Anne Tolman, Timo Kauppinen

BARRIERS AND LIMITATIONS FOR INNOVATIVE ENERGY SAVING SOLUTIONS OF RETROFITTED PUBLIC BUILDINGS

Energy improvements. Base and background for energy related renovation. Innovations.

- The context of this presentation
  - *1.Owners requirements and needs for renovation*
  - *2.Quality Control Toolbox (check list)*
  - *3. Savings potential in existing building stock.*
  - *4Retrofit Design Guidelines,*
  - *5BRITA Information Tool,*
  - *6 BISH (Building information sheets)*
- This presentation covers the first item,*Owners requirements and needs for renovation*
- The following presentations cover the rest of the items

The presentation is based on:

- WP 2 Design guidelines
- WP 4 BRITA Information Tool
- WP 6 Training, see the Builing Information Sheets
- Reports on the concept development of the demonstration buildings

The contents of the above mentionet WPs are available at http://www.brita-in-pubs.com/internal/index.htm

BRITA-in-PuBs website:

- The BRITA-in-PuBs **website/homepage** is a common website with national sub-websites. The website will function as the place for inspiration and will be the central element in disseminating the technical information. The website holds and presents the results of the project:
- BRITA information tool (BIT)
- BRITA quality control tool-box
- BRITA design guidelines
- BRITA report on financial schemes
- The demonstration projects

The setting

The main part of the energy consumption of European buildings is in the field of existing buildings built before 1980. The main part of the Finnish building stock to be refurbished in the near future originates from years before 1980.

Residential and service buildings account for some 65 % of the total building stock volume, but their energy consumption is bigger than the volume portion, namely about 75 %. The entire building stock consumes some 40 % of total energy (end user) consumption in Finland.

There are BARRIERS AND LIMITATIONS FOR IMPLEMENTATION AND EXPLOITATION OF INNOVATIVE ENERGY SAVING SOLUTIONS

The assumption of the barriers

1. Information barrier.

   Decision makers have not enough information about low energy innovative solutions and the right information is not available/not present at the right time for the right people in the decision process.

2. Economical barriers.

   The economy is generally a main barrier. There are no limits in the budgets to allow extra costs for energy friendly solutions. Financial and other incentives are not effective enough or not well known. Building developers and building owners fear high extra costs.

3. Organizational and institutional barriers.

   Building developers and building owners are not necessarily the decision makers. The decision can be influenced other forces. Who the decision maker is, depends on the organization in the municipality and the project.

Current obstacles

Based on these hypotheses, BRITA in PuBs developed an interview guide*. The questions were grouped into four headings and some general background information:

1. General information
2. Retrofit innovation, low energy solutions, general.
3. Economy
4. Organization
5. Information

* Work package leader: Kari Thunshelle
kari.thunshelle@byggforsk.no

THE SITUATION IN FINLAND

- The total of Finnish building stock was year 2000 about 1830 Mm3,the net growth of the building stock is about 1 % as the loss is taken into account.
- Residential and service buildings account for some 65 % of the total building stock volume, but their energy consumption is bigger than the volume portion, namely about 75 %.
- The entire building stock consumes some 40 % of total energy (end user) consumption in Finland.
- The main part of energy, which is included in statistics, was produced by district heating. The share of district heating was 90 %. In the consumption statistics the share of educational buildings is 31 % and residential buildings is 23 % (2004).

The kWh consumption of energy

- The normalized (weather corrected) heating energy consumption of public buildings was 48 kWh/ m3.
- The specific heat consumption of residential buildings was 30 % higher, 62 kWh/ m3.
- Public buildings consumed electricity 19 kWh/m3 and residential buildings (facilities electricity) 13 kWh/ m3.

The trends in consumption

The specific heat consumption is increased 5 % from the year 1997, when it was at its lowest in public buildings. This upswing is against all the goals.

Specific consumption of electricity has risen 30 % in public buildings since 1994.

Also the combined specific consumption of heat and electricity is increased 9 %, compared with the year 1997 .

Explaining the upswing

The effective factors are, among others:

- the efficacy of the use of the public buildings, like schools, has increased (evening activities)
- to avoid moisture and mould damages, air exchange rates are higher throughout
- partial reason may be the reorganization of maintenance - the occupants are tenants with only rare cases of rewarding for the activity to save energy

- **Specific consumption of electricity tends to rise in refurbishments along with the proliferation of equipment (i.e. cooling units).**

Renovation projects

- The most probable renovation measures will deal with schools, hospitals, health centers and nursery schools and also sport facilities.

- Many renovation projects (the main part of them) are motivated by the user reclamations of indoor air quality, thermal comfort and in general, indoor air conditions.

- The other major reason for renovation has been moisture damages and mould problems. Maybe part of these problems is caused by incorrect and wrongly understood energy saving operations.

Empirical study

An empirical study was conducted as an interview of 9 facility managers in order to find out about

- Innovations in renovation projects and energy solutions in particular
- Berriers for implementing energy savings inoovations in renovation projects
- Economy matters in renovation projects as obstacles (i.e. budget limits) or iniciatives (i.e. state contributions)
- Organization for renovation projetcs
- Sources of information

In addition, the personal professional background was enquired as an explanatory matter

How was it done?

- The number of interviews was 9. Four interviews were made in personal face-to-face situation and 5 interviews in the phone.
- The results have two main domains: communities and real estate companies.
- The interviewees represented 4 bigger cities, population > 30 000 and 5 real estate companies, of which one was a business park. It is fair to say that these organizations represent the highest level of facility management in Finland.
- The respondents were managers or directors of their organizations, and all of them having long career in the business.

The findings about decision making

About the decision making of renovation projects:

- The technical personnel in the cities are working according to the plans and boundary conditions accepted by the political decision makers, usually after interactive negotiations. City government and city council will make the budget decisions, according to the proposal. Under control of board responsible of facilities there is an organization, nowadays very often public utility-like, which takes care of facility management. Generally in big cities, the organizations are dealt into producer (construction) and procurement (client) units.
- Real estate companies can have more space of freedom, of course within the economical framework and also customer demands.

The findings about decisions

- Especially the communities hardly ever begin their retrofits and repairs only based on energy related reasons.
- The reason for repair and renovation is very often change of use or reclamations of the users.
- The cities have normally a short-term and long-term plan for renovation, and a priority list for the measures.
- The plans are based on condition surveys and energy audits, which has been made relatively systematically, and also needs of the users.
- Whenever possible, the various support forms for energy conservation are used.

The findings about energy saving options

The most frequently used energy saving measures are:

- Improving heat recovery of ventilation
- Ventilation repairs in general

- Change of windows and blocking the leaks of exterior walls
- Additional insulation in some cases

- Renewing of water fittings

- Renewing of lamps

Prefered energy saving options

Almost all respondents emphasized the significance of the measures which does not need investments or just relatively minor investments for the devices:

- Monitoring and benchmarking the building stock
- The optimization of running time of ventilation systems
- The proper use of existing systems and installations in general (like balancing of the heating system, tuning)
- Utilization of free heating
- The training and motivation of personnel

- The staff is in the key role – misconceived attitudes and inappropriate working reflects also to the energy related topics

Most utilized novel energy saving options

Almost all organizations had used some new or innovative technologies in particular projects:

- new very precise water meters
- electric glazing, low U-value windows
- air heat pumps
- free cooling with natural outdoor air (wintertime)
- stepwise operation hours of equipment
- savings by adjustments of building automation
- smart heating and ventilation systems
- the reclamation of condensation heat from refrigerating machines in preheating of incoming air supply
- decentralized ventilation installations
- district cooling systems

ECONOMY

- All the interviewees said that the full costs – generally expressed life-cycle-costs - should be the base for investments.

- In practice, there may be some boundary conditions.

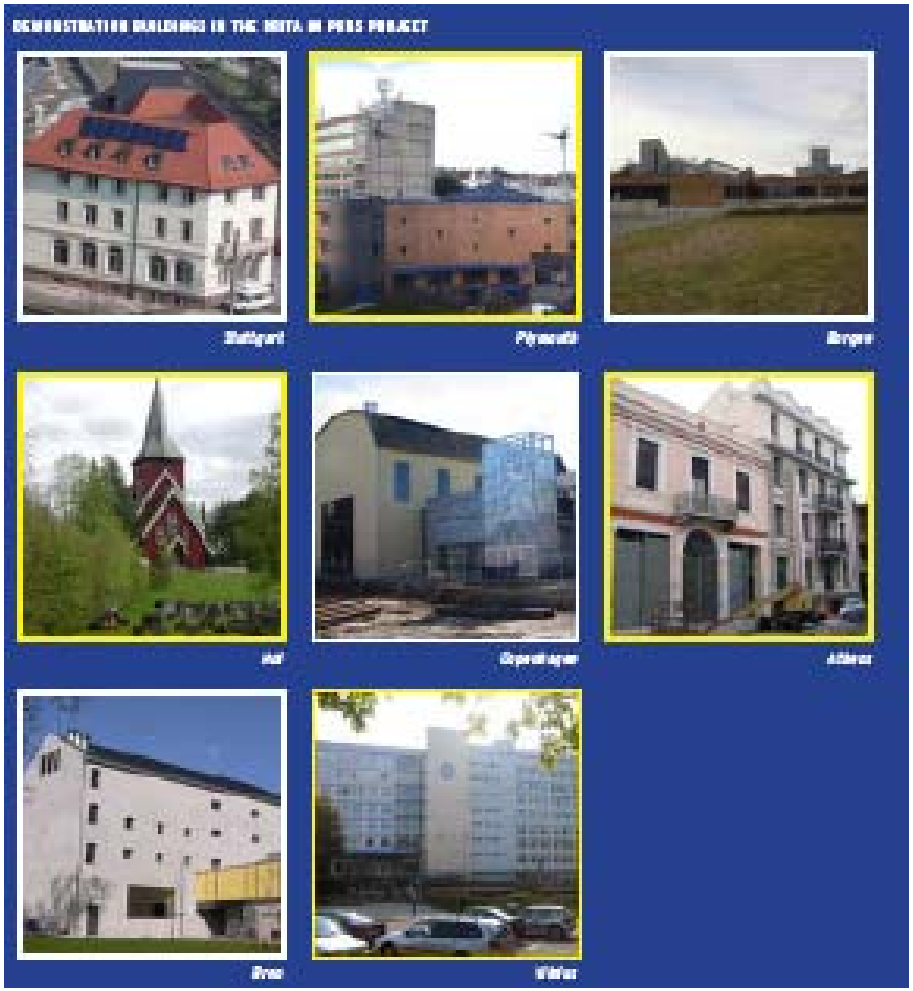
SUMMARY AND CONCLUSIONS

- The main conclusion is that just in very few cases the reason for retrofitting is only energy saving.
- Energy savings will be reached along when indoor conditions will be improved or damages have been repaired.
- The first stage for energy saving is the proper use of the buildings – in many cases good results can be achieved by zero investments.
- The decision making is more and more based on full costs, i.e. life-cycle-costs.

CONCLUSIONS FROM OTHER PARTICIPATING COUNTRIES

- The main reason for choosing low energy or renewable energy solutions is energy saving.
- The main barrier for not choosing these solutions is investment costs, even if life cycle costs are reported in the interviews as to be taken into consideration.
- The second most important barrier is the lack of information.
- The information needed during the decision phase is investment costs, energy savings, a general overview of each solution proposed with experience from other projects and its benefits/limitations.

Practical pilot cases around Europe



Filderhof, Strutgart, Germany

- Architectural influences may have a strong impact on the retrofit concept regardless whether a building is listed or not. In the case of Filderhof it caused the change from external insulation to internal insulation on the outside walls. This may lead to less energy savings and results in more planning work on details in order to prevent thermal bridges.

- Economic influences may change the material used for building parts. At Filderhof, the glazed atria roof has now only small glazed parts. The designer had to react on the situations and transfer the planned PV system to the opaque roof parts.

City College, Plymouth, UK

- Untested opinions and ideas are critical to the creative process; however, the modelling of these ideas is Essential;time needs to be built into the programme to facilitate sufficient analysis and testing of these ideas.

- The long payback period discourages the choice of some technologies unless funding is available to support the investment.

- Consultants are often very inexperienced with regard to certain technologies for example wind turbines.

- Better control of services can save considerable quantities of energy; this should be covered with high quality commissioning procedures and concise training of the client in the best use of the system. Poorly trained people will not use systems effectively and energy consumption will suffer as a result.

Borgen Community Centtre, Asker, Norway

- Problems with sound in ventilation culverts, and some with fresh air inlet; these need special planning
- Moisture (from rain and snow) eneters the system from the air inlet towers and has caused lower part of the wall enclosing the filter unit to become moist. Too short distance from inlet tower to the filter- and heat recovery housing, use of wrong materials and the lack of a properly slanted floor towards the drain, has resulted in development of some fungus.

- Technical personnel should be educated during the building period to get acquainted with the technical installations before the building is opened.

Hol Church, Hagafoss, Norway

- Existing, listed buildings are part of an architectural heritage that is well protected by the state throughAntiquarian Authorities. They have an important job at protecting the valuable listed buildings and groups of buildings. This important job often is in conflict with the equally important job of reducing the energy need in existing buildings.

- The processes described above are time- and resource demanding. One should be prepared for several roundsbefore an approval is possible – if ever.

- In this instance, had it not been for the Bishop overruling the AA, there would have been no solar thermal system.

- A motivated client and a motivated caretaker is a crucial element towards success.

Cultural Centre Proevehallen, Copenhagen, Dk

The main impression is that by pushing and trying hard enough you can move “what is possible” quite a bit further than what is first indicated by building designers and contractors.

The examples of this experience are:

- The finding of the architect that the minimal construction of the roof was already strengthened because of the crane, so it could actually carry the weight of the additional insulation.
- The competition between the window manufactures made it possible to come up with quite low U-values for the whole window even considering the rather small individual glazing areas.
- As always the first reaction from the contractors is that “this is too expensive”. In the actual situation it was the BEMS (building energy management system). But by negotiations it finally got through the process.

Evonymos Ecological Library, Athens, Greece

- It is often difficult to combine public financing procedures for the restoration of public buildings with the prerogatives of a research project. In the case Evonymos project, the construction process has been greatly delayed because of the lengthy procedures involved in building restoration financing trough the Greek Ministry of Culture, to which the building belongs, as a listed building. The eligible part of the project would not have been completed in time if the project team had not secured the participation of private sponsors.
- This project has been innovative in terms of the combination of private and public sponsors in the retrofitting of a public building.

- Each building should be considered individually and passive solar features introduced into the overall design concept so that the best possible balance of thermal and visual comfort is achieved and the retrofitted building meets the occupants' practical and aesthetic needs.

Social Centre Brewery, Brno, Czech Republic

- Application of Building Management Systems brings a potential of significant energy savings even in the retrofit of a very old building.
- Monitoring of occupancy, while being an effective energy saving measure, is not easy to implement in a costeffective way.
- Even a very old building in a really bad condition can be retrofitted in a way to exceed the requirements of the contemporary building codes. The cost of a retrofit being only a fraction of what a new building with similar parameters would cost.

Main Building Vilnius Gediminas Technical University (VGTU), Vilnius, Lithuania

- During the VGTU renovation aiming at energy savings measures, modifications occurred. Because of financial shortages the third renovation component, i.e. ventilation and in consequence the ventilation system, was not foreseen to be refurbished. However, in the process of renovation the three main components – building envelope, heating and ventilation - must be kept in balance. As **€** 42,605.61 was saved by replacement of the windows, it was therefore decided to use that money for the renovation of the ventilation system.