

Networks for energy management in the Tertiary Building Sector – replication of the successful Norwegian Building Networks program

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Abstract

The Norwegian programme for Building Networks (NBN) was established in 1996 and has since been the main national tool for reduction of energy use in the tertiary building sector (TBS). Based on the good results and experiences made, a SAVE project has been initiated to replicate best practise and develop the program further.

The four main elements of the building network projects are:

- Long-term energy performance contracts (minimum 10% reduction in energy use).
- Co-ordinated effort on training, auditing and energy monitoring. Together with extensive energy efficiency (EE) planning this constitutes a holistic and systematic approach, where energy management is integrated on company management level.
- A forum for building owners with similar interests; exchange of experience, “competition” and co-operation to continue after the 2-year project period.
- Benchmarking based on statistics from a national database. Annual reporting of participants’ energy use.

Today the program consists in over 100 network groups with 35 building owners and 1 800 buildings (9 million m²). 80% of the building area is public buildings, but focus has recent-

ly shifted more towards private buildings. Total funding since 1996 is 10 million Euro, and 600 GWh has been saved.

The SAVE project will investigate if and how the experiences from Norway can be used in Europe. Replication of the concept and establishment of the basis for implementation of pilot network projects in partner countries is the aim of the project.

The Norwegian Building Network programme

BACKGROUND

Energy Efficiency Networks for Buildings – the NBN program - has since 1996 been the main national programme for EE in the tertiary building sector in Norway. The Norwegian Directorate for Water and Energy (NVE) has been responsible for running the programme through its Operating Agent for Buildings. Through the initiation, development and full-scale phases the programme, tools are now well established. The NBN programme has proven positive results based on four main elements:

- A **holistic and systematic approach** to RUE in TBS comprising management and owner policy level as well as operators and building users over a period of 1,5 – 2,5 years.
- The network programme promotes and **co-ordinates existing** RUE tools in a project concept focusing on the process and continuous focus on energy use (energy monitoring, training, audits, measure planning, etc.).
- **Long-term energy performance contracts** are signed committing the building owners to energy saving aims (minimum 10%) on management level.

- The BN projects constitute a **forum for building management organisations** with similar interests to ensure exchange of experiences and results.

In Norway the national organisation of EE work has undergone major reorganisation over the last two years, but the philosophy of the building networks program are continued in new programmes established.

RESULTS AND FIGURES

- By May 2001 a total number of 85 building network groups (BNGs) consisting of more than 1 700 buildings are or have been participants in the NBN. This accounts for almost 30% of the total TBS area in Norway.
- A high amount of participants are local authorities (i.e. public buildings), but also large and smaller private companies are involved.
- Minimum energy saving objectives of 10% during the project period (additional 5% estimated after project period as a result of investments).
- Calculated resulting energy savings (to be implemented within a 5 year period) of the program is 100 GWh for each programme year (a total of 600 GWh since 1996, accounting for almost 2% of the energy use in the Norwegian TBS).
- Total costs of the NBN program are 180 million NOK or 22,5 million Euro. On average 40% of the costs is funding from the programme while the building owners cover the remaining costs by the time put into training and energy management. Investments in RUE measures are kept separate from the programme costs and are not supported by direct funding.
- The NBN programme represents a holistic and systematic approach to RUE, based on integration of energy into the existing building management organisation. The combination of energy measures, general maintenance, renovation, indoor climate improvements and environmental strategies creates a broad motivation basis for the RUE action.

WHAT IS A BUILDING NETWORK GROUP (BNG)?

Organisation

Each Building Network Group (BNG) consists of 3-5 (usually large) building owners with similar interests geographical and/or commercial, representing typically 20-40 buildings. The purpose is to establish a relatively small group to ensure good contact between participants and easy administration. The similar interests of the participants (also outside energy use, i.e. business areas, local issues, etc.) further increase the "companionship". There are often no established forums for caretakers and/or managers, and the network groups has been seen to fill this need in many cases. The social aspect is important in many of the network groups and has been used successfully to improve commitment and motivation (i.e. field trips, two day courses with dinner, etc.).

After a brief mapping of energy use and saving potentials the main target buildings for the project is chosen (3-5 buildings per building owner). The project period is

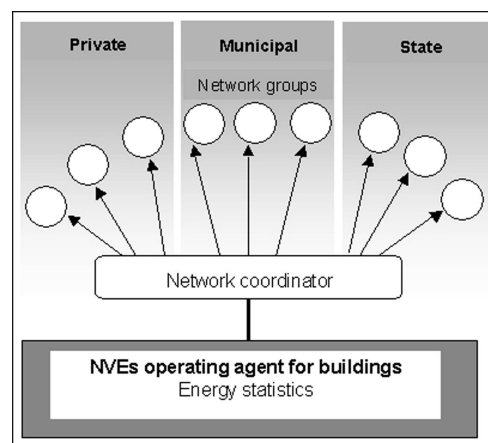


Figure 1. Organization of the NBN program. The new EE body Enova SF took over the responsibilities of NVE from 2002.

1,5-2,5 years, and in this period several activities take place to promote RUE operation and management.

The national programme is based on a network of local coordinators. The coordinators are mainly regional energy efficiency centres (Energy Agencies) but also private technical consultant companies. Each network group is initiated by a coordinator, who operates as project leader organising and driving the project during all its phases. A project leader from each participant acts as the contact person and is responsible for the internal activities. The skills of the coordinators are important to the success of the projects. National workshops for local organisers are held twice a year as part of a national network to secure competence and exchange of experience. Activities of the national network also include management of the energy statistics and development of tools (guidebooks, software, CDs, etc.). The organisation of the NBN program is illustrated in Figure 1.

Activities

The network process aims at involving all levels in a building, from management to operating personnel and occupants. The activities of the a network group are shown in Figure 2. Some activities are compulsory while some are voluntary based on the individual needs of the participants. Compulsory activities include weekly **energy monitoring** (follow-up), **training and courses** (4-6 over 2 years), as well as **meetings** to exchange experiences and results. **Energy audits** are implemented as basis for development of an **EE action plan** for each building owner. **Energy management** is introduced as a system of long-term integration of energy into the general building management system. Investments in EE measures are not funded by the project.

Energy monitoring

Energy monitoring is an important task for all participants. Energy monitoring is a system for registering and reporting of weekly energy use. The simplest method is to read electricity and oil meters (and other energy use if used) manually and calculate the weekly energy consumption by hand. The consumption is plotted in a graph versus the weekly average temperature (an ET graph – see Figure 3) and from this the "building energy signature" is derived after some

months. This line can be used to detect errors in operation of the building installations as deviations from the line means that something is not working as intended. The graph is also a useful tool in evaluating EE measures and the effect of training etc. Energy monitoring can also be done automatically by use of specially designed software and/or data loggers. Temperature data is usually gathered from a data logger situated in the building or nearby (cost approx. 270 Euro per logger). Energy monitoring is an important part of an energy management system.

Energy audits

Energy audits are also important elements of the network process. Normally a preliminary evaluation of the building stock is carried out prior to the network project (preparing the application for funding). If needed this is done in more detail in the beginning of the project to identify target buildings (i.e. buildings believed to have the largest potentials, taking into account plans for maintenance and refurbishments). For the targeted buildings simple energy audits are implemented (funded by the project). Simple energy audits are defined by the national operating agent for buildings and templates and training material has been developed to ensure that they are implemented consistently for all projects. A simple audit are implemented by an energy consultant (or building owner staff in special cases where skilled personnel can be found in the organisation) is based on an on-site inspection of the building and information from the caretaker/operating personnel. The inspection will normally take 2-5 hours depending on the building size. Constructional factors and building installations are surveyed and documentation/drawings investigated. Few or no measurements are made. The consultant then produces a report describing the status (EE work, energy use etc) and recommended measures. Measures are described in general terms and savings and investments are estimated based on experience (i.e. no detailed calculations).

If the simple audit identifies large/complicated measures or more information/investigation is needed to proceed a detailed audit can be implemented. This often implies measurements in the building, simulation of energy use, detailed calculations of savings and/or economic parameters and call for tenders for recommended measures/installations. Detailed audits are normally only carried out for 1-2 buildings (if any) for each building owner during the project period.

Long-term performance contracts and savings

The BNG participants must commit to the project and its goals by a contract signed on management level at the beginning of the project (i.e. after an initial evaluation of the buildings and energy use only, not based on audits). The contract contains objectives for energy saving (minimum 10% reduction in consumption during the project period). The participants also commit to implementing EE measures with payback time of less than one year (or less). Other requirements are to establish an energy monitoring and energy management system and participate in training activities. Detailed reporting of annual energy data to the national building statistics for a number of buildings is also required.

The philosophy of the program is that the experiences made working with the main target buildings will influence the building owners' general attitude towards energy.

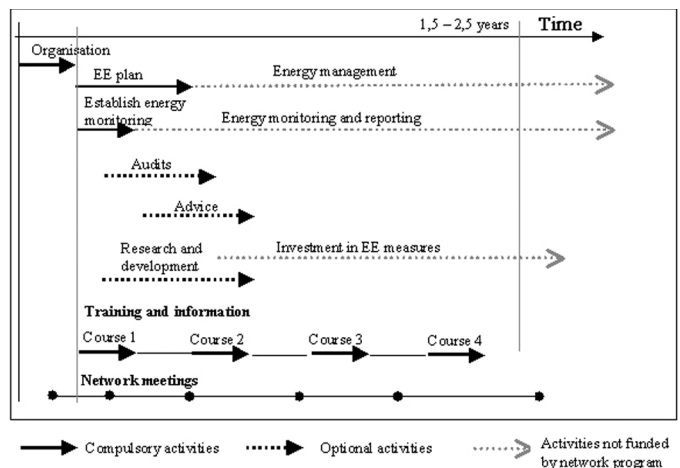


Figure 2. The network process.

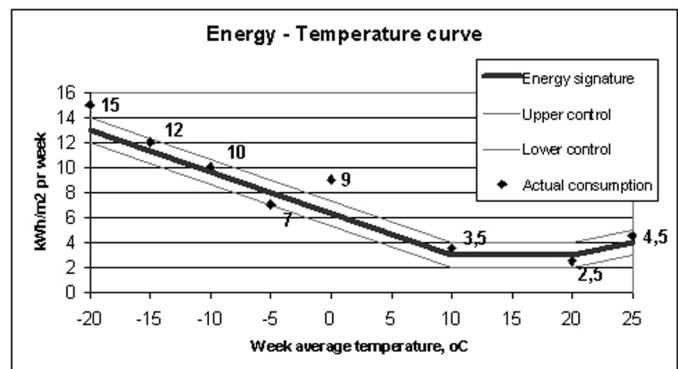


Figure 3. Example of ET graph.

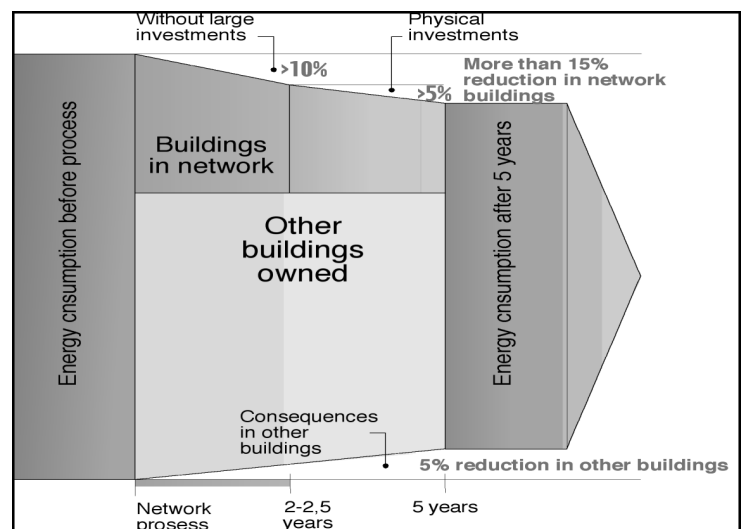


Figure 4. Energy savings among the NBN participants.

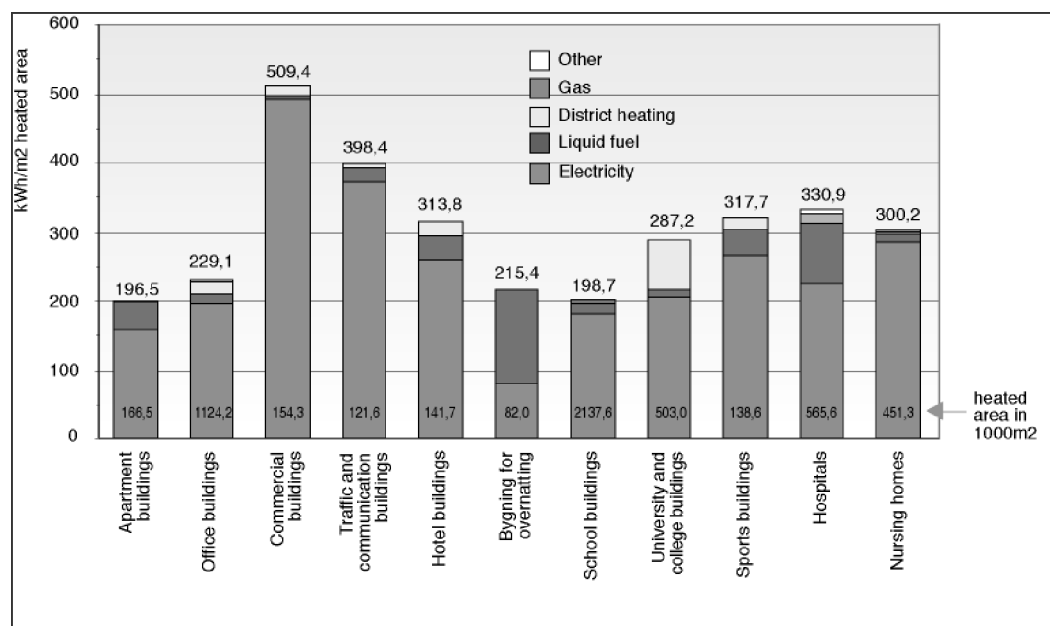


Figure 5. Energy use in various building types.

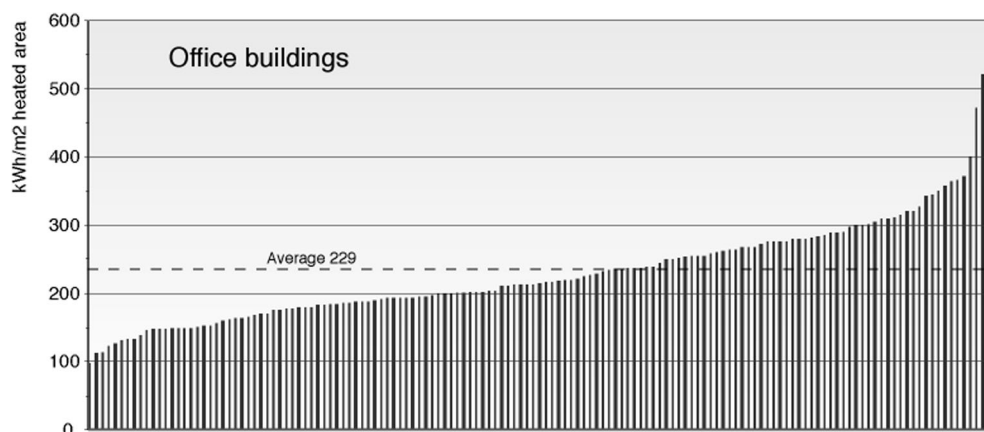


Figure 6. Energy use in participating office buildings. Each building owner gets a graph where his own building is marked in red for comparison. Other buildings are anonymous.

Hence the energy consumption will be reduced also in other buildings owned by the same organisation. After the project period (2 years) further reductions will be made as described in Figure 4.

ENERGY STATISTICS AND BENCHMARKING

An important part of the NBN program is a national database for energy consumption based on building type. The objective is to give the building sector a practical tool for planning and managing buildings with regards to energy. All participants in local network groups must commit to report annual consumption data every year (also after the project period of 2 years). This data is used to produce statistics as grounds for comparison and evaluation of the various building types and categories. This is presented in annual reports (available online last year). Building owners also receive personal feedback in the form of a short report comparing their consumption to other buildings of the same type (i.e. benchmarking). The national database is operated by the national statistics bureau (SSB) and provides a vital basis for the net-

work groups. The 2001 statistics contains 1 300 building objects and hence represents a large data basis, but as the buildings are not randomly chosen it is not representative for the national TBS statistically. Still the statistics is unique as it shows energy use for different building types, different energy sources etc. Examples of graphs from the annual report are shown in Figure 5-7.

The statistics are useful both to building owners who can compare energy use from building to building and from year to year, technical advisors require key figures for their planning and consultants performing energy audits and budgets. Energy suppliers will also be able to use the energy statistics as a means of dimensioning net capacity. The statistics also include data regarding the buildings' age, technical installations, and utilisation period, etc.

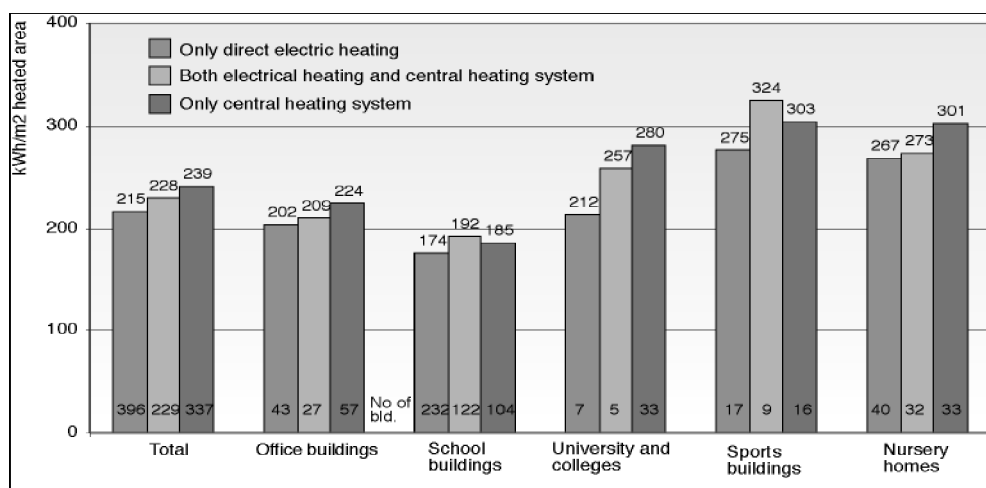


Figure 7. Energy use by building type and heating system.

Replication of good practise – the SAVE project EE BN

Important lessons have been learned during the NBN program but still new impulses based on international development will be valuable. Therefore the program was used as basis for a SAVE project started in May 2002. The project aims to replicate good practise and gather input from experiences made with similar programmes in four European countries. The objective is to test to what extent this concept is applicable in other EU countries and if so what improvements or adjustments that can be made to ensure adoption and use of the programme.

PROJECT OBJECTIVES

Main objective: Reduction of energy use and hence environmental impact in the tertiary building sector through a systematic and holistic approach to RUE actions.

Short term project objectives:

- Increased replication of the BN concept as a successful RUE programme:
 - Increased knowledge throughout Europe of the BN concept and its results.
 - Develop an adapted BN concept and make corresponding tools available for implementation in pilot BN projects in partner countries.
 - Establish the basis for 3-5 pilot BNGs (identify and prepare local organisers and participants/building owners, barriers, etc.).
- Improved knowledge and skills among partners regarding RUE instruments and results, as well as operational improvement potentials.
- Consideration by the relevant authorities of partner countries of the feasibility of adopting the BN concept on national level.
- Improved EE motivation and possibility of assessing EE potentials, based on overview of energy consumption data and benchmarking systems for different building types.

- Prepare involved actors for the new EU Directive on energy performance of buildings.

Long term project objectives:

- Improved effectiveness for RUE programmes (national and regional/local level).
- Adoption of the adapted BN concept as a national programme for the TBS in partner countries.
- 30% of total building area in partner countries participate in BNP from 2004 - 2009.
- Minimum 10-15% reduction of energy consumption in these buildings at a total cost of 0,23 Euro/kWh, or maximum of 0.11 Euro/kWh public finding.
- Establishment of a European benchmarking and statistics system for energy use in TBS.
- EU wide adaptation of the BN concept based on experiences from the partner countries.

PROJECT PARTNERS

The consortium consists of 5 partners from 4 different EU countries and one EEA country: Germany, Austria, Greece, Portugal and Norway. The partners all represent organisations with energy efficiency, renewable energy and sustainable energy use as their main task. This is also a partnership with considerable experience of co-operation in the European context.

It was important to choose participants who are well informed about national objectives and actions to achieve the project objectives. The participants have good knowledge about national policies and have close contact with superior authorities. Networks and buildings play an important role in the partners every day operations. Each partner has the skills and knowledge to act as local organisers for pilot BNGs, and can implement the individual tools of a BN programme (audits, courses, energy management, etc.).

BARRIERS TARGETED

The SAVE project will operate on two levels; **building level and policy level**. The first level involves building owners (management, operating personnel as well as users). The second level is aimed at policy makers and policy actors

(RUE programme operators). The project addresses barriers at both levels.

Building level

EE operation of buildings and investments in EE measures are both major challenges to be overcome in promoting and getting good results of RUE actions in the tertiary building sector. Traditional RUE instruments tend to focus on aspects of the organisation, operation and investment in measures separately. Experience from the NBN program shows that a more **holistic approach** that includes and coordinates all levels in the organisation (from operating personnel to management) is vital for effective realisation of the RUE potential.

The Building Network concept targets a set of barriers:

- Lack of RUE knowledge among management, operating personnel and building users (by training, courses and seminars as well as individual advice).
- Lack of commitment to and focus on energy use from the management (by contracts, energy management etc.).
- Lack of integration of energy into building management.
- Lack of forum for exchange of experiences (general and specific) between building owners with similar interests (geographically or by building/service type, etc.).
- Lack of co-ordination of RUE tools (audits, training, energy management etc) – nationally or locally.
- Lack of follow-up and longer term systematic approach (a two-year network project ensures continuous focus on RUE).
- Lack of energy consumption data (knowledge of “normal” energy use) which makes it difficult to assess if a saving potential exists – i.e. benchmarking.

National and regional level

On the policy level some of the barriers are:

- Lack of knowledge and experience with other EE instruments and programmes nationally and internationally
- Lack of communication, development of competence and continuous improvement on the promotion and implementation of RUE actions
- Lack of holistic approach to the RUE in TBS
- Lack of national and international benchmarking system for different building types as basis for promotion activities and energy potential assessment

National policies on RUE in the TBS vary considerably among partner countries. Focus range from information/training to legislation and economic incentives like grants and loans. The main aim is to ensure effective use of resources and focus in the future both on national and local levels.

PROJECT STATUS

Lessons learned so far

In the first phase of the project a brief mapping and comparison of existing programs and policies in the participating

countries has been implemented. This has shown that there are major differences in the general approach to RUE in TBS. There are no other national programmes focusing on the network process and energy management. The NBN approach will represent a new way of thinking in many cases, and the introduction and adaptation must be considered carefully.

There are also significant differences in the general framework for funding of measures among the partner countries. Energy performance contracting (third party financing) is becoming common in Germany and Austria but not in Norway and Greece. This influences the focus of public RUE programs. A main focus of the NBN program has been to train the building owners and personnel to enable them to implement measures themselves. If this is outsourced this knowledge is less important. On the other hand it can be useful to evaluate offers and results of external financing contracts. Knowledge on how the funding is organised is important to adjust the NBN program to national framework.

There is a general lack of energy statistics for the TBS, and consumption by building type is not available. A system for building benchmarking will be useful to gain more knowledge of the factors influencing energy use and how they vary between regions and countries. The data would also be useful in the work to set energy performance limits related to the new Directive on energy performance of buildings. The ET graph is only used in Norway and the other partners find this approach very interesting. Parts of the annual energy statistics from the NBN program are currently being translated based on request from the partners.

Germany

The German partner Fraunhofer ISE has worked with a group of 24 buildings in a program called SolarBau since 1995. The buildings involved are highly sophisticated buildings designed for energy use of maximum 100 kWh/m² (primary energy, i.e. electricity is rated times three). Equipment for metering energy use in detail is installed and the data has been analysed. The project has focused on working environment and user acceptance, not just reduced energy use. Operating personnel or building users has not been involved to a great extent so far.

The SolarBau group will be used as basis for a pilot network group for the SAVE project, and the main interest is to investigate new methods for energy monitoring and statistics. Use of an ET graph is currently discussed in the development of an Internet based software for weekly energy readings. However the weekly temperature data is not easily available. In Norway it is common that the building owners have their own temperature loggers, and the project is investigating the use of a similar tool. The work done both on the system for energy monitoring and the numbers themselves will be very useful for the other participants in their work to establish pilot BNGs. A format for comparing available national energy statistics for TBS is being developed based on investigation on existing numbers.

Austria

The partners from the Austrian Energy Agency have worked with a group of hospitals from 1996 to 1999. The objective was to motivate and encourage the building owners

and users to focus on energy and implement measures by using their own expertise. They are now working with a group of hospitals as basis for a pilot network group focusing on similar aspects. A web site has been established¹ and regular newsletters have been distributed. Workshops are also planned. Benchmarking is not the main interest so far but can be used as grounds for comparison if the group sees this as useful at a later stage.

Greece

The Greek partner CRES² has worked with hospitals, hotels and airport buildings, but there has been no specific program for the TBS. Main national focus has been on grants and funding of measures. CRES is currently working to establish the basis for a pilot network group among hospitals and/or airport buildings. The building types were chosen based on previous collaboration and existing data as well as positive response from the involved actors and identification of large energy saving potentials. The building owners have (more or less) professional technical personnel who can participate actively in a network process. Focus for the network groups will be on the influence of personnel behaviour on energy savings, as well as the maintenance of heating and cooling systems, replacement of old equipment and use of solar systems for hot water production.

Portugal

ADENE in Portugal has decided to work with hotels as basis for a pilot BNG. They are seeking the involvement of relevant groups/societies operating in the Portuguese tourism industry, namely in the private hotel sector. The strategy is to encourage important hotel/tourism groups to adhere to the project and not single hotel infrastructures. A list of relevant groups/societies has been prepared for future contact, aiming to disseminate the BNG concept and the Norwegian experience. Previous work by ADENE has detected the importance of the tourism sector in the Portuguese economy, the contribution of hotels to the tertiary energy consumption and the need to implement "pilot-projects" with large energy consumers in selected sectors. The main goal is to commit groups or societies to establish and operate policies of rational use of energy in the operation of its hotel buildings.

In addition a BNG in primary schools is also considered. The idea would be to establish a network with Municipal and Regional Energy Agencies (SAVE) and to exploit the opportunity of future investments of Portuguese Municipalities in primary schools.

Development of the Norwegian program

As the national organization of RUE work in Norway has recently changed with the establishment of Enova SF new programs have been launched. The BN program is the basis for a new program for larger building owners. All the major features and activities are kept as they have been successful.

There is however a increasing focus on energy savings (kWh) and commitment to these:

- Funding per kWh (saving objectives) is reduced (i.e. less money for smaller building owners and more focus on short term energy reduction and training).
- Performance based funding; 10% of the funding is withheld until the objectives for energy reductions are reached.
- Maximum funding reduced to 40%. The participants have to contribute to the cost of energy audits by funding as well as own work.
- More involvement of operating personnel, i.e. through implementation of audits.

Conclusions

Network groups have been a successful tool to promote energy efficiency in the TBS in Norway. Vital elements of the program are energy monitoring, energy management, energy audits and training. To use these elements in a systematic and long term process have proven more effective than individual efforts.

In particular the establishment of building statistics based on building type is unique and can be a useful tool in the work with the new Building Directive (guideline/recommended values, etc.).

A Save project is established to spread the knowledge of the Norwegian programme and test whether the approach is applicable to other countries and if so how and why. Results so far show significant differences in national frameworks and strategies but a general lack of systematic programmes for the TBS and especially lack of energy statistics.

Glossary

EE	energy efficiency
TBS	tertiary building sector
RUE	rational use of energy
RES	renewable energy sources
NBN	Norwegian Building Networks
BN	Building Networks
BNG	Building Network Group

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