



EVALUATION OF BELOK (PROCUREMENT GROUP FOR COMMERCIAL BUILDINGS) (SWEDEN)

WITHIN THE FRAMEWORK OF THE AID-EE PROJECT

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1 Characterization of the instrument

The BELOK programme was launched in 2001. BELOK is an acronym for Beställargrupp lokaler (i.e., Procurement group for commercial buildings). BELOK can be seen to represent a continuation of the technology procurement programmes that were started by the Swedish Board for Industrial and Technology Development (NUTEK) in the early 1990s. The basic idea behind these programmes was to bring more energy efficient technologies to the market. Products that were targeted then included refrigerator/freezers, clothes washers, ground source heat pumps, windows, etc. For this purpose, NUTEK set up procurement groups consisting of buyers or potential buyers of a technology. These groups were asked to make technical specifications concerning performance, including energy efficiency requirements, for the technology at hand. One important motivation is that the distance between manufacturer and final users may be long, involve many actors, and entail misplaced incentives. Potential manufacturers/suppliers were approached and invited to take part in a competition to meet or surpass the specification. The winner was typically guaranteed a number of sales and would get publicity. The technology procurement programmes have generally been deemed as successful. There has been a small element of critique that technology procurement is not effective (i.e., that market introduction and diffusion would have happened anyway), and that it is not appropriate for government to manipulate or get involved with market actors in this way. Partly due to government pressure to increase the level of co-financing from participants, the ad-hoc procurement groups were made more permanent by the Swedish Energy Agency (SEA) through the establishment of BELOK and its smaller sister group BEBO which targets residential buildings. A more permanent group can facilitate more sustained efforts as well as deal with more complex systems and approaches not linked to a specific technology or piece of equipment (e.g., tools, models, management systems). In this sense, BELOK takes the original idea of technology procurement one step further.

1.1 Targets, including relation to end use sector and relation to national Kyoto target

BELOK is operating in the difficult area of bringing near-commercial or pre-commercial technologies to the market through demonstration projects and other activities. Hence, BELOK has not set any quantitative targets for energy savings. Instead, BELOK has formulated a **vision**:

BELOK is a group of real estate owners with commercial buildings that value cooperation concerning energy efficiency and environmental issues.

The group has continuity and presents itself with a common platform nationally and internationally. BELOK is a model for several EU countries.

And goals:

The activities of the group lead to an earlier market introduction of energy efficient systems and products. In practical projects it is possible to show, through measurements and evaluations, at least 20% energy efficiency improvements while improving function and comfort. BELOK participates in at least two EU-projects within three years.

In the vision statement for BELOK it is stressed that energy efficiency measures must not jeopardise the function and quality of the building and that measures must be cost-efficient, or have the potential to become cost-efficient in the future. It is also stated that participants in BELOK get closer access to development projects supported by SEA and can influence the content and direction of the efforts.

It should be noted that the goals are self imposed by the group and they are considered as a guide or ambition rather than as hard targets. BELOK is in the process of revising its vision and goals (winter 2005/06).

Technology procurement as a way of promoting energy efficiency has been an component in Swedish energy and energy R&D policy for more than 25 years. It is not strictly related to the Swedish Kyoto target although energy efficiency in general is recognised as an important strategy for reducing carbon dioxide emissions and for reaching other energy policy goals.

1.2 Period the policy instrument was active

BELOK had its first meeting in March 2001 but it builds on the previous experiences from technology procurement programmes. It is still active. Presently it is funded by SEA for 2005 and 2006, and it is likely continue thereafter.

1.3 Actions, Specific technologies and/or energy efficiency measures

BELOK has been active in three main areas:

- Formulating energy performance specifications for buildings
- Developing tools for energy modelling, management, and building energy declarations
- Technology procurement and demonstration projects

BELOK has set as a priority for 2006 to increase its communication concerning the group, its activities, and results.

There are four specific activities (described in more detail below) that are included in this assessment:

- demonstration of a new type of device for room outlet of air (supply air terminal device).
- supporting the development of a new low pressure-drop air filter
- a technology procurement of a new system for management and monitoring of energy use in buildings
- performance specifications concerning indoor air quality and energy efficiency (total energy use, for appliances, lighting, HVAC, etc).

In addition, BELOK has produced eight “good practice” examples in 2-4 page leaflets describing innovative and energy efficient solutions, initiated development in the area of daylighting and solar shading, developed a tool for architects to calculate energy performance (BV2Arch), developed a tool for life-cycle cost calculations, proposed a database for building energy performance and worked on issues concerning statistics and implementation of the buildings Directive, etc. On the whole, BELOK takes a very practical and results oriented approach towards facilitating improved energy efficiency in buildings, through technical development, methods, tools and organisational issues. New ideas and projects can be suggested by anyone in the group. BELOK also serves as a forum for sharing ideas and experiences from activities that were not necessarily supported by BELOK.

Air outlet demonstration/procurement

A Swedish innovative firm has developed a room air outlet with built-in monitoring of carbon dioxide concentration and control so that the air-flow is automatically regulated by the room outlet. It allows conversion of constant air-volume (CAV) systems to variable air volume systems (VAV) and in new installations it can be used instead of systems with cooling coils – reducing investment costs and energy use. Through BELOK, a large number of such units have now been installed in various buildings. Experience is that the conversion from CAV to VAV can save about 30-50% of fan electricity and, with lower volumes of air, reduces the need for heating. The device, Intelligent Diffuser for Climate Control (IDCC) developed and marketed by LindinVent AB won innovation/environmental prizes in 2003 and 2004 but had problems reaching a larger market without being able to show reference cases. Through BELOK, the supplier of this innovative technology was able to get several valuable demonstrations.

Low pressure drop filter

A Swedish inventor has proposed and developed a new air filter with near zero pressure drop. The concept was first submitted to a technology procurement organised by BELOK. It is in principle an electrostatic filter with an innovative design. However, the filter needs further development and testing. BELOK has supported the development through financing testing of the filter at

SP Swedish National Testing and Research Institute. It is likely that BELOK will continue supporting the inventor with some additional funding for development and further testing. The potential savings in Sweden from reducing pressure drops in air filters are about 1 TWh at present and 3-5 TWh if stricter indoor air-quality standards are imposed (since stricter standards could lead to more losses in conventional filters).

System for managing and monitoring energy

During 2003 BELOK, did a technology procurement for a new improved energy management system. A specification and wish list for an improved system was drawn up by some of the members in BELOK. From the proposals that were submitted, three promising concepts are presently being tested and evaluated. Specifically, BELOK wanted a system with a better user interface, a system for handling long-term anomalies, a tool for simplified reconstruction of an energy system, possibility for simulating the energy system, and possibility for using it through internet. A winner was announced in March 2006.

Performance specifications

The specifications are intended to be used by builders when contracting for a new building or for retrofits. In the absence of clear specifications concerning energy performance there is always a risk that the contractor is trading off construction costs for operating costs in terms of energy use – a classic case of misplaced incentives leading to high energy costs unless careful specifications are made. The document specifies e.g., insulation levels, lighting and HVAC energy used, as well as total purchased energy in new buildings (less than 80 kWh/m², of which a maximum of 35 kWh electricity, excluding tenant electricity use).

1.4 Target groups

The target group for BELOK broadly includes builders, real estate companies, architects, equipment suppliers, etc. The BELOK group itself is comprised of real estate companies which together account for a substantial share of the floor area in commercial and public buildings. The members of the group include:

- Akademiska hus (university and college buildings)
- Statens fastighetsverk (heritage buildings and Swedish embassys)
- AP Fastigheter (commercial buildings, owned by pension fund)
- Luftfartsverket (airports)
- Vasakronan (commercial buildings, state owned)
- Locum (mainly hospitals in the Stockholm region)
- Fortifikationsverket (buildings for the Swedish military)
- Specialfastigheter (prisons, courthouses, etc)
- Castellum/Brostdaden (commercial buildings, listed on the stock exchange)
- Faberge (commercial buildings, listed on the stock exchange)

- Midroc (real estate but also builder, etc. private)

In addition, the group includes Professor Enno Abel (CIT Energy Management) and Tomas Berggren (representing SEA). The work has been coordinated by WSP Sweden (part of the WSP Group) and since 2005 by CIT Energy Management. SEA appoints 3 board members. Part of BELOK is also Byggherreforum, Swedish Construction Clients Forum, (who appoints 3 members of the BELOK board), an interest organisation representing real estate owners. Starting in 2006 The National Board of Building Housing and Planning (Boverket) is also represented.

1.5 National context

Energy use in buildings has been relatively constant during the last 30 years although floor area has increased considerably. There has been a shift from oil to district heating and electricity as energy carriers. A specific concern has been the rapidly increasing use of electricity in commercial buildings and for common uses (elevators, ventilation, etc.) in multi-family buildings. The electricity used for these purposes has increased from 8.4 TWh in 1970 to 30.2 TWh in 2003. The increase has been caused by increased use of office equipment, more lighting, increased cooling needs and more ventilation. Although some efficiency improvements have been realised in the area of lighting and improved ventilation systems there is still a considerable energy efficiency potential. In the context of Swedish ambitions to phase out nuclear power, trying to limit the growth in electricity use has been an important political priority. At the same time, increased demands for indoor air-quality and indoor climate tends to result in higher electricity demand in commercial buildings.

Energy efficiency has a prominent role in the Swedish energy policy and it is stated in official documents that government efforts should be directed towards accelerating technical development through, for example, technology procurement, support to market introduction, systems development and development of certification systems. Hence, BELOK is very much in line with government intentions as formulated in the most recent energy bill from 2001/02.

1.6 International context

The work and experiences of BELOK is relevant in an international context. The same development in energy use for commercial buildings has been observed also in other countries. Similar efforts in other countries may be done differently due to different structures in the building sector and different organisational and cultural settings.

1.7 Market failures to overcome

BELOK attempts to address all types of market failures or barriers that can be observed in the building sector. One of the basic ambitions in technology procurement programmes is to bring new technologies to the market, or at least bring them to the market sooner than what would be the case without an intervention. One of the barriers in this case is that there is a long way between the final user or buyer of equipment and that there is a need to communicate end user demands to equipment manufacturers, consultants, etc. The end-users are often many and fragmented compared to manufacturers/suppliers and by putting important end-users together in a group, common demands and specifications can be formulated. A prize, publicity, and, or, an order for the improved equipment serves as a carrot. Combined with other policy mechanisms (standards, rebates, publicity, education, etc), technology procurement programmes are an important part of market transformation.

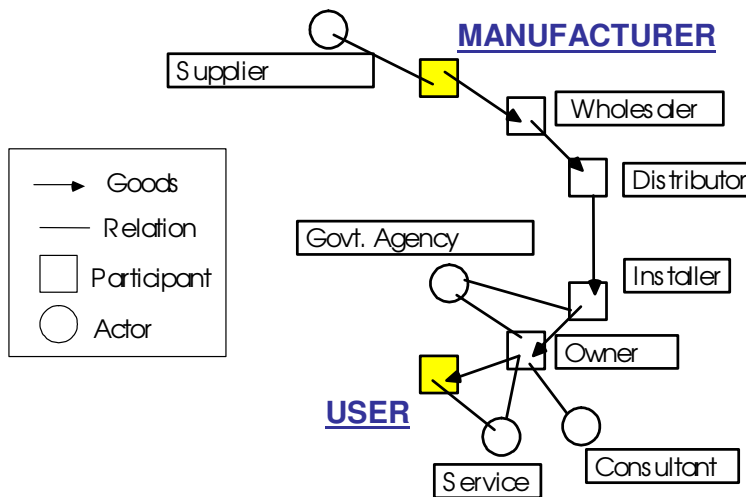


Figure 1 Illustration of how the final user may be disconnected from the manufacturer, motivating the need for procurement groups that can make performance specifications and communicate these to relevant actors/participants (Source H. Nilsson, www.fourfact.com).

BELOK is also addressing the issue of misplaced incentives. One example is the performance specifications which if used ameliorate the problem that building contractors lack incentives to build for low operating costs. BELOK has also investigated approaches to address the landlord-tenant problem, where it may be debated who should pay which parts of the energy costs and how in order to create good incentives for energy efficiency and savings for both landlord and tenant.

Lack of information is another general barrier that BELOK is addressing through issuing leaflets with good practice examples, by funding demonstration projects and

their evaluation, by being involved in developing building energy declarations and databases/statistics, etc.

In summary, BELOK takes a practical and results oriented approach to various barriers to energy efficiency in the construction and operation of commercial buildings, based on practical experiences from the participating companies.

1.8 Organisations, which are responsible for implementation and execution

SEA has the overarching task of promoting energy efficiency through technology procurement and several other means. For practical purposes, BELOK is since 2005 a network under Byggherreforum (Swedish Construction Clients Forum). Through this arrangement, BELOK can maintain its flexibility concerning decisions on project funding and be more effective in disseminating results or attracting new members. BELOK has a board where 3 members are appointed by SEA and 3 members by Byggherreforum.

1.9 Available budget

SEA has made a decision and reserved 5 + 5 MSEK (0.5 + 0.5 MEUR) for 2005 and 2006. Proposals are initiated and developed by the BELOK group before they are brought to the board. The board of BELOK then take decisions to fund individual projects, with a minimum 50% co-financing from the participating companies. In several cases, a relatively small contribution from BELOK has been enough to realise projects.

1.10 Available information on initial expected effectiveness and cost-efficiency of the instrument

Effectiveness is a measure of to what extent the instrument contributes to reaching stated goals. There is no documentation connected to BELOK that explicitly states any expectations on how effective BELOK could or should be. In addition, the goals are formulated in rather qualitative terms. However, it is clear that technology procurement is considered as an effective instrument by the government and by SEA, based on more than 10 years of experience using this instrument.

The cost-efficiency of BELOK is very difficult to assess in quantitative terms. There have been no evaluations made of cost-efficiency for BELOK but earlier evaluations of technology procurement programmes point in different directions. Some procurements have been successful in terms of a new technology being established on the market, whereas others have failed in this respect. Some rate of failure is inherent in the risky area of technology development. A parallel can be

drawn to venture capital for start-up companies where the expectation is typically that 5-20% of the investments are commercially successful. In the case of BELOK, for example, an attempted technology procurement for solar shading systems did not result in any proposals that fully met the requirements. Instead, the effort was reoriented and resulted in a university based research project.

Even when a technology procurement is successful, it is debatable what would have happened without the programme. Would the improved technology have reached the market anyway, and how soon, or not at all? The baseline is very difficult to determine in cases like this. Take the example of low pressure drop filters that may, if the technology works and is commercially successful, result in savings worth 50 to 150 MEUR/yr (assuming 1-3 TWh/yr saved in the longer term in Sweden alone). Should BELOK's investment of, say, 0.05 MEUR be credited with this success or would the inventor had found other ways to get the funding (government or private)? Could someone else have developed the same idea at a later stage?

The issue of cost-efficiency leads to the broader question of what is the role of government in supporting research, development, demonstrations and dissemination of results and information? There is general agreement that government has an important role in supporting RD&D. In addition, innovation policy is becoming increasingly important and prioritised in most countries.

1.11 Side effects

Positive side effects of BELOK may potentially include better indoor environment in general, improved international competitiveness for Swedish manufacturers (when technologies are successful), lower non-energy related environmental impacts, more useful building energy declarations and databases, and the like.

Negative side effects of BELOK may potentially include rebound effects (in theory, highly energy efficient ventilation may facilitate, or lead to, higher air-flows in the long term).

2 Policy theory

There is no explicit policy theory stated or documented in the context of BELOK. However, from documentation related to BELOK it is clear that the main idea is to accelerate energy efficiency in commercial buildings mainly through technology procurements, demonstrations and information dissemination. Technology procurement is described in various other publications from SEA and its predecessors. Whereas technology procurement has traditionally focused on specific products, BELOK has been involved also in the development of tools and models for supporting the implementation of energy efficiency in commercial buildings.

2.1 Cause-impact relations, indicators and success and failure factors

The policymakers', i.e., SEA's, more or less explicit assumption on how BELOK will function is that a group of competent representatives of real estate companies can identify and formulate various barriers to energy efficiency and how to address them, as well as promising innovative technologies. Involving such a group in the whole process from identifying problems and addressing them through various means, with co-financing from the members, ensures that the activities are relevant and that the users are committed to applying the results. In this sense, BELOK takes an important step further than just employing advisory groups. By having a procurement group that represents much of the total floor area in commercial buildings it can also be expected that the good solutions developed get used in practice, within as well as outside the group.

One of the strengths of BELOK is the flexible and results oriented approach to addressing problems or exploring opportunities. This leads to a multitude of activities but it also means that this policy instrument is demanding to evaluate. In this report we have opted to evaluate BELOK at two levels: (i) the relative success of BELOK as a whole, and (ii) the relative success of the four identified activities listed in chapter 1.3.

2.2 Interaction with other policies

BELOK is operating in a context with a multitude of policies and policy instruments concerning buildings and, or, energy. The most influential on the activities of BELOK is perhaps the Buildings Directive which requires energy declarations for buildings. BELOK takes an active role in the implementation of this directive through suggesting ways to make declarations and associated databases/statistics as useful as possible. Energy prices resulting from market developments, energy taxes and emission trading is an important but less direct influence on BELOK.

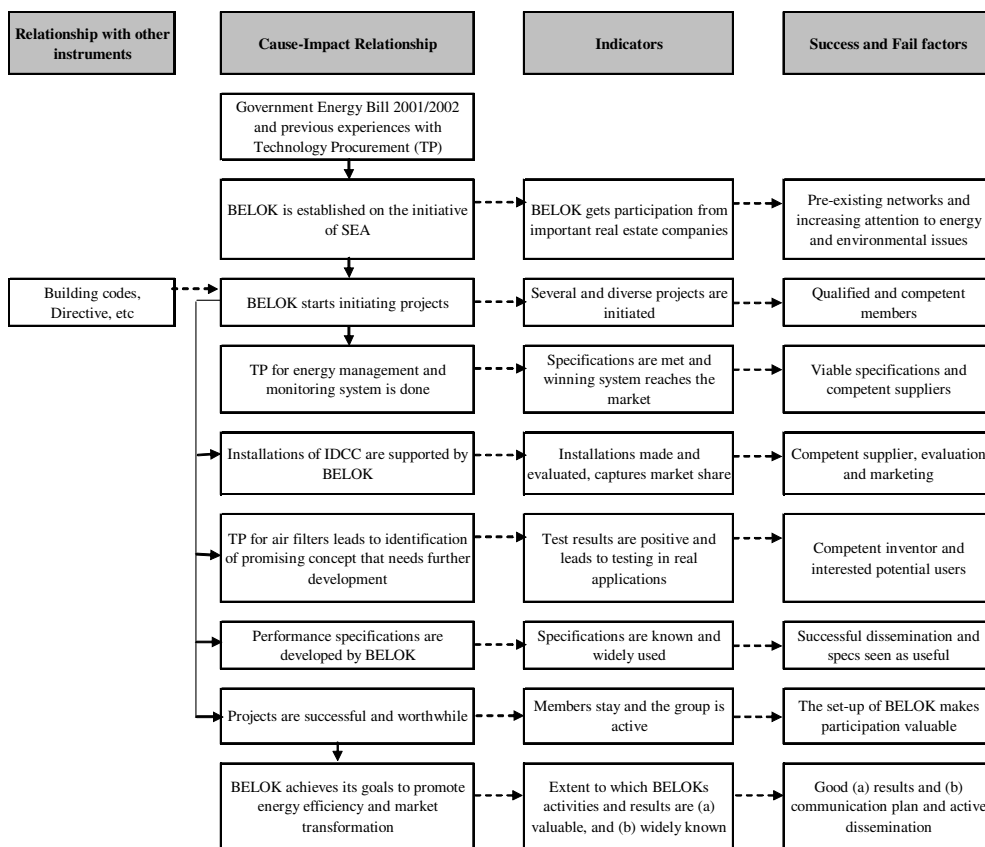


Figure 2 Overall picture of assumed functioning of BELOK: cause-impact relations, indicators, success and failure factors and interactions with other instruments

3 Evaluation

BELOK can be evaluated at two levels: (i) the general level, and (ii) by assessing the relative success of individual projects. In the following, we comment on the indicators used in Figure 2.

3.1 Rate of participation

BELOK from the start attracted the participation of major Swedish real estate companies accounting for much of the commercial floor space. This is in line with the initial ambition of SEA to have broad participation. The success is partly explained by the pre-existing networks in the sector (through SEA and others) and by that a qualified and enthusiastic person (Stefan Camitz from WSP) was engaged as project leader by SEA. Other important people, such as Professor Enno Abel and Tomas Hallén (Technical Director of Akademiska Hus, and winner of an important energy prize in 2005) were also involved at an early stage. An important factor behind attracting dedicated people at important companies was an intensive round of meetings, telephone calls, discussions, etc aimed at identifying suitable individuals from the respective companies.

3.2 Number of projects and activities

BELOK started in the spring of 2001 and has since its conception initiated a large number of projects. Not all of them have been successful but it is inherent in promoting technology development and introduction to take risks and sometimes fail. It is in many ways too early to evaluate the outcome of BELOK but it is clear that the group has been very active with well attended meetings about four times per year and a large number of projects. New project ideas are continually developed. The success in terms of high level of activity is mainly explained by the composition of BELOK with competent and creative members that have a clear interest in energy efficiency through the position as energy managers and the like in their respective companies.

3.3 Market introduction of energy management and monitoring system

The three systems for management and monitoring of energy use were installed during 2004/2005 and are evaluated at the time of writing. The winner (Larmia) was announced in March 2006 and the results will be reported in June 2006. The background is a technology procurement during 2003 from which three proposed systems were selected. It was not possible to identify a winner based on the presentations made of prototypes and data, hence the jury proposed an evaluation based on full scale tests of the best three proposals (from Honeywell/INU-Control, Siemens Building Automation, and Larmia). Reportedly, all the six companies that submitted proposals have valued the input provided by BELOK through the specification prepared for the procurement and the resulting dialogue. Both BELOK members and the companies submitting proposals appear to value the communication channel facilitated by BELOK, bridging the gap between supplier and user (Malm 2006, Widén 2006). It is reasonable to assume that the winning system, as well as followers from competing companies, will be commercially successful. Resulting savings are difficult to determine but the general experience is that building energy management systems, if properly used, result in savings through detection of malfunctions and anomalies, better operation strategies, and identification of investment opportunities.

3.4 Installations of air diffusers

The Intelligent Diffuser for Climate Control (IDCC) was awarded an energy prize in 2004 and an indoor climate prize in 2003. The device has its origin in ideas and discussions between the inventor Herman Lindborg at LindinVent AB and Tomas Hallén at Akademiska Hus. Only a few installations had been made at the time that BELOK decided to support the evaluation and co-financing of the device in Akademiska Hus buildings at Göteborg University. According to the inventor, T. Hallén has had a very important role all the way from discussing the idea to testing and evaluation in buildings. By January 2006, about 4000 devices had been installed in total and LindinVent is expecting that sales will increase. It is difficult to determine how important BELOK's initiative has been for the market diffusion of the IDCC. According to H. Lindborg, Hallén was instrumental and the support and interest from Akademiska Hus and BELOK has been very valuable for LindinVent. According to Hallén, the support from BELOK (mainly for evaluation and some for investment) was necessary for getting Akademiska Hus to go ahead with the project. The demonstration has produced well documented electricity (-50%) and heat (-90%) savings through a retrofit project. Although it is still a bit early to determine, it appears that the IDCC will be a commercial success. Important factors behind the success so far is that LindinVent is a company with a track-record and good reputation (especially in the area of laboratory ventilation); that a competent buyer was present through Hallén and Akademiska Hus; and that a small amount of support was available for demonstration and evaluation through

BELOK. Documented savings through an independent evaluation as was done in this case is important for future marketing by the supplier.

3.5 Positive test results for air filter

The electrostatic air-filter with extremely low pressure drop is developed by an inventor (Andrzej Loreth) with a small company (AD Air Design) which works on various innovative solutions for ventilation systems. The first round of testing, which was supported by BELOK, was not successful in the sense that problems with moisture occurred after 3 months of testing. The filter design was modified and a new round of testing has commenced, and long term testing of the filter in existing buildings owned by BELOK members is planned for. It is much too early to comment on whether this filter will be a commercial success. The first step is to demonstrate the technical performance. It is clear, however, that the inventor values BELOK's involvement very highly. Partly because of the financial support for official testing by the SP Swedish National Testing and Research Institute, and the prospects for further development support. But, equally or more important according to the inventor is the possibility of using BELOK as a channel for reaching the real estate companies and try the technology in real applications in long term tests. BELOK has provided an important bridge between inventor and future users of the technology.

3.6 Performance specifications are known and used

Referring to various documents, standards, and specifications when contracting for a new building, or retrofits, is a common practice. However, specifications of energy efficiency have not been common. There have been classifications of ventilation systems and lighting systems that could be referred to (for example, classification of ventilation systems according to specific fan power), but BELOK has brought together, and updated, such specifications into one document. The specifications can be downloaded from www.belok.se for anyone to use. So far, the specification has been used by some of the member companies, and it is not possible to say how many other companies that have used it by downloading or referring to BELOK. BELOK has not yet been very active in disseminating the performance specifications, although they have been requested by consultants even before becoming available on the web page (BELOK meeting notes, May 2005).

3.7 Members stay and BELOK is active

One indicator of the level of commitment and usefulness of BELOK is that the group continues to be active and meetings well attended. Typically, the BELOK meetings are attended by 8-12 people, including the coordinator, SEA, and sometimes a guest. This clearly demonstrates that the participating companies find

BELOK a worthwhile activity. With the relatively small contribution from SEA and the requirement of 50% co-financing, money is obviously not the reason for participating. Based on discussions with members, one impression is that they strongly feel that they are actually achieving something important through BELOK, that they make a difference, rewarding to society, their companies, and themselves in their profession. Factors behind this success, as testified by members, is the organisation of BELOK, and the individuals in the group. As a result, the way is short from ideas to action, and also there is much action and little talk.

3.8 BELOK is known and results contribute to energy efficiency in buildings

It is beyond the means of this evaluation to survey how well known BELOK is among various actors. The impression from asking a handful of people in the building sector, and some academics in the energy field, is that BELOK may have been heard of but the specific activities are relatively unknown. BELOK is also approached by innovative firms who wants to get BELOK support, which indicates that the existence of BELOK and its activities are known. The impression that BELOK could be better known is consistent with the view of the members of BELOK as mirrored in the discussions during BELOKs 22nd meeting (November 2005, attended by the author of this report). At this meeting, an information strategy was on the meeting agenda. It was subsequently decided that the web-page should be upgraded and that the possibility of publishing results in relevant Swedish trade journals should be investigated. Furthermore, BELOK was scheduled to be presented in at least two national conferences. On the whole, BELOK members felt that not enough effort had gone into communicating results, but on the other hand, until recently (e.g. early 2005) there were little results or important information to disseminate. The BELOK group has decided to consult the information department at SEA for assistance in preparing a communications plan.

One goal of BELOK, is that the activities of the group should lead to an earlier market introduction of energy efficient systems and products. This has been achieved in the case of the air diffuser and the energy management and monitoring system. It can be achieved in the case of low pressure drop filters, and through the application of performance specifications.

3.9 Net impact

The net impact of BELOK with its variety of mostly not yet finished and newly initiated projects is impossible to determine in quantitative terms (e.g., kilowatt-hours saved). Potentially, BELOK can have a very large impact, assuming that at least one or two of the innovative technologies supported by BELOK are commercially successful, and assuming that they would not have been successful without

BELOK. The baseline is impossible to determine with any certainty and bold assumptions are needed in order to quantify net impact, ex-ante as well as ex-post.

3.10 Effectiveness

While it is very difficult (and definitely too early) to determine the net impact, and since there are no quantitative policy targets, it is not possible to comment on effectiveness in this sense.

Rather than policy targets, BELOK has formulated relatively soft and self imposed goals that are generally aimed for (not hard targets). Linking back to the formulated goals (i.e., market introduction, 20% savings, and two EU projects), BELOK has been quite effective:

- BELOK has accelerated the market introduction of air diffusers. Improved energy management and monitoring systems are in the pipeline and air-filters may follow. BELOK has introduced tools such as a performance specification, a simulation tool for architects, a life-cycle cost calculation tool, etc. but it is not clear yet what the market uptake will be.
- More than 20% savings are clearly possible with the technologies (IDCC and air-filter) included here. Savings resulting from energy management system, performance specifications, and other tools may be lower or higher depending on the baseline.
- BELOK has not participated in any EU funded projects except for a planned, perhaps indirect, participation in the project GreenBuilding by a couple of the companies. Instead BELOK has made study and information exchange trips to England, France, and Finland.

From the perspective of carrying out projects it is the judgement of this observer that BELOK has been very effective. In a relatively short period of 4-5 years, a large number of projects have been initiated and a handful have been completed, or nearly completed, already. Judging from participation in one of the meetings, and from earlier meeting notes, there is a steady flow of ideas for important technologies and problems to address.

From the perspective of bringing new technologies, methods and tools to practical use, it is difficult to envision something more effective than having a committed user group representing a large share of commercial floor area in Sweden taking active part in the formulation of problems, and the development of solutions.

3.11 Cost efficiency

The cost-benefit ratio for BELOK in terms of EUR/MWh saved or EUR/ton of carbon dioxide avoided cannot be determined. It may be noted that a relatively small amount (0.5 MEUR per year) is spent on activities that can potentially save several TWh per year if technologies and tools are successful and broadly implemented in the longer term (e.g., 5-10 years).

3.11.1 Society

Supporting RD&D is generally considered a good investment from the societal point of view. The cost efficiency is difficult to determine but a simple calculation can put the numbers in perspective. The total annual spending on BELOK, including co-financing, is about 1 MEUR. This represents the value of 25 GWh (assuming 4 cEUR/kWh), equivalent to 0.08% of the electricity used in commercial buildings and for common purposes in multifamily buildings. Assuming that BELOK's activities over 10 years (10 MEUR) result in electricity *and* fuel or heat savings of 1 TWh (less than 0.7% of final energy use in buildings *in Sweden*) per year over 10 years (10 TWh) the cost per kWh saved is 0.1 cEUR/kWh

3.11.2 Government

The money spent by the Government, 0.5 MEUR/yr, may be considered small in relation to the potential benefits – not only in terms of energy savings but also for industrial development job creation among equipment suppliers and other companies.

3.11.3 Other organisation

Not applicable

3.11.4 End-user

Members must feel that it is cost-efficient to participate in BELOK, judging from the high level of activity and participation. Presumably, they also consider the investments they voluntarily make in demonstrations projects, etc., to be cost-efficient in the long term.

4 Conclusions

4.1 Net impact, effectiveness and cost efficiency

BELOK is working mainly in the areas of market transformation and technology procurement, and is not aiming at realising short term savings potentials through various incentives. The primary goal is to bring energy efficient technologies to the market through technology procurements, tests, demonstrations, and evaluations. It is a relatively long-term endeavour for which it is difficult to determine the impact, effectiveness and cost-efficiency in quantitative terms. The impact of technology procurement is a debated issue: what would have happened without the procurement? Would a particular technology or practice have reached the market anyway, and how soon?

Based on documentation from BELOK, internal meeting notes, interviews and participation in a BELOK meeting it is concluded here that BELOK (started in 2001) has an impact already and is poised to have a considerable impact in the longer term. However, it is too early to even attempt to quantify the impact. The evaluation shows that BELOK is considered a very valuable mechanism and platform by the members for advancing technologies, tools, and practices for energy efficiency in commercial buildings. It is too early to draw firm conclusions about the impact of the four projects included here but it is clear that BELOK has played, and is playing, an instrumental role in the innovation and commercialisation process.

It is also concluded that BELOK is a very effective mechanism for addressing various barriers to energy efficiency in commercial buildings. The primary task is to bridge the “valley of death”, i.e., help an innovative technology through the difficult steps from idea, development, prototype, testing, demonstration, etc., to reach the stage where it can be considered commercial. The role of SEA is to catalyse this process through a modest (0.5 MEUR/yr) financial support. The role of BELOK is to bridge the (frequent) gap between users (represented by building owners in the BELOK group) and inventors, suppliers, and manufacturers of innovative energy efficient equipment and systems.

The reason why BELOK can be so effective in this role is that it gathers a group of dedicated and competent representatives of companies that own a substantial share of the commercial floor area in Sweden. Based on everyday practical experiences these individuals can exchange ideas and formulate projects. As a group, they are in a position where they can exert a greater influence on prospective suppliers and developers than they could as individual companies. They can also pool their re-

sources and expertise in a way that is difficult for individual companies, as well as share the risks (together with SEA) of developing and trying new solutions. From the perspective of a supplier, BELOK is a very attractive counterpart offering the possibilities of, among other things, doing demonstration projects with independent evaluations to document the results. Proven technologies with documented results are important to show in order for builders, consultants, contractors, etc., to be willing to adopt new solutions.

The cost-efficiency is not possible to quantify. In general, RD&D efforts are considered a good investment for society and the importance of innovation (for sustainable development) on the political agenda is increasing. In contrast to some arenas for improving energy efficiency, buildings are complex systems, the function of which is strongly influenced by their users. In addition, the building construction process is complex and involves a large number of actors. Landlord-tenant relations and other organisational issues add another dimension. The conclusion drawn here is that an inexpensive mechanism such as BELOK is a very good investment for promoting innovative solutions in this complex area.

4.2 Success factors

An important success factor for getting BELOK started, and approved at SEA, has been the dedicated work of Tomas Berggren at SEA. Based on his experience and networks, a qualified project leader (Stefan Camitz), a respected academic and senior expert (Enno Abel), and several key people from real estate companies were engaged.

The high level of activity, indicated by the number of projects and attendance in meetings, can be attributed mainly to that dedicated and motivated individuals from relevant companies were involved from the start. A success factor is also that they took part in the initial stages of shaping BELOK. The attention given to energy issues in general has increased since the start of the program due to increasing fuel and electricity prices.

Reasons for the likely success of the technology procurement for an energy management and monitoring system is that a qualified group of individuals could put together a viable specification for a better system, and that there were suppliers that could meet the specifications.

One of the reasons for the almost certain success of the air-diffuser is that BELOK provided for a demonstration of the technology, including a careful and independent evaluation that the supplier can refer to when approaching potential buyers.

It is difficult to judge at present whether the air-filter will become a success, but results so far are promising. From the perspective of the inventor, the support from BELOK and the access it provides to final users who are willing to test the filter, appears invaluable.

General energy performance specifications that can be used in procurements were successfully developed through pooling the experience and expertise of BELOK members. Whether they will be a success in terms of actually being used depends on (a) if they are known by builders, and (b) if builders will increasingly put such demands on contractors.

The way BELOK has been set up organisationally as a group, or network, of about 12-15 individuals facilitates efficient cooperation. The way from idea, to project proposal by BELOK, to decision by the BELOK board is short. This is a factor which is highly valued by the members, as is the possibility to interact with peers, and to share experiences, risks, etc. The immediate feed-back on ideas is noted by members as important.

A simple thing, which has resulted in high participation rates in meetings, is when BELOK decided to have lunch-to-lunch meetings.

The extent to which BELOK and its activities are widely known cannot be determined but the impression based on anecdotal evidence, supported by the view of the BELOK members, is that not enough effort has been put into communication and dissemination. One factor is that the member companies do not necessarily have strong incentives for doing this. It is perhaps mainly in the interest of, and a task for, SEA. An information strategy is currently in the making.

An overall success factor is that BELOK is user driven. Practical problems and ideas that originate from the everyday work of energy management in buildings can be effectively addressed through BELOK. Through BELOK, the users/members are also committed to applying innovative solutions, and can use BELOK (e.g., results, support, to legitimise, etc.) to get support within their own organisations.

One important success factor is probably to have a competent, and credible in the eyes of the members, project coordinator with a background both in research and practice.

Important success factors for other countries to consider is the work going into creating the group and how the concept is set up organisationally. Other approaches may be more suitable in other settings than Sweden. Financial support is not an important motivation for participating. Value to society, participating companies, and themselves, is what motivates individuals to allocate precious time to BELOK. Ultimately, the level of success is determined by the interest and commitment of

the participating individuals. It may be noted that the participants do not necessarily have a strong personal interest or stake in disseminating results, indicating an important role for the hosting organisation.

4.3 Fail factors

In the start-up phase it may be relevant to consider the reputation and credibility of bodies and individuals involved in organising the program in order to get the attention and confidence of prospective participants. Stakeholder involvement is important to ensure commitment. Pushing a ready-made program top-down onto potential participants could be one road to failure. Furthermore, the interest in participating may erode quickly unless participants feel that the activity is valuable and fruitful to them.

A program such as BELOK is a low risk activity since it involves relatively few individuals and little financing. The probability of failure should not be underestimated but the consequences of failure would be very limited. Hence, trial and error can be employed as a strategy.

4.4 Monitoring and evaluation

BELOK as a program had not been evaluated before this evaluation was made. However, monitoring and evaluation is not possible in the conventional sense for an energy efficiency programme, i.e., weighing costs against energy efficiency improvements. Since BELOK is often operating relatively early in the innovation chain, trying to bridge R&D with market demonstration and introduction, it is not possible to construct baselines with much certainty. Although ex-post evaluation is in principle possible (through making assumptions about business-as-usual baselines), the effects of BELOK activities may be several years into the future. It should be noted that BELOK makes careful evaluations and assessments of technologies as part of the projects but these are not aimed at estimating long term market impacts.

One difficulty is presented by the complexity of the commercial sector and its energy use. Sales data for new technologies (e.g., air-diffusers or low pressure filters) can be monitored and resulting savings relative to conventional technologies can be estimated. But, it is difficult to determine how much of the sales that should be attributed to, in this case, BELOK. When it comes to tools such as performance specifications or building energy management and monitoring systems it is even harder to quantify the savings.

Nevertheless, programs such as BELOK should be assessed. One weakness of BELOK is that no attention was paid to evaluation from the start of the programme. An evaluation plan could have guided some of the efforts so that, for example,

attempts at systematic scorekeeping would have been integrated. One simple measure would be to have the web page count the number of visits in different parts and the number of downloads of various tools and documents. A bi-annual questionnaire to the participants could be used to measure various indicators (e.g., rate of application of new technologies and tools within their organisation, anonymous rating of the value of different activities, etc). The Annual Report 2005 from BELOK contains a good overview and description of the activities but does not serve the function of a critical self-assessment. A sharper controller function with the host organisation, and the resources to maintain that function, would facilitate better scorekeeping and “running a tighter ship”. However, it must be done without increased bureaucracy and burdening of the participants with administrative tasks.

As for evaluating the effectiveness and cost-efficiency of a programme such as BELOK, it would have to rely heavily on low cost approaches, such as, engineering estimates and assumptions (ex-ante) of market shares, or assumptions (ex-post) of baselines. For illustration of a rough ex-ante calculation: in the case of low pressure air filters, total filter losses are estimated at 1 TWh per year. Assuming that the turnover rate is about 5% and that the low pressure filters go from 0% to 20% market share over ten years, a cumulative amount of 500 GWh would be saved over these ten years, worth 20 MEUR (*in Sweden alone*). This type of estimates can be complemented by market surveys and statistical analyses when needed.

It should be noted that BELOK is not purely an energy efficiency program but has the simultaneous goals of improving other aspects of environmental performance, indoor air-quality, and promote innovation, industrial development, and competitiveness. Hence, evaluations should consider such aspects as well.

4.5 Learning experiences

The most important learning experiences include:

- It is important that an instrument like this is user-driven in order to ensure participation, interest and commitment.
- More action than talk is highly valued by members.
- Finding the right individuals is important for getting a creative group
- An idea about, or plan for, scorekeeping and evaluation from the outset would facilitate evaluation.
- As in any government sponsored activity, care should be taken, as BELOK has, when determining procedures, so that some potential beneficiaries (equipment suppliers, universities, institutes, consultants) are not favoured over others.

This type of instrument is difficult to evaluate in the context of quantitative savings targets such as those proposed in the Energy Efficiency Directive. It is nonetheless an important policy instrument for ensuring that the energy efficiency market is fed with new technologies and tools, and thereby potentials for future efficiency improvements.

References – documents

Notes from all (22) meetings

Annual report from BELOK 2005

Access to BELOK internal web pages

Internal documents and memos

Good practice leaflets

Powerpoint presentations of BELOK and activities

Evaluation reports (2) of the supply air terminal device

Funding decisions by SEA.

References – interviews

List of interviewed people:

Stefan Camitz, WSP (died in 2005)

Egil Öfverholm, STEM

Herman Lindborg, LindinVent

Andrzej Loreth, AD Air Design

Sven Malm, AP Fastigheter

Per Erik Nilsson, CIT Energy Management

Per Widén, Statens Fastighetsverk

Tomas Berggren, Swedish Energy Agency

Conversations and discussions (not formal interviews) with several other members of the group in conjunction with the BELOK meeting in November 2005.