

# Agreed performance criteria for efficient housing solutions

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## Abstract

A Buyer Group from leading multifamily housing companies has been working in Sweden for more than 10 years. The members of the Buyer Group represent about 70% of all apartments in Sweden. The Buyer Group has initiated a number of energy-efficient projects during these years. Refrigerators/freezers, washing machines, driers, ventilation/filters and lighting are among the areas for activities. A number of cases will be analysed. Lessons learned will be compared with some experiences from other innovation projects.

The overall objectives were to inspire development of more efficient solutions in the energy and building area. The immediate goal was to reduce the use of energy, the environmental impact (use of water, noise), or to reduce the total cost for both production/construction and operation.

Within all the cases analysed the procedure used was *technology procurement* including creation of a group of customers/buyers in which the requirements for the work were formulated as performance criteria. These criteria were to be fulfilled by the contractors and/or suppliers in proposals submitted, prototypes, and full-scale pilot projects. Different mechanisms for rewards have been used.

Concrete results in the cases are components and systems with 20-50% energy reduction. The project managers and experts involved have identified a large number of lessons learned, which will be presented in the paper.

## Introduction

Already in 1988 work started, in collaboration with the predecessor to the Swedish Energy Agency (STEM) to find out the interest among property owners to jointly map out problems, requirements, and possibilities to reduce operating costs and energy use, and at the same time improve the service level in multi-family houses and premises. STEM financed preliminary studies, formulation of requirements and testing and allocated some money to the buyers of the first hundreds of the new products. Starting with a core of companies and persons, with, in some cases, already established relations from earlier development projects, a Buyer Group was formed in 1989 with representatives from municipal-owned housing companies, nationwide co-operative building societies (as HSB), and private companies. The Buyer Group was also completed with some experts from the National Board of Housing, Building and Planning, some energy companies, and from the Testing Laboratory at the Swedish Consumer Agency. Today, the Buyer Group represents about 70% of the total stock of multi-family houses in Sweden, and has worked with a large number of projects in order to reduce operating costs, especially energy costs.

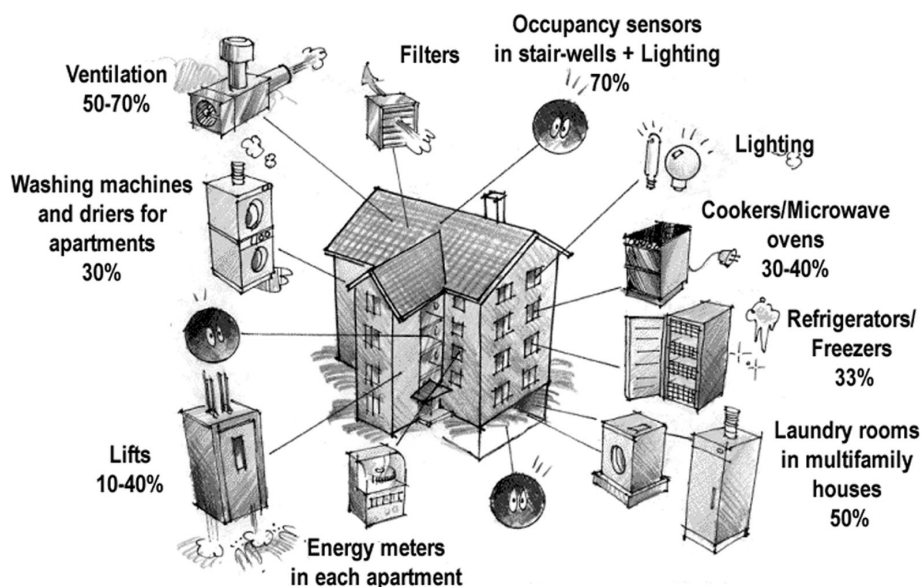
## Approach

The work has, to a large extent, used technology procurement as the method for the tasks.

*Technology procurement* is an entire acquisition process on the demand-side with the expressed purpose of stimulating innovation. The creation of new networks, which include future-oriented buyers, has proven to be of large importance for innovations. It is particularly important to involve influ-

**Table 1. Examples of energy-efficiency projects initiated by the Buyer Group.**

Project area	Result	Energy reduction in products measured
Refrigerator/freezers	From 1.2 kWh/litre comparable volume per year to 0.8	By 33%
Washing machines and dryers for laundry rooms	From 2.6 kWh/kg of laundry to 1.2	By 50%
Ventilation: Replacement of fans in residential area	From 750 kWh/apartment and year to 380	By 50%
Lighting in stairwells	From 24 000 kWh/year to 7 000 by means of new sensor technology	By 70%
Cooking – Ovens	Combinations micro – induction	By 30%

**Figure 1.** Overview of projects initiated by the Buyer Group/Network and generated savings – per product or system.

ential buyers and *leading users*. Some similar work has been carried out in the USA by the Consortium for Energy Efficiency and within the International Energy Agency with cooperative procurement projects where the “DSM Award of Excellence” was introduced and presented for heat pump driers, electric motors, and also for the “Copier of the Future” with reduction of energy use down to 25% (Westling, 2000).

The above-mentioned Swedish representatives formed a Buyer Group (Westling et al, 2000), which has worked as a network and has carried out competitions, procurements, demonstration projects, and early purchases of newly developed, more energy-efficient solutions concerning refrigerators, ovens, washing machines, ventilation systems and filters, and lighting solutions for stairwells. The members of the Buyer Group have worked hard to prepare documents, participated in sub-groups, compiled data, drawn up documents for requirements, informed about ongoing projects, participated in evaluations of various competition proposals including purchasing of newly developed products and testing of solutions. In order to inspire innovation and better meet the actual demands from facility managers/users the Buyer Group has drawn up specifications of requirements in functional terms, often expressed on two levels, *mandatory* requirements, which must be met, and *desired* requirements,

which are evaluated as positive in procurements and competitions. It is also of importance to have a complete set of performance criteria, not only for energy but also for other areas in order to increase acceptance of new products. These criteria can include environmental issues, labour safety, and important boundary requirements to facilitate for new components to be put into a system.

Manufacturers were attracted to participate because of the high prestige and large publicity that was accompanying the competitions. They were guaranteed some early sales to influential buyers, which would facilitate business for successful winners. The early buyers were offered some government incentives in order to accelerate the diffusion of new solutions.

### Project examples

A succession of projects has been carried out, see *Table 1* and *Figure 1* (Westling et al, 2002).

STEM has contributed 50 000 – 500 000 Euro per technology procurement project including costs for testing and some premiums to the first buyers. The total financing from STEM from 1989 to 2002 has amounted to about 3 million Euro (SEK 25 million). To this should be added the large energy-efficiency efforts that the participating

kWh/kg laundry

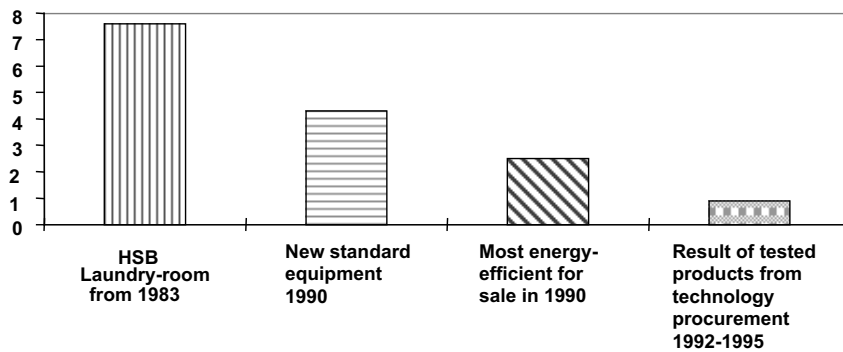


Figure 2. Electricity consumption in laundry-rooms in multi-family houses.

companies have contributed during the years, which have not been included but should count for a considerably larger amount.

To a great extent it has been shown that in order to make challenging demands, they must be based on relevant data. For refrigerators/freezers, washing machines and driers, and in several other areas this has meant that special measurements at the starting-point have to be carried out. It has also been important to develop new testing procedures, which better reflect the actual use. The Buyer Group decided for example, when establishing the requirements for the measurement of energy use per kilo of laundry that tests at half loads also had to be carried out, which is of great importance for the evaluation of the solutions (standard testing is only performed with full loads). This new procedure reflects the actual behaviour better, and it led to the result that the bidders concentrated on trying to develop solutions in order to adapt the washing programmes to the actual conditions, i.e. washing laundry with half loads in the machines.

For the development of washing machines in laundry-rooms see Figure 2 (HSB:s Riksförbund & Statens Energiverk, 1991 and Konsumentverket & NUTEK, 1996).

The Buyer Group has consistently chosen to write the requirements specifications in English besides in Swedish, and invited to international competitions. In some cases, the Buyer Group has chosen not to carry out complete technology procurements, as it has been more fruitful to make tests and requirements successively in order to influence the market. This concerns for example the area lighting in stairwells, where the Buyer Group's work has contributed to bring forward improved sensor technology. Lately, the Buyer Group has arranged competitions for energy-efficient stoves and air-filters.

#### ENERGY-EFFICIENT VENTILATION

In a recent ventilation project in Sweden (Lindgren & Blomberg, 1999), there was a technology competition and procurement, followed by testing and evaluation of installations. The installations comprised improvement of exhaust air systems with better functioning fans and cooker hoods. Energy and indoor climate measurements and surveys were carried out in 1998-99. To get a balance between energy efficiency and air comfort, a group of representatives of major housing companies had drawn up a performance specifica-

tion with a number of mandatory and desired requirements. These requirements comprised air change, filtering of smells of frying, sound levels, air exchange efficiency, thermal indoor climate, air quality, energy efficiency as well as operation and maintenance.

Five pilot objects were tested. The installation that was appointed winner in the competition met all mandatory and most of the desired requirements. The energy consumption of the fan was reduced by *two thirds*.

The project proved successful with satisfied tenants and no increase of the energy use, which led to the result that one of the participating housing companies, AB Familjebostäder, chose to invest in pressure-controlled mechanical exhaust air ventilation, both when rebuilding their existing systems and building new dwellings. This means that the present strict requirements on energy-efficiency for the building of new dwellings must be met in other ways than via heat recovery, which is usually obtained with added insulation of the building's climate shell, but also through recirculated air to for example a garage. There have also been proposals regarding individually controlled ventilation.

One experience derived from the project was that the calculations of LCC (Life Cycle Cost) need to be improved.

#### The LCC-perspective

The LCC-perspective for systems has to be used from the beginning with operating costs during their economic and technical lives. In an IEA-project "Co-operative Procurement" (Westling, 2000) this became very evident for electric motors since a longer life through reduced losses at lower temperatures could directly be shown. It was found that these Hi-efficiency motors showed reduced energy losses by about 20-40% (compared to standard motors) and very short payback periods, between 1-3 years for many industrial projects.

This could be difficult to show in other areas, for example for refrigerators/freezers, if the purchase is made by an individual property owner, while the reduced energy costs will be a saving for the user/tenant. In another case, concerning laundry-rooms in multi-family houses, some examples of short payback periods could be shown when new solutions with both lower energy and water consumption had been in-

roduced and the savings went to the investor/property owner.

In some areas, like refrigerators and laundry rooms, a total penetration for the more energy-efficient products has followed. It is difficult to estimate the total impact of the Buyer Group activities, as many other programmes for labelling, information and technical development have taken place.

To enable a new product to be positively accepted on the market, it must be profitable to install, and the profitability must be defined. Criteria number one is that the income shall go to the party that pays the costs. As very few products give an immediate return a life cycle perspective must be defined. Usually, in life cycle calculations, you calculate with depreciation and interest costs during the product's technical life, with an increase of income or a cost reduction during the same period, after which the calculations are corrected with regard to the assumed real rate of interest.

With the above theoretical view many more products should be accepted than is the case in reality. A plausible explanation would be that the calculations according to the above model are not made with adequate *risk costs*. In short, a risk cost can be defined as the extra premium an investor wishes to receive for giving up the possibility to make an investment in the future hoping for more profitable investment alternatives at that time.

## Conclusions and lessons learned

1. It has proved essential to successively build and develop a *network*, which provides possibilities for a confident exchange of experiences to stimulate energy-efficient innovations in the multi-family housing area. It is very important to maintain such a forum as this Buyer Group for a long time to be able to exchange experiences and to obtain possibilities to express common problems and demands.
2. Uncertainty regarding *rules and regulations* risks delaying important development projects, and consequently, it is necessary to have the prerequisites ready to obtain early support in various areas.
3. It is important to agree on the *appropriate level for various requirements* in competitions and procurements with consideration taken to national as well as international development.
4. It is also important to allow *enough time* for each different stage of development. In certain cases, alternative possibilities have been considered to shorten the time from the start to the implementation of activities. Sometimes it can be enough if a large and important Buyer Group agrees on common requirements. For certain areas, this can in some cases push forward development work without the need to carry out any large, concrete procurement.
5. In various areas it is important to contribute to the drawing up of *internationally recognised testing procedures*. For example, this was the case for the project Energy-efficient cooking/stoves. It is a very time-consuming process, and it will now be brought up again for the ongoing competition for ventilation/filters.
6. The Buyer Group may introduce some prestigious *competitions with "Awards"* in some areas, which could also contribute to increase interest and accelerate development.
7. Buyer activities should also be combined with *information efforts*.
8. A prerequisite of a successful technology procurement is that it is expected by the Buyer Group that the *product considered becomes profitable*.

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