/m^2
Heating	177,186 kWh	42 kWh/m^2
Water	499 m^3	0,12 m^3/ m^2

Table 2: ASV Horsens, 2005 energy and water consumption figures

Behavioural patterns

The usage of the centre varies considerably over the year compared to a normal school, for instance in terms of opening times, sports hall usage, number of students (depending on the timetable), etc. Analysis has indicated that there are considerable changes in energy and water consumption due to this variation.

Needs assessment

Monitoring objectives

ASV Horsens has devolved energy budgets on a monthly basis based on manual meter readings, which have been passed on to the regional authority. Based on the incoming data from the building, the regional authority advise on how to improve the energy consumption in the building. The consumption figures were read manually every month as a part of the building management procedure.

Parameters to monitor

In order to get an insight in the total energy and water consumption of the building and its users the building monitors energy consumption, in terms of electricity and heating use, and water consumption.

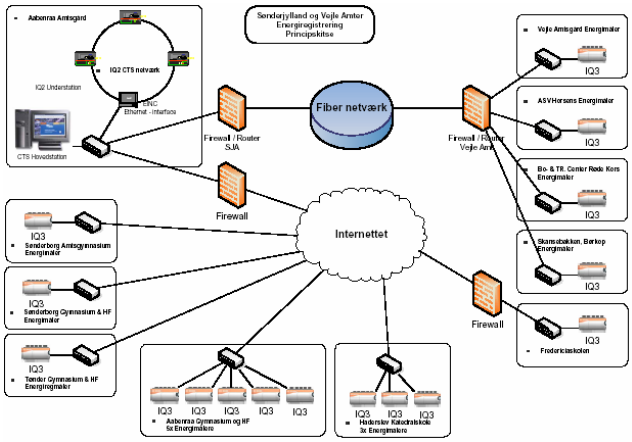
Energy and water are the most controllable elements in the building's budget and by using simple and cost effective efficiency measures utility bills can often be reduced.

Lessons learnt

Even if the building management was already 'green' in the way of thinking about consumption, there was still a saving potential available, which only became visible once the monitors were installed.

Monitoring systems

For all the buildings that are a part of the Intelligent Metering project, the data is collected in the same way.



Above is the drawing of data collection from the Danish buildings to the central server (CTS) in Aabenraa.

Communication (Data Transmission Protocols)

From the CTS on the main station in Aabenraa County building, the data is collected once a day from the IQ3 boxes. This takes place between 6-7 p.m. It takes approximately a minute per sensor. The sensor data is transported to Aabenraa County via the local network and the line that connects the two county buildings included in this project.

The collected data is saved in an Access database. When the data is transported on to the Intelligent Metering database, the data is sent as CSV files. The CSV files are sent daily via FTP to the SQL database around 9 pm.

Data management (Data storage)

Within the European Commission supported Intelligent Metering Project (ref. EIE/04/107/S07.38635) the half hourly information, once collected, which is transmitted to an SQL database, is used to generate consumption graphs which are displayed on the project website (www.intelmeter.com). The school can then access their information via the public Internet.

Hardware

Meters were installed on the main pipes for electricity, heating and water. The meters send pulses every half hour to the local computer, this data is then sent on to an SQL (Structured Query Language) database once a day.

This automatic reading of meters and data analysis allows monitoring against historical targets or theoretical guidelines. Consumption can be related to weather, occupancy, production or a signature of past consumption profiles.

Costs

The cost for the system was 18,400 DKK (approx. 2,500 EURO) including all components, programming and electrical works.

Lessons learnt

The collection of data in an SQL database proved to be a successful solution due to the possibilities for analysing data afterwards. However, since the building is now also using the figures for showing students in classes, it would have been beneficial to make consumption data available as quickly as possible. As the system is now, the data is one day old and therefore perhaps less interesting for

students, but good for energy management.

Monitoring Management

Procedures

The system automatically sends data to the Esbensen SQL-database once a day with half-hour pulses from the last 24 hours.

Responsibilities

As with all of the buildings based in Denmark managing the monitoring output has been the responsibility of HO Service A/S, a service provided by the local authorities.

Lessons learnt

It is beneficial to have alarms set that warn building managers or technical staff about unusual behavioural patterns, especially if it is not possible for the technical staff to view the graphs on a daily basis.

Data Analysis

The graphs shown below are produced from the Dynamat software by the Energy Management Bureau.

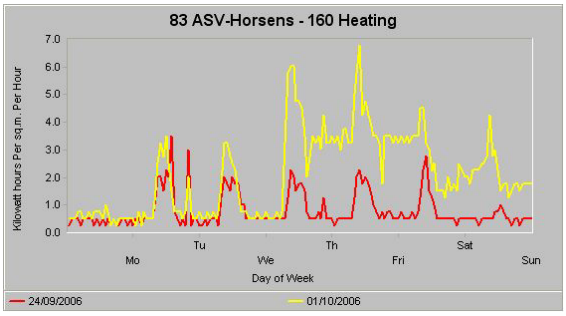
Energy performance analysis

The energy consumption data is compared as key figures to the previous day, week and month, so that the images of the consumption are always two graphs on top of each other. This gives a clear image of how the energy and water is consumed compared to a similar day/week/month.

Saving identification

Heating

The example from a DYNAMAT graph – week-on-week heating consumption.

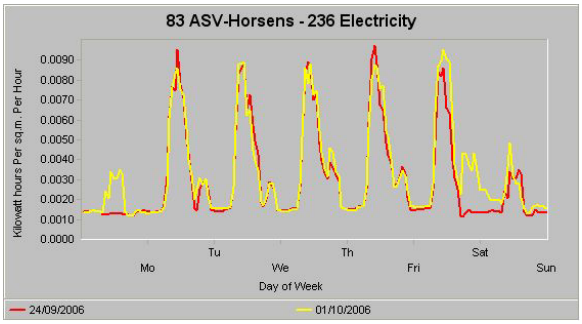


There are two key issues to consider:

1. sudden jump, found to be due to colder weather conditions or use of larger facilities
2. low consumption over night.

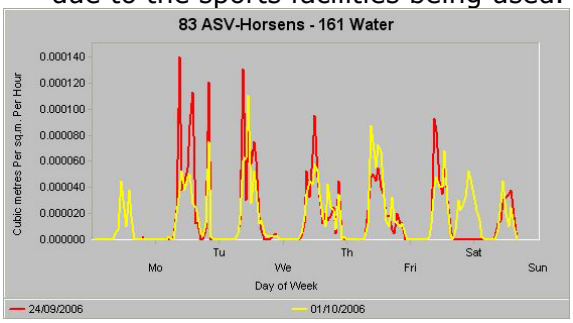
A similar graph (below) for electricity also illustrates two key patterns:

1. very even weekly pattern;
2. low stand-by consumption.



A graph (below) for water consumption illustrated that:

1. there were no leaks during the week;
2. there was consumption over weekend, which was investigated and found to be due to the sports facilities being used.



Lessons learnt

Using the intelligent metering and monitoring has made it much easier to track the consumption and define the reason for any unusual consumption patterns so that in the future any problems can be recognised quickly.

Training package

A training package, produced as part of the Intelligent Metering project was developed and customised towards Danish buildings and standards. It was then presented at a launch event for the building managers. The training package's aim was to provide support so that building users could change their usage patterns in order to save energy and water. In order to give the training more structure, the training plan was divided into three main areas:

Enabling - This is the range of techniques and factors where the intervener provides alternatives to existing unsustainable actions and behaviours.

Engaging - These are the tools available to communicate with and engage the building users in the sustainable development process.

Incentivising - In this case they are municipal authority interventions, for example economical rewards for reducing energy and water use.

To ensure that these drivers translate into real change **catalysing** is required. This is where combinations of the three drivers are brought together with one key element that stimulates mainstream change in actions and behaviour.

Training used

As well as the launch event individual meetings were made by the local authority, Vejle Council, to the centre to show the graphs for consumption figures and firstly, to review the immediate and future potential for energy efficiency. Secondly, to define the need for training building users to enhance awareness on energy savings and hence cost saving measures, based upon the graphs provided on the website.

Analysis of training actions

The training of building users proved to be a welcoming part to the overall wish from the building users to become 'green'. The building managers where sceptic if they could save additional energy by having the monitors installed, and this was partly true. However, during the training it was pointed out that even though there may be small stand-by consumption, it is also worth it to look at the consumption peaks and try to locate ways to bring down the top of the peaks. This will be the goal of the building managers in the near future as a part of the overall 'green' plan.

Supported by:
Intelligent Energy Europe