

# Energy Management in Municipal Buildings

# ODENSE Denmark

*The experience of Denmark in energy labelling for buildings is currently the most advanced in Europe. The energy management approach of Odense was developed in the context of the long Danish history of promoting energy saving in the building sector. The city of Odense has progressively reduced the energy consumption of its buildings over the past twenty years through better monitoring, management and improved equipment and insulation standards saving 48 millions euros over the period 1981-2002.*

## THE CITY

Located at the very heart of Denmark, Odense, Denmark's third-largest city and the capital of the island of Funen (Denmark's second-largest island), has about 185 000 inhabitants. The city of Hans Christian Andersen is one of the oldest cities of the country and dates back to pre-Viking times. A bishop's seat from the 10th century, it became a centre of pilgrimage to the shrine of Canute. It grew after its port and harbour were built and the Odense Canal was opened in 1804. It is now a major shipbuilding and manufacturing centre.

### **Climatic data:**

Annual mean temperature: 7.9 °C

Degree days: 3,112



## DANISH CONTEXT

### **The energy-labelling scheme for buildings**

The energy-labelling scheme is a part of the overall Danish policy to reduce emissions of greenhouse gases and especially to reduce the energy consumption of existing buildings.

The general rules for the scheme are given in the *Act to Promote Energy and Water Savings in Buildings* of June 1996 and the two *Executive Orders on Energy Labelling etc.*

The specific rules for the energy audit, the calculation methods to be used and the proposals to be made are given in the *Energy Consultants' Handbook / Energy Management Book*, a quality manual for the energy labelling of small buildings. The act sets the rules for energy management in small (<1,500 m<sup>2</sup>) and large (>1,500 m<sup>2</sup>) buildings, special rules for public buildings, and rules for maintenance schemes for heating systems or other large energy-consuming equipment. Two labelling schemes were developed: the "Energy labelling of small buildings" (EM) carry out by Energy Consultants and "Energy management in large buildings" (ELO) carry out by ELO Consultants (Energy Management Consultants). The seller must provide energy labelling for small buildings before the property is sold, and the

label must be available before the sale. In contrast, the label for large buildings is renewed every year.

When the *Act to Promote Energy and Water Savings in Buildings* was passed in 1996 the yearly energy savings and consequences for the environment each year were expected to be:

- 4 – 6% reduction of heating in 2005
- 300 – 600 GWh of electricity saved in 2005
- 0.5 – 10 million m<sup>3</sup> of water saved in 2005
- 0.6 – 0.8 million tons of CO<sub>2</sub> emissions saved per year by 2005
- 0.2 – 3% reduction of total heating and electricity consumption in the sectors covered

The energy labelling of buildings in Denmark was developed in the context of a long history of energy auditing activities, including the Heat Consultant Scheme in operation from 1982 to 1996. The development of energy labelling was based on a need to improve and modernise this scheme.

Energy labelling was developed by the Danish Energy Agency in close co-operation with various private consulting companies. Representatives of consultants, consumers, estate agents and other bodies each made their own small contribution to the development of the scheme.

A special training course was devised for the education of energy labelling consultants. They have to take part in an annual one-day refresher training course and they receive a newsletter at least four times a year telling them about new rules and providing clarifications and general information on the development of the scheme. The quality of the labelling is inspected by means of a special quality control system, including the relabelling of some buildings chosen at random, visual checks of some of the label assessment forms, recalculation of consumption, etc. Consultants who don't meet the quality standards of the labelling scheme will lose their registration. All of the costs for developing the scheme were covered by the Danish Energy Agency out of the national budget. The "energy labelling of small buildings" stipulates that consumers – i.e. building owners – must cover all of the costs for energy labelling, energy audits, and the administration of the scheme.

The information has to be drawn up on one of two standardised forms depending on whether it is for small or large buildings. For large buildings, the labelling can be separated into two different parts, each with a different function (three in Odense).

- *The Energy Mark* is one page and includes a standardised energy rating or labelling of the building containing information about energy and water consumption and CO<sub>2</sub> emissions compared to other buildings with a similar use.

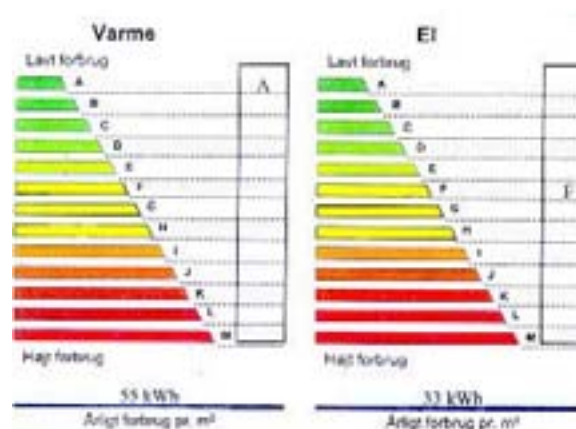


Fig. 1 – Example of an Energy Label (heat and electricity consumption per m<sup>2</sup>)



Fig. 2 - Energy rating for CO<sub>2</sub> emissions

- The energy plan for the building shows consumption over the last three years in figures and in columns and includes an action plan on profitable energy-saving measures for all types of energy and water use in the building. Estimated costs of the investments necessary and the annual savings of the measures are given as well. Finally, it gives information on the technical lifetime of the proposed measures.

For buildings owned by the Municipality of Odense, a third point applies:

- Information on the documentation of the labelling and the energy plan. The documentation contains information on the present state of the building: the climate shield, the systems for heating, water, ventilation, electricity, etc.

### The rating system

The energy rating permits one to classify buildings with a similar use on the basis of their heat, water and electricity consumption as well as their CO<sub>2</sub> emissions, the lowest energy consumption or CO<sub>2</sub> emissions being grade A and the highest grade M (see Fig. 1 and Fig. 2 above). Odense has adopted an application code that defines the different types of buildings: schools, hospitals, offices, etc.

While developing the Energy Label, the Danish Energy Agency also introduced a classification scheme for each building type.

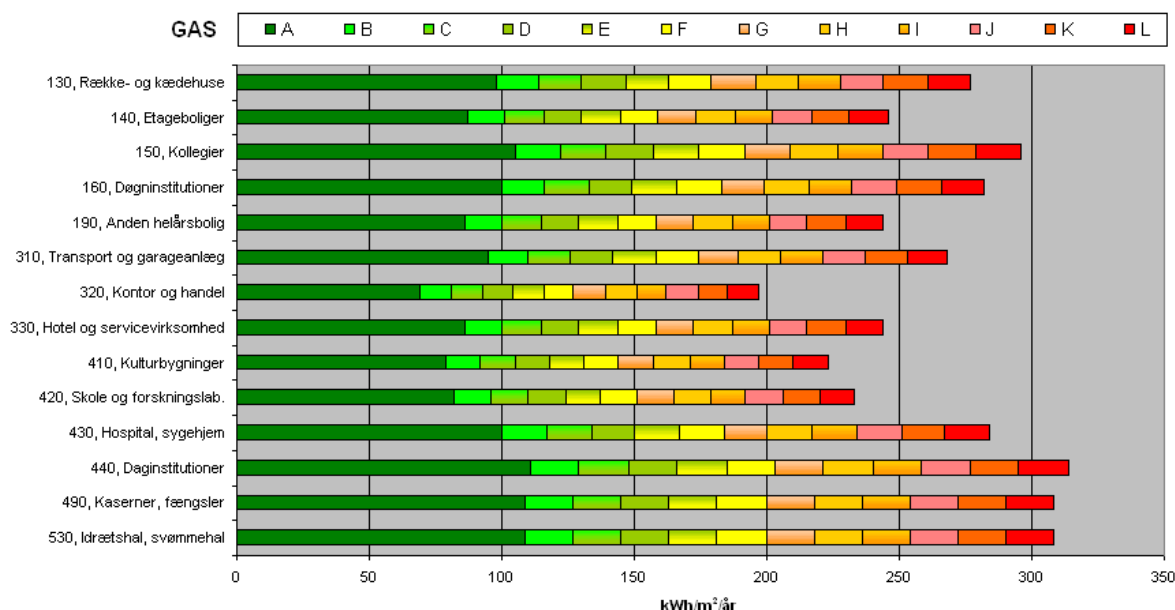


Fig. 3 - Relation between annual gas consumption per m<sup>2</sup> and energy rating for each kind of building

The energy labelling is a way to achieve energy savings in existing buildings. These buildings were built before high requirements for insulation were introduced. They cannot be addressed by traditional initiatives such as Building Codes or Improved Building Standards and the potential for energy savings in existing buildings is huge.

# EXPERIENCE OF ODENSE

Today, the Odense Municipality owns 625 buildings: schools, day nurseries, nursery schools, administrative offices, sports facilities, cultural centres, social housing, etc., with a total of 2,600 energy meters. About 105 of the 625 buildings have 1,500 m<sup>2</sup> or more. The heated area is 950,000 m<sup>2</sup>. The municipality manages all these buildings and is responsible for energy use.

A systematic approach to energy management started in 1979 in order to save heat, electricity and water in buildings maintained from the budget of Odense Municipality. This programme was introduced because district heating prices tripled in that year and the local power provider could not obtain coal, oil and natural gas. Therefore, the local authority began a critical review of energy consumption in municipally owned buildings with the aim of saving energy.



At first a message was sent to all users of municipal buildings with the following message:

- Turn off the light when leaving the room.
- Not more than 20<sup>0</sup> C in rooms.
- Control your ventilation.

In addition, all of the heating valves on radiators in schools were replaced with thermostatic valves.

The main points of action were:

- Knowledge of energy consumption (budget, recording and accounts)
- Knowledge of the energy economy of the buildings (heat surveys)
- Modification to buildings and installations (energy saving measures)
- Information for decision-makers and users

Today, the energy management department in Odense employs 5 people. Their main tasks are:

- Meter reading and monitoring
- Annual energy inspections (site visits and establishment of an energy balance sheet): "Energy Rating" and "Energy Plan" for properties of 1,500 m<sup>2</sup> or above
- Information, communication and training courses for building users
- Implementation of energy saving measures

## **Meter reading and monitoring**

Since 1997, energy meters for heat and electricity have been required by law in each household in Denmark, and water meters are required in each building. The municipality reads electronically connected meters every day and the other (non-electronically connected) meters once a month.

In order to achieve savings – and thus ensure correct bills – it is vital to monitor the energy consumption of buildings. Usually monitoring saves 5 - 15% of the consumption; in Odense, about 15% of the savings are due to the monitoring of consumption.

### **Energy inspection / auditing**

The law also requires an annual energy inspection of all properties above 1,500 m<sup>2</sup>. For the energy inspection, the annual consumption of heat, electricity and water is assessed in relation to the budget. An inspection of the building is undertaken in order to make an energy assessment of the building's envelope and equipment. On the basis of this, the "energy label" is issued (see *DANISH CONTEXT above*). At the same time the "energy plan" is drawn up (produced using the software ELO developed by the Danish Energy Agency). This contains both proposals for changes in behaviour and proposals for energy saving measures.

### **Information**

The information provided includes:

- Reports to all the energy managers and officers responsible for buildings. In these reports information is given about the budget, consumption and observations/comments
- Thematic training days to raise awareness among building users
- Training courses for building managers and caretakers.

### **Energy-saving measures**

Energy consumption is reduced in existing buildings by improving the buildings' envelope, technical installations and – most importantly - the building's automation system. An action plan is drawn up, and savings and economics are calculated so that measures with payback times of less than six years can be implemented.

### **Energy savings in schools**

The City of Odense has decided to focus on energy efficiency in schools because:

- Its 35 schools made up one third of the total energy consumption in municipal buildings
- In each school, 2 people are responsible for energy use: the headmaster and the caretaker
- The control of energy use in schools also has educational value for children

Today Odense Municipality manages 40 schools and they remain the most important group of buildings in terms of energy management. The programme doesn't run itself. Rather, it requires constant promotion and depends on the motivation of the people concerned.

## **EVALUATION AND OUTLOOK**

### **Results**

The Municipality of Odense has committed itself to reduce energy consumption by 15% in 2005 compared to 1988 - in line with the government's "Energy 2000" plan.

The targets for savings of heat, electricity and water consumption have already been met in many of the buildings (see *Fig. 4*).

Energy management has been highly beneficial for the municipality over the last twenty years. A total investment of 16 million euros has generated savings of 48 million euros over the period 1981-2002. The annual saving is now 2.5 million euros and the total energy bill for municipal buildings (heat, diesel oil, natural gas, electricity and water) was about 15 million euros in 2002 (including VAT).



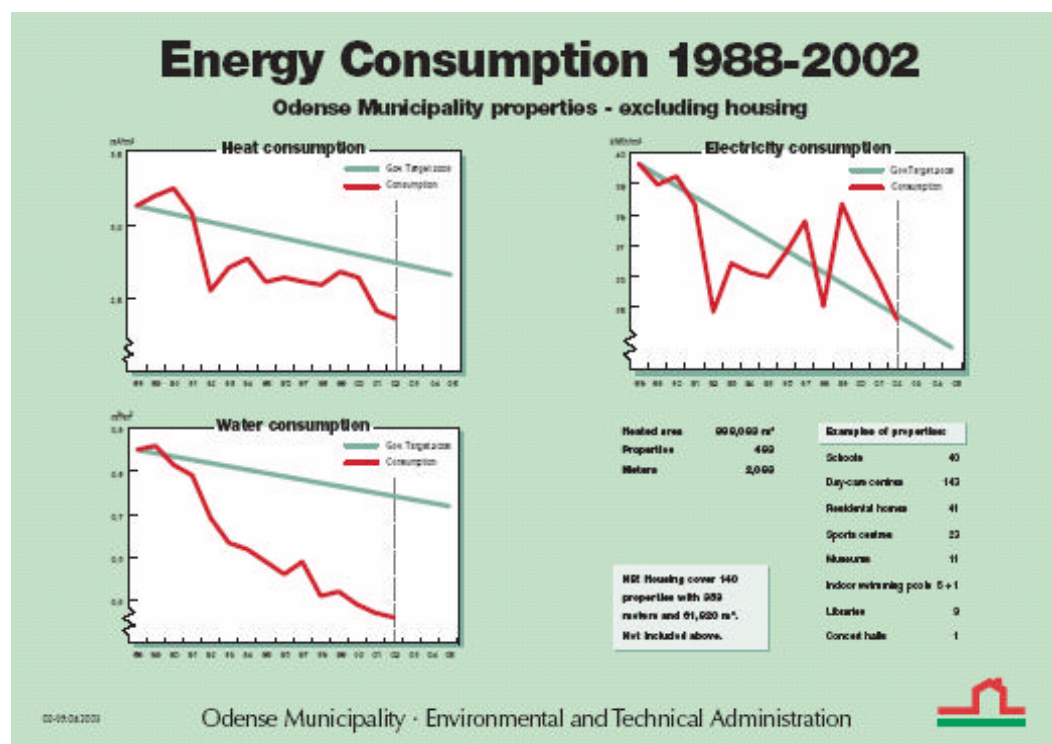


Fig. 4 - Energy consumption in Odense municipal properties from 1988 to 2002. The green line is the 15% saving objective. The red line is the actual consumption.

### Difficulties

The Odense municipality has met and overcome numerous kinds of difficulties. The main difficulties were:

- **Monitoring**

When monitoring started in 1981, not much information about energy consumption was available (either in terms of energy or cost). Therefore the City of Odense introduced energy budgeting systems for their buildings and started meter reading and motivational campaigns addressed to the person responsible for energy in each school. On the last working day of each month these people have to read all the meters and to communicate the data to the energy management office. The municipality had some difficulty getting this done - and it is still a problem today. However, the most important buildings now have electronic meters connected to workstations. Since January 1<sup>st</sup>, 2003 data registration has had to be done via the Internet. This permits the energy manager to make a virtually immediate link between monthly consumption and the budget and enables him to compare this with the relevant values for the last 6 years.

- **Motivation for energy savings in the schools**

Keeping teachers and children aware of energy use is a continuous challenge. For example, one can forget to switch off the light when leaving a classroom. A study showed that in a school, over a year, the money spent on lighting rooms with no people inside is equivalent to the cost of 3 cars (Danish car prices). Therefore a decision was taken in Odense to install sensors for daylight and movement.

- **Keeping electronic equipment up to date**

More and more electronic equipment is being used to achieve energy savings. Telephone lines are used for electronic connections to read meters and support building management systems. Telephone lines have given a great many problems. Over the last year, therefore, Odense has changed many such lines to Intranet

TCP/IP. But new equipment and building management systems also require more education and the training of personnel!

It takes quite a few years to complete the process of achieving energy efficiency and a big effort is still needed to keep energy management running. Measures introduced have to be evaluated and new measures planned. It is also important to keep raising the awareness of users. Today the most important instrument of energy management in Odense is energy labelling.

## FOR FURTHER INFORMATION

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