SEC Tools

Guide to
Energy Management in Municipalities

ENERGY CONSULTING NETWORK

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0 Introduction

This 'Guide to Energy Management" presents general guidelines for introducing and operating Energy Management in municipalities and in general.

Introduction of energy management should be coordinated with the national legal framework following EU directives related to energy efficiency in buildings.

Actions on making energy labelling are not covered by these guidelines.

The guidelines have been amended and refined by Energy Consulting Network for use in the **SEC Tools** project, partly based on adaptation of a guide written by Energy Consulting Network under the project: Energy Management in Public Buildings, Latvia – Danish Environmental Related Energy Sector Programme, 2005.

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1 Why is Energy Management necessary?

- Public institutions will save money by making a more efficient use of the installations and the equipments, or by using better equipments
- By using energy efficiently public institutions can achieve a more comfortable working environment and indoor climate
- EM is a way to clearly identify all the energy costs
- Improved energy efficiency will contribute to reduce the CO2 emissions to the atmosphere
- Awareness about energy and environmental matters can improve a municipality's/institution's image to the outside world

2 Which factors does Energy Management deal with?

People
Inefficient use of energy is to a large extent related to bad habits of people. Thus, change of such habits will result in a more efficient use of the energy and, as a consequence, public institutions will save energy and usually also money.

Buildings
The following aspects of the building influence the energy necessities.

- Sun light and sun heat
- Energy system controls: Control devices such as thermostatic valves, switches etc.
- Energy system distribution
- Energy system efficiency
- Insulation and materials.

Energy type used
Energy services can be achieved by different types of energy.

Installed equipment
The installed equipment is one of the most important energy solicitors of the building. Depending on their efficiency and performance, there will be a different level of demand on energy.

External factors
Some external factors, such as the weather conditions, influence energy demand and therefore Energy Management.

3 What is Energy Management?

An energy management system comprises a set of systematic and continuous actions aimed at reducing an institution's energy costs and increasing productivity.

In short, energy management implies:

- Frequent and regularly measurements and controls/inspections
- Proper evaluation of the measurements and the controls
- Efforts to implement necessary measures in time
- Implementation of technical improvements when necessary.

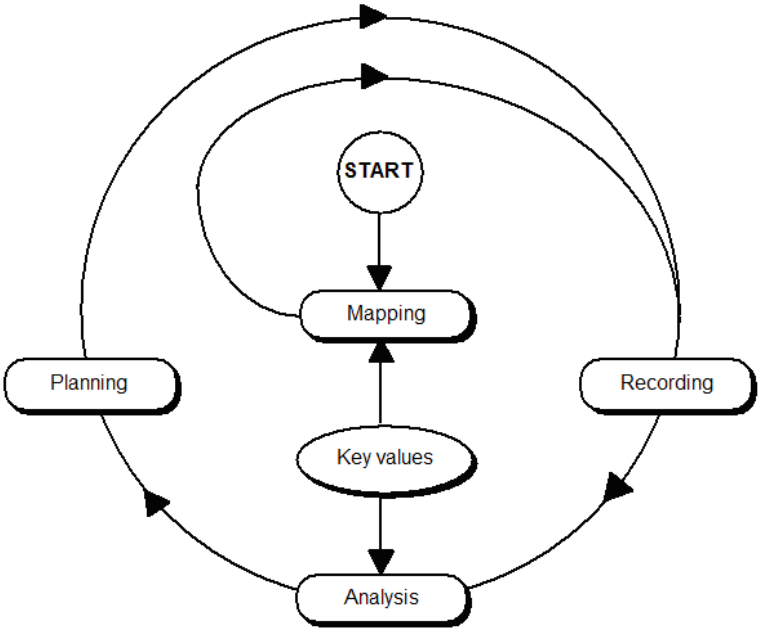
Hereby:

- Defects and inexpedient operations are revealed and can be changed
- Intervention can be made quickly when unfavourable trends occur
- Profitable improvements and their priority are more easily pointed out.

Before the energy management is launched, an Energy Manager (co-ordinator) and energy responsible persons in every institution/building should be appointed, who are given the task of energy management.

3.1 The EM Circle

Energy management can be explained in relation to an energy management circle:



Start
When introducing energy management the first time it is advisable to determine objectives for activities and results within the first two-three years.

Mapping
This starts with a temporary mapping of energy consumption, where and when the consumption take place. A budget must be prepared, e.g. based on the consumption from the previous years.

Key values
Key values can be used as a basis for the objectives. Key values could for example indicate the relation between the annual energy consumption and the heated floor area, e.g. heat consumption per heated square metre, enabling comparisons among buildings. The key values primarily give an indication about the level of the energy consumption in the institution.

Recording
The recording of the actual consumption in the buildings should start as quickly as possible. The units are normally kWh for electricity, MWh for district heating, m3 for hot water and m3 for natural gas. Later, it may be necessary to install additional meters enabling recording of consumption in separate parts of the buildings thereby improving the control possibilities.

Analysis
An important task in energy management is the analysis work. This includes comparing the recorded consumption with e.g. the budget figures, reference values and previous years. Comparisons among buildings may also be useful. Deviations have to be analysed, partly through control of the buildings and the way they are operated, partly by critical control of the budget assumptions. On the basis of these analyses the Energy

Manager is able to make proposals for changes and improvements, which can enter into the next phase.

Planning
The results of the analyses are incorporated into a new budget for the forthcoming period. The new budget should also incorporate the improvements already achieved. In addition, plans must be prepared for implementing energy efficiency measures during the period. In this way, an ongoing improvement of the budget assumptions and of the energy level of the buildings is obtained. The following year(s) objective for energy management is to be determined, including how to prioritise the various tasks.

Following this procedure, an institution would operate within a good "energy management circle" continuously keeping the energy consumption at the lowest possible level, without compromising function, comfort and economy.

4 Organisational Set-up

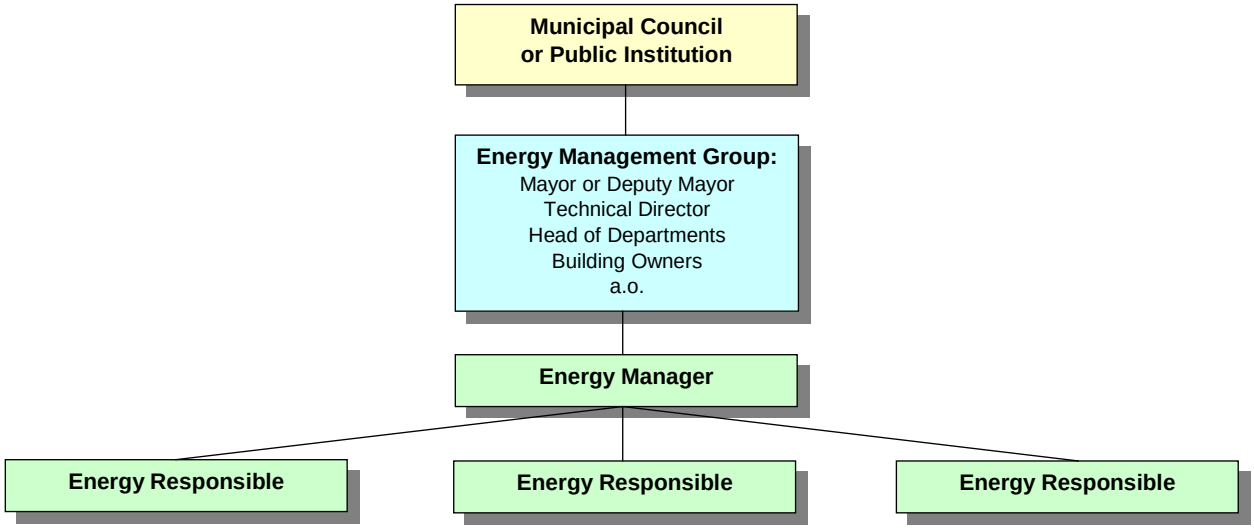
The work involved with energy management requires effort from all levels in the Municipality system or in the system around state institutions.

Municipalities and state institutions are of very different sizes and local conditions will have an influence on how the work can be best arranged. In addition, the energy political objectives have a deciding influence on how the task is approached.

Therefore, it is not possible to give a general answer as to how energy management is best organised. It is, however, important that the function of energy management is positioned centrally and as close as possible to the political and economic decision makers.

4.1 An Energy Management Organisation Model

The figure below shows one possible way of organising energy management in a municipality or in a state public institution:



It is the responsibility of the management to ensure that energy management is launched on the basis of an objective and a strategy, which have been politically agreed upon. It is further the responsibility of the management to delegate authority and tasks to the organisation in the Municipality or in the state institution where the practical aspects of energy management should be controlled.

4.2 Energy Management Coordination Group

Depending on the size of the municipality or the state institution it is recommended to establish a permanent "Energy management Group" representing various departments/institutions (or others) to co-ordinate and monitor the activities initiated as well as reporting to the political level, including providing recommendations for adjustments of objectives and means of intervention.

The Energy Manager (co-ordinator) and the energy responsible persons (e.g. in buildings or institutions) will have the responsibility for the daily operation of the energy management system.

The position of the Energy Manager in the organisation can vary from Municipality to Municipality (or from state institution to state institution) depending on the administrative and organisational structure. It is important that the person in question is positioned as close as possible to the political and economic decision makers. Commitment at the high management level and at the political level is a pre-requisite for successful energy management.

4.3 The Energy Manager

An Energy Manager's role is to manage both the Municipality's or the state institution's current energy needs and its future energy strategy in an environment where supply and price fluctuations can have a significant impact on budget performance. In general terms, an Energy Manager is part strategist, part project manager and part change manager. He/she should be able to focus both on the technical aspects of the work, and on issues of communication and involvement.

The Energy Manager should be someone who is interested in new developments, and who is committed to assess and test new ideas and new ways of solving problems. He/she should also be someone who can plan and take a long-term view, especially as savings accrue in both long and short timeframes. He/she should be good communicators, with a solid understanding of how to introduce change in complex environments.

On one hand, the decision maker in terms of Energy Management is mainly the Energy Manager with the support of the decision makers. They are the people who can change the energy policy. On the other hand, everybody who uses the building can do something to improve the energy use. One of the most important tasks of Energy Management is to inform people with the aim of changing their habits as far as energy use is concerned.

Managing energy consumption within an institution requires a number of functions to be performed. These would in general include:

- Developing policy
- Monitoring and reporting energy consumption
- Researching and identifying best practice energy management
- Implementing programs and policies to achieve energy savings
- Securing the support of management and staff
- Influencing new works policies, tender specifications and construction briefs.

In relation hereto the Energy Manager should undertake the following functions:

- Lead and Coordinate the Municipality's or the State Institution's Energy Management Group
- Assist the energy responsible persons with the start up and running of the energy management system

- Disseminate information concerning the energy management system throughout the organisation (both upwards and downwards)
- Establish links with the information departments of the energy supply companies
- Gain control over the way energy is used. Ensure it is being purchased in the most economical and energy efficient way and promote good housekeeping and waste reduction
- Measure and monitor energy performance, and compare it with previous years as well as internal and external benchmarks
- Report energy performance simply and clearly to managers and supervisors
- Ensure investment requests are backed by data and a realistic business plan
- Give advice on economic aspects and investment frameworks in order to choose and give priority to initiatives that yield the greatest savings
- Disseminate and promote achievements to management and publicise success to staff to ensure ongoing support and enthusiasm for the energy management system
- Prepare an annual status for presentation to the managers and politicians. Together with the energy management group, he/she should present suggestions for possible adjustments in the objectives, strategy and means

Selecting an Energy Manager:

Key selection criteria for an Energy Manager could include:

- High-level communication skills, including liaison, negotiation and consultation skills
- An understanding of energy costs and the structure of the energy industry
- Familiarity with engineering systems and energy efficiency technologies
- A demonstrated capacity to learn new skills and integrate new knowledge into existing work activities.

Other relevant skills, knowledge and experience include:

- Experience with implementing and promoting complex, multi-output energy management systems
- Motivation and willingness to undertake further training and skill acquisition
- Commitment to ecologically sustainable development and reduction in greenhouse gas emissions
- Ability to use word processing, spreadsheet and database packages
- An understanding of operations and other areas such as safety, quality, finance and environment issues
- Some knowledge of the English language.

4.4 The Energy Responsible Person- Building Level

The institutions and building complexes in municipalities and state public buildings vary greatly in size - from large hospitals with specific operation departments to small institutions with only 1 employee taking care of the daily operation.

When selecting the energy responsible person, the following considerations should be taken into account:

- he/she should be placed close to the management of the institution

- he/she should be in close contact with the various sections which take care of the technical operation within the institution in question.

It would be an advantage if the energy responsible person possesses some technical knowledge, however this is not a requirement. He/she could therefore come from either an administrative function or a technical department (if such exists).

For larger institutions, possibly with their own operation departments, it would not be unusual that the energy responsible person be appointed from amongst the operational personnel - for example, a person who is involved in the management team of the institution or the company.

For smaller institutions without a separate operation department, the manager of the institution often performs the tasks of the energy responsible person in addition to his other duties. He/she could, of course, choose to delegate some of the practical tasks in connection with energy management to one of the employees.

In housing associations, the janitor/boiler-man/caretaker will typically be the person, which can be nominated as an energy responsible person

4.5 Resources Needed for Energy Management

The size of the municipality's or the institution's energy bill and the potential savings give the best indication of how much time should be devoted to energy management.

Depending on the size and activities of the company, the Energy Manager may be more than one person. In large municipalities or state institutions there may be a number of people with responsibilities, together with the Energy Management Coordination Group.

4.6 Outsourcing Energy Management

External consultants may perform some energy management functions. For example, technical consultants can undertake energy audits. Specialists may also be engaged to perform particular tasks, such as tracking and monitoring energy use. Energy performance contracting may also be useful to fast-track and provide external funding for energy projects.

5 Establishment of Energy Management

Prior to the practical initiation of energy management, it is important to obtain an overview of the energy consumption in the buildings to be covered by the energy management system. The main idea is to be able to point to the energy intensive areas and areas where energy savings can be realised with the fastest pay back time.

Already at this stage, it is important to obtain as much data as possible since this will later form the basis for the initiation and operation of the energy management system.

As a minimum, the following data should be collected:

- Energy consumption statistics
- Meters (number) and tariffs
- Building information

5.1 Mapping of Energy Consumption

Mapping of the energy consumption can be done with various levels of detail. As a minimum, however, it should always contain the following parameters:

- Total energy consumption (kWh or MWh),
- Total energy consumption for heating and hot water per energy supply type (district heating - MWh, GJ, Gcal; natural gas - m^3; oil - m^3 or tonnes; electricity - kWh),

For several reasons, energy consumption statistics *must* be given in units. Firstly, energy consumption given in monetary terms cannot be used in analyses, comparisons and consumption control. Secondly, the energy units are very important when considering the environmental consequences of energy usage.

5.2 Mapping of Buildings

The next element in mapping covers the collection of data on the building stock.

The following data should be collected for each institution/municipality in order to implement the energy management system:

- Building number(s)
- Usage category (given with a code)
- Floor area
- Heated area
- Type of heating
- Any additional heating and type
- Number of floors
- Construction year
- Construction year for any extensions.

5.3 Mapping of Meters

With the help of each individual institution, the position of all meters should be recorded. This should also include details of which buildings and which usage each meter covers. If there are problems in locating the meters, the energy supply company can usually assist.

For institutions with own heating supply (e.g. oil boiler), the consumption can be registered by means of invoices from the suppliers.

In the case of electricity consumption, there will normally be a meter for every property.

All data concerning meters and buildings should be registered for each institution on a specially designed scheme or in a PC program dedicated for the task.

The measurements should always be recorded together with the meter identification number and measurement unit (kWh, MWh, GJ, m3 etc.).

5.4 Mapping of Other Conditions

In connection with mapping, the tariffs used for charging users can also be noted. For example, some tariffs are divided into two or three bands whereby usage is registered depending on which period of the day it occurs.

Over and above the physical mapping of buildings and meters, it is also advisable to take note of other conditions, which may - directly or indirectly - have an effect on the initiation of energy management systems - for example, problems with the indoor climate.

It is also important to note the opening hours (usage time) of each institution. This is particularly relevant when comparisons are to be made between the energy consumption in one institution with that of another similar institution.

6 Initiating the Energy Management System

The information obtained during the mapping and data collection form the basis for the commencement of the energy management system.

The results would enable identification of areas to put focus on in the first instance. A strategy could also be to focus on all areas of consumption.

In principle, the work on the energy management system can be initiated at any time of the year. It is not necessary to start at the beginning of a new year or at the start of a new fiscal year.

A number of technical preparations should to be made prior to the practical start-up of energy management activities.

6.1 Basic Data

For use in the preparation of budgets, energy consumption figures and expenses can be presented as a set of basis data (reference data). In the case of heating demand, the figures should be converted to show demand in a "normal year" (climate adjustment).

Basis data must be current and should be used as the basis for comparison in the institution in connection with the continuous follow-up and analysis of the development of energy consumption. The basis data represents an important set of assumptions for controlling the energy management system.

The basis data should be kept up-to-date with any changes made in the institutions e.g. building extensions, completion of energy saving measures, changes in the use of the building or changes in the opening hours (usage time).

6.2 Meters

Precise measurements and records of energy consumptions is an important pre-requisite for s successful commencement and operation of the energy management system.

Necessary measures to obtain registration of the entire consumption for electricity, heat and hot tap water, such as installation of meters, should be carried out in the start up phase.

6.3 Tools

For easy exchange and handling of consumption data between the energy management function (Energy Manager) and the decision makers, it is an advantage to utilise PC systems for the daily registration, and for preparation of budgets and analysis work.

The use of PC systems involves a number of resource-related advantages including the fact that PC tools are suitable for ongoing analysis and reporting.

The PC tool can be a standard internet-based tool, where all data are manually or automatically put into the EM tool via the Internet. Or it can consist of a tailor-made spreadsheet model.

7 Operation of the Energy Management System

7.1 Recording Energy Consumption

The energy responsible person at each institution/building should record the energy consumption figures on a continuously basis.

Energy consumption should be recorded frequently in order to be able to follow the development in the demand and compare it with the budget expectations or with demand in the previous year(s).

Registration of energy consumption should be made on a weekly or monthly basis - usually on the last day of the week/month. Each element of energy consumption considered in the energy management system should be measured. The readings should always be made at the same time in order to facilitate comparison with previous years.

For very energy intensive institutions, it may be advantageous to make daily readings of energy consumption.

7.2 Recording Sheet

Records should be made for each individual meter (electricity, district heating, oil etc.). The energy responsible person should note the *date* and *meter readings* on the sheet and should pay attention to the measurement units used (kWh, Mwh, GJ, m3 etc.).

7.3 Reporting to the Management Organisation

The Energy Management Group and the Energy Manager should continuously control and follow up on energy management at each individual institution in cooperation with the energy responsible persons.

7.4 Energy Consumption

It is the task of the energy responsible person to regularly report the actual consumption figures to the management organisation i.e. at time intervals agreed. For this purpose a special form could be designed which can be possible sent by e-mail.

7.5 Follow-up of Energy Management

Energy Management should be followed continuously by means of the registration and the analysis of energy consumption. The follow-up work should be carried out at two levels:

- Institution level
- Overall level (the entire Municipality or State Institution)

Among other things, the follow-up work should show whether the users are following the agreed budget.

7.6 Preparation of Energy Consumption Budgets

If an institution has never previously been involved in energy management, the previous years consumption and expenses could be taken into account in the preparation of the budget. .

The first budget may therefore equal the consumption in the previous year (heating demand should be converted to a normal year). During the preparation of budgets, the Energy Manager should compare these base figures with some key figures.
There may be some expansions/down-sizing, or other changes planned which will have an effect on the energy consumption and expenses within the budget year. In such cases, the base figures should be adjusted.

Budget preparation should cover all forms of energy consumption. The information should give consumption figures in units (kWh, GJ, m3 etc.).

The budget preparation should divide the consumption into weekly or monthly figures. The fact that the consumption varies throughout the year must be taken into account.

Naturally, the variation in heating demand depends on the climatic conditions. Heating demand is at its highest during the winter months, and at its lowest during the summer months. The distribution depends on many factors e.g. the use of the building, the number of hours the institution is open each day, and the condition of the insulation of the building.

Unlike heating, the variation in electricity consumption is hardly affected by the climatic conditions. The portion of the electricity consumption which is used for lighting will be greatest during the winter months when the number of daylight hours is at its lowest. As with heating demand, the electricity demand will depend on what the building is used for and to what extent.

The Energy Manager should collate the energy budgets for the individual institutions/buildings with a view to preparing a combined input to the budget for the entire Municipality or Institution.

7.7 Analysis of Energy Consumption

On the basis of the input from each institution, the Energy Manager should make an analysis consisting of a comparison between the actual consumption figures and those budgeted. Deviations should be carefully analysed by, for example, carrying out an inspection of the building, its technical installations and how they are operated - together with a critical look at the budget assumptions. This analysis should be done regularly (either monthly - once the meter readings have been received - or quarterly).

The Energy Manager should report immediately to the energy responsible person if any irregularities are found. It might be required that the Energy Manager assists the energy responsible person at the institute with a thorough control of the building.

Naturally, trends in energy consumption are interesting from an economic point of view. Determining the energy expenses of an institution will be based on the energy management system. Any deviations in energy consumption - in a negative direction - will negatively affect the economy of the institution. With the help of an energy management system, and ongoing monitoring and analysis of energy consumption, one ensures that problems are identified and dealt with promptly - which is also an economic benefit.

Comparing the actual consumption with the budgeted consumption will indicate the development in the energy consumption. The development should be followed for both electricity and heating.

During the analysis of the development in heating demand, particular attention should be paid to the basis for the budget since the demand figures for the previous year may have been used. The climatic conditions vary from year to year and one should be aware of the fact that the actual demand development may vary from what was budgeted.

To make it possible to compare energy consumption in one period with that during a similar period in the previous year (budget figures), both figures should be corrected for differences in climatic conditions - they should be converted to "normal" consumption. If the energy consumption for heating for a full year is under consideration, the figures should be converted to a "normal" year.

The conversion into a normal year can be based on the so-called degree-day system.

Electricity consumption will not normally be affected by the climatic conditions to the same extent as heating demand. During an analysis of consumption figures, the actual readings can therefore be used without making any conversions.

In connection with the analysis work, it is also a good idea to compare the consumption with the heating and electricity consumption elsewhere. This is most easily done with the help of key figures.

Key figures for the various types of energy use are calculated as an annual consumption in comparison to the area of the building (e.g. kWh/m2). When comparing the available statistics, attention must be paid to the basis for the key figures e.g. type of institution and building floor area.

Is it the gross floor area or just the heated area that forms the basis for the key figures for heating and electricity?

When making up key figures for own heating demand, one should remember to convert the demand to a normal year with the help of a correction for degree-days. This should be done prior to comparing the figures with other institutions with similar functions.

Comparisons with key figures for the various types of energy use can only give an indication of the institutions own energy use. Finding oneself at the "good end" or "poor end" of the scale does not show whether an institution is a particularly "good" or "bad" institution seen from an energy point of view. There will often be a scope for using energy more efficiently.

7.8 Environmental Evaluation

Analysis of energy consumption and its development should also include an environmental evaluation. Such an evaluation is done to obtain a picture of the environmental consequences of the use of energy. This is necessary since by far the majority of energy consumption is based on the use of fossil fuels (coal, oil, natural gas), which emit CO2 and other emissions when burnt.