Value chains and energy efficiency measures

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1. SYNOPSIS

Systems of value chains in appliance acquisition, maintenance of buildings and municipal services are identified. According to LINKKI 2 results, consistency of goals, motivation and monitoring is essential.

2. ABSTRACT

Energy efficiency measures are necessarily introduced to various existing contexts and situations. The success of those measures is influenced by their compatibility with the overall context of production or consumption. One way to describe the context is the system of *value chains*: the steps, by different actors, necessary to produce a product or service. Each step and actor is there in order to contribute to the usefulness or attractiveness of the product or the service. This paper identifies three main types of value chain: home appliance acquisition and use, maintenance of buildings (residential and services), and municipal services (esp. schools).

In Finland LINKKI 2, a national research programme on energy conservation decisions and behaviour, is due to finish shortly. In this paper the results of over 20 projects are described in terms of their place and role in the relevant value chains. Conclusions are made emphasising the importance of consistency within value chains from the strategic decisions level to the operations. Monitoring and motivation are some of the key issues. Voluntary energy conservation agreements as a government instrument are compatible with these conclusions.

3. INTRODUCTION

Energy efficiency measures are necessarily introduced to various existing contexts and situations. The success of those measures is influenced by their compatibility with the overall context of production or consumption. One way to describe the context is the system of *value chains*: the steps, by different actors, necessary to produce a product or service. Each step and actor is there in order to contribute to the usefulness or attractiveness of the product or the service. Energy efficiency measures should be targeted at the right audiences, introduced at the right moment, to the right actors, in order to be adopted. If brought up at the wrong phase in a process, they are often too late to be fully utilised.

This point has been taken into account in the Swedish market transformation programmes, organised by STEM. There is often a chain of companies moving equipment from a manufacturer to the user. Those companies have to make their living from this process. Any one can stall the process of dissemination of efficient products if he finds his business in jeopardy. (Suvilehto & Öfverholm 1998)

Kasanen and Persson have studied the conditions for the diffusion of high performance windows, identifying the stages of decision and adoption and the relevant actors at each stage (Kasanen & Persson 1997).

A very relevant concept for this work is “energy-relevant” decisions, in the paper on energy relevant decisions within office buildings by Lukas Weber (1999). In an empirical study of Swiss office buildings he shows that only one seventh of the total reduction in electricity consumption was expressly intended to save energy. Most energy savings were a positive side effect of core business –related activities. This finding emphasises the need to take the real value chains seriously.

LINKKI 2 Research Programme on Energy Conservation Decisions and Behaviour has, in 5 years and 26 projects, produced a body of knowledge concerning energy conservation decisions and behaviour in organisations and by households. The programme was mainly financed by the Ministry of Trade and Industry. In order to emphasise the importance of finding the right actors and situations for energy efficiency efforts, in this paper we describe some of the findings of LINKKI 2 programme in the framework of the value chain. The paper begins by a clarification of the concept of value chain. Some of the essential types of value chains in the domain

of LINKKI 2 are then described. Then these types of value chains are discussed in more detail, organising the findings of LINKKI 2 projects in the chains.

Finally, conclusions are made concerning the consistency of efficiency measures and efforts within each value chain, reaching to the steps before and after the value chain as well. Conclusions are also made concerning the possibilities to cross and mix value chains, to enhance energy conservation.

4. VALUE CHAINS AND LINKKI 2 PROGRAMME

The value chain model suggested by Porter (1985) has been widely used and adapted for various purposes. Within each company there is the internal value chain, starting from inbound logistics to bring in the necessary raw materials etc, going through operations to outbound logistics, marketing and sales and after sales service. These are the primary activities, shown as columns in the lower part of the fat arrow in figure 1.

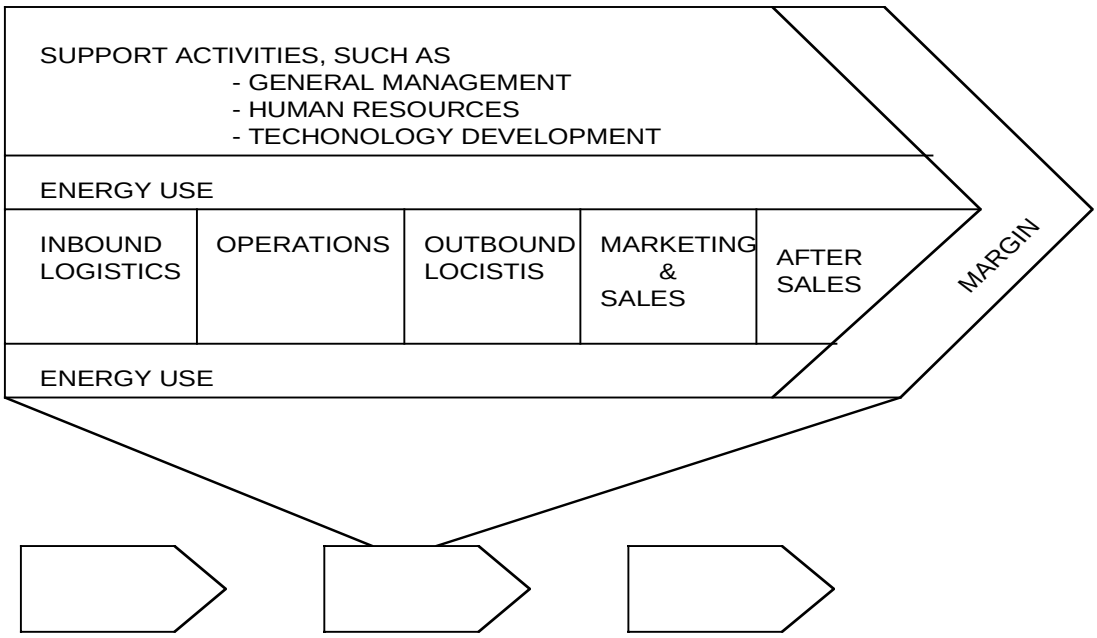
Within the company various support activities are needed (upper part of the arrow). The adaptations of the value chain model list different combinations of support activities, such as firm infrastructure or general management and strategy, human resources management, technology development, financial management and accounting, procurement.

The product of all this is valuable to a customer and is sold at a margin which is how the company creates value for itself.

Apart from this, a company must see its role as a part of a larger system producing value to the final customer of the product or service in question. There are parts of the system before the company, for example those producing the raw material. These suppliers have their own value chains and meet our company at the point of its "inbound logistics". For the product to reach the final consumer there may be other value chains, such as the channel value chain and buyer value chain. To illustrate this, figure 1 shows several arrows, zooming on one of them.

The main focus of interest can be at any part of the system, thus making the "antecedent" or "subsequent" positions relative to how the focus is fixed.

Figure 1. The value chain and the value system



The primary activities use energy in many forms: for transport, for heating or cooling premises, for lighting, for creating suitable conditions to store items, for the production process, and for communications and travel. The support activities also need energy for their processes and can influence the energy consumption of the primary activities. The arrow in figure 1 has slices to illustrate energy use.

The LINKKI 2 research programme on energy conservation decisions and behaviour
is organised under four main themes*: Households and Residential Buildings*, concerning the immediate environment of consumers; *Municipalities, Companies and Organisations*, concerning decision making, energy conservation agreements and information activities; *Follow-up Measures* on the success of conservation measures, developing monitoring practices and indicators on efficiency trends; and *Adoption of New Technology and New Methods*, focusing on the adoption possibilities of existing energy efficient technologies and methods.

Based on the programme we have insight on various possible systems of value chains, such as those related to household activities (food preparation, clothes maintenance, living space maintenance, hygiene), residential building renovations, maintenance and activities, office and service building renovations, maintenance and activities – education in schools as a special case, the media, retail of appliances and production and distribution of energy. The research has not systematically covered any complete value chains, since it has not been an organising principle in the programme. However, it is possible to shed new light on the acquired results by adopting this perspective.

We identify three main types of value system. They are chosen because within each, a large number of LINKKI 2 results can be combined to reach an understanding of the energy conservation possibilities involved:
- Home appliance acquisition and use
- Maintenance of buildings (residential and services)
- Municipal services

Each system consists of several value chains that are linked together to provide the product or service in question. The level of resolution is sketchy rather than detailed, serving the interest of analysing energy efficiency decisions and activities rather than technical issues.

5. VALUE CHAINS FOR HOME APPLIANCE ACQUISITION AND USE

We distinguish between three main value chains: manufacturing appliances, supplying and selling them to the customer, and their use in and by the household. It is the manufacturing stage that determines the efficiencies of the appliances that will be on the market. Within the EU, minimum efficiency standards and energy labels, among other things, influence the efficiencies. A report on the first three years of the Energy Label showed that the label has had an (encouraging) impact on the speed and intensity of energy efficiency improvements (Winward et al. 1998).

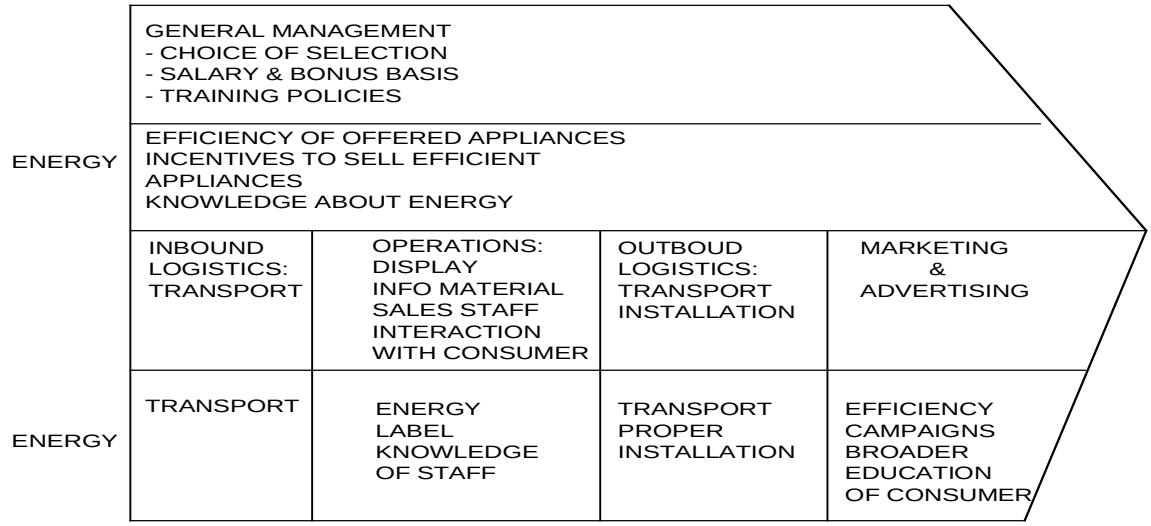
The appliances are then made available to appliance retailers by importers of brands and wholesalers of appliances. Their strategies and policies have some influence on how the selection at appliance stores is constructed. In LINKKI 2 there is no research into the value chains of manufacturers and the influence of retailer strategies.

Figure 2. The system of value chains: home appliances

As we approach the household, the central phase is the retail store. In the value chain of the retailer, the general management level has a strategy that will determine the store's, or often the chain's, response to the offering of manufacturers, importers and wholesalers. Energy efficiency may or may not be a parameter in this selection

process. The chosen selection will, however, express some average efficiency and some distribution of efficiencies, whether explicitly determined or not.

Figure 3. The value chain of appliance retailer



In the management and support activities, other energy relevant decisions are made. One concerns the salary and bonus policies of sales staff. These may explicitly or implicitly encourage or discourage efforts to focus on the more energy efficient appliances. Another issue is the training policy and practice. The staff may be more or less knowledgeable and motivated about energy efficiency and life cycle cost, depending on the frequency and quality of training that they participate in.

As regards the primary activities, the inbound logistics include transporting the appliances and other materials to the store. While this is energy consuming, and the choices made here can be important in terms of energy consumption, we do not focus on these logistics here.

Once in the store, the predetermined (by management) selection of appliances is displayed, energy labels are attached, informative material is made available, and sales staff are there to help the customer choose an appliance. The customer walks in and the interaction can begin.

During the interaction the salesperson and the customer should discover the needs of the household and the purpose to which the appliance is intended, in order to avoid unnecessary energy consumption by means of an appliance that is e.g. too large or otherwise unsuitable to the household. The specific conditions of the household should be determined, e.g. to find out the optimal dimensions of an appliance that needs to be fitted in a given space. Suitable locations of appliances should be discussed (ovens and fridges should not be next to one another, etc).

The salesperson should also be able to explain how a somewhat more expensive appliance will accumulate lower life cycle costs, if efficient enough. The energy label may need some clarification, as well as the user's manual. The salespersons would often need training in these energy efficiency related issues and that support material to keep this information handy would also be needed. The energy issues are not unrelated to safety issues and to functional characteristics of the appliances. Therefore, training should emphasise the interdependence of these issues rather than allow salespersons to ignore energy efficiency as something of secondary importance. (Kasanen *et al.* 2000). Such training should be built into the personnel strategies of retailers and be reflected in incentive systems. Decisions about this need to be made at the general management level.

The outbound logistics in this value chain involves transport to the customer and sometimes installing the appliance. The installer should be aware of the requirements of energy efficiency. The installers can be a part of the retailer's own value chain or outsiders providing this service.

Marketing and sales could directly focus on energy efficiency – or, more common, on product prices almost exclusively, ignoring energy issues. However, there are examples of retailers having joined forces with energy agencies in campaigning for more efficient appliances, for example in the context of launching energy labels.

Taking a broader view of marketing, we remember that the customer brings in his or her expertise into the interaction with the salesperson. The customers should be aware of their needs and conditions at home. They may also be educated in energy and environmental matters and arrive at the store ready to demand efficient appliances. This education is provided in many contexts: at schools, in efficiency campaigns, in material provided by energy agencies or companies, and in the media.

Motiva, the Energy Information Centre for Energy Efficiency and Renewable Energy Sources, has produced information and education material for schools, a.o.t. (see e.g. Tarvainen *et al.* 1999). Motiva was founded in 1993 by the Ministry of Trade and Industry. Since the beginning of 2001 it is a state-owned company. Jylhä (2001) investigated how a local support person could help schoolteachers make better use of Motiva's education material. The most important support was to arrange funding for the schools for purchasing the offered energy efficiency education material. Funding in this case was given by local energy companies, to whom this is one of the ways to fulfil obligations to encourage energy efficiency among their clientele. Other practical help was also appreciated by the teachers. Some teachers requested expert visits and additional information.

The Energy Efficiency week, co-ordinated by Motiva, is a combination of campaigns to remind people about energy conservation possibilities and to inspire organisations to start their own activities in this area. Some of these organisations target their activities at the general public by organising exhibitions and giving advice (Wahlström 2000). The success of the exhibition organised by Motiva and Helsinki in 2000 was analysed in detail (Tolonen 2001). This exhibition attracted 1500 visitors which is four times the number of an exhibition arranged in 1999. This time the location was equally central but with less competition for the interest of the passers-by in the immediate neighbourhood. It was also easier to step into the exhibition from the street. The exhibition was advertised in a livelier way. For the future, the study recommends developing more interactive exhibits and focusing on making the information material visually interesting.

Leino and Jalarvo studied the needs and plans of energy companies to develop their energy efficiency information material targeted for their customers. Energy companies (the local distributors) are considered natural sources of conservation information, such as feedback and focused information, even if primarily the dissemination of conservation information is considered to be the duty of authorities. Along with customer magazines, telephone advice was considered important and the growing importance of Internet was foreseen (Leino & Jalarvo 1999).

Leppälä (1999) studied how journalists mediate energy information in the context of the Energy Efficiency Week. Her recommendations include shifting the information from the genre of social campaigning to reporting on the ongoing process of energy efficiency. This approach could enable more interesting media coverage.

Finally we turn into the third value chain of this system, that of the household using the appliance. Appliances are elements in the value chains in which household services are produced. The services are food preparation and storage, clothing care, shelter and entertainment. Cold appliances, cooking appliances, dishwashers; clothes washers and dryers; cleaning equipment and various entertainment appliances (TV, VCR, Hifi) are used in combination with other materials, using energy and time.

Many studies suggest that a more fundamental rethinking of household services than just appliance choice is necessary to turn energy consumption trends downward. A European project *The Sustainable Household* (Vergragt, 2000) suggests alternative ways to provide these services. Melasniemi-Uutela (2001) questions the adequacy of the energy efficiency approach in reaching environmental targets. Overall energy consumption is growing while appliances become more and more efficient. More radical changes in the way of life of households are needed, such as rethinking foreign travel and travel to leisure activities and second homes. The responsibility for energy conservation should be shared by decision makers and citizens in a common learning process, rather than tossed from one to the other. On a more practical level, Reisbacka *et al.* (2001) have studied the use of common laundries for apartment houses instead of individual washing machines in each household. This is a way to conserve energy in the laundry function of households. The laundry facilities need to be functional and attractive, and the chosen appliances should be energy and water saving. Ventilation often presents special challenges.

At home, given the lifestyle and technology, and having acquired some appliances, the user's manuals for the appliances should be referred to, to make sure that correct and efficient ways of use and maintenance are followed. Manuals often leave something to be desired in clarity and attractiveness, however (Reisbacka & Rytkönen 1999).

In daily use the habits of different households may vary considerably. By maintaining economical habits, besides choosing efficient appliances, households can further contribute to efficiency. Haakana *et al.* (1998) analysed the long time effects of feedback and focused advice on household energy consumption. After monitoring and advice that was given 2,5 years before this study, many households were still trying to decrease their energy consumption in various ways. However, these efforts did not necessarily result in actual savings, and overall the consumption of electricity and water in this group had slightly increased. While not representative of a larger population as such, this result highlights the difficulty of achieving spectacular results by any single means alone in the household sector. In this case, the focus was on energy saving habits rather than the potential of efficient appliances.

6. VALUE CHAINS FOR MAINTENANCE OF BUILDINGS

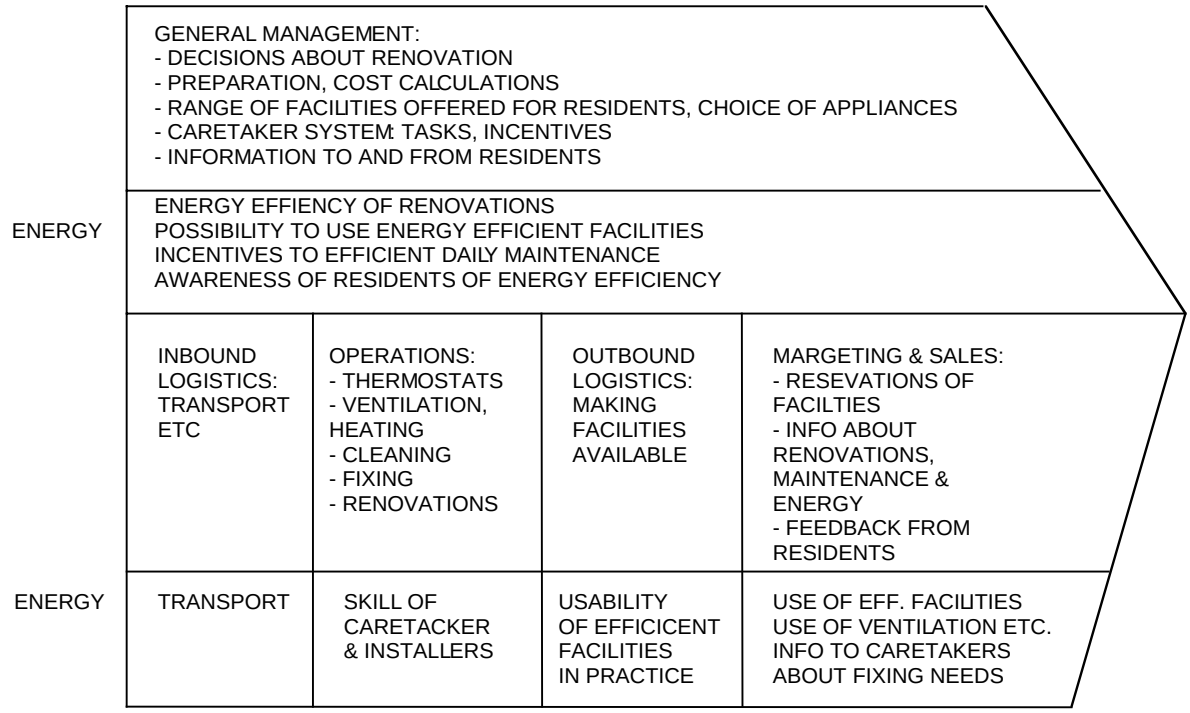
Residential buildings

Here again we distinguish between three main types of value chain: first, manufacturing of renovation components such as windows, planning agencies etc; second, the maintenance activities in and by the building and its management, and third, the activities of households living in the building. The manufacturing and planning chains determine the efficiency of plans and components available for renovation and maintenance. The attitudes of window manufacturers have been studied. They would welcome requirements to lower the U-value of windows to 1,4 and would like to include renovations in the building code. Window energy rating was considered a good voluntary method (Hemmilä *et al.* 2000).

Figure 4. The system of value chains for management of residential buildings

In the second type, the residential building itself, management and support activities are important for energy relevant decisions. A supervisory board of condominium owners or some other representative of the owner makes decisions about renovations. The building manager is in a central position to prepare such decisions and point out the need for those. One of the main issues in this context is the presentation and understanding of life cycle costs. These plans have a major influence on the energy efficiency of the building. Hemmilä *et al.* (2000) found that building managers and experts in energy efficient windows played a key role during preparations of window renovations. Their role is important because they inform residents about the new low-energy windows.

Figure 5. Value chain for building maintenance



At this level, important decisions about the range of facilities available for the residents are also made. These facilities include e.g. network outlets for block heaters of cars (to avoid cold starts), common laundries and saunas. The availability and use of those can be important in terms of energy consumption. The laundry facilities should be functional and attractive, and the technical challenges of ventilation should be met. Appliances should, of course, be energy efficient (Kalenoja & Lahti 1999, Reisbacka 2001).

The conditions for daily maintenance are set at this decision making level by choosing a caretaker and defining the tasks and incentives for daily maintenance. The ways in which residents are informed about energy efficiency issues, a.o.t., are also defined at this level. So called “energy experts”, residents who voluntarily want to focus on energy issues in the building, have been seen to be a good resource in rental apartment buildings. These experts have been recruited by the house manager and given some training by consultants trained by Motiva. They are individuals who have an active interest in improving their living environments, some technical skills and enough time to commit themselves to these activities. They are not paid for their work. In condominium buildings fewer successes have been observed so far. There, this system needs to be properly established and motivated by the manager and residents’ council to have a chance to get results (Savolainen & Savolainen 2000).

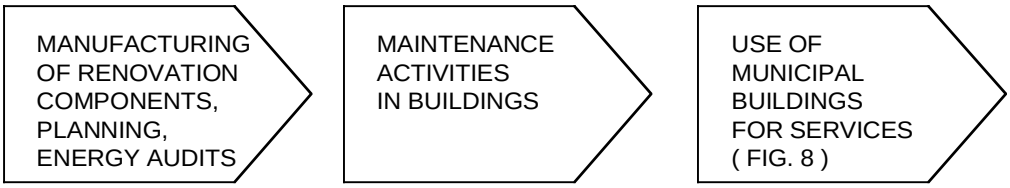
The “operations” in the primary activities of this value chain include setting thermostats and ventilation, checking and cleaning, fixing small problems, replacing worn parts, etc. Also the renovations are carried out at this stage. Outbound logistics could here be interpreted as the ways by which heater outlets or laundry use are made available to residents. The marketing and sales activities include reservation procedures for those facilities, information activities by management to households about renovations, maintenance and energy issues, and the procedures by which resident feedback is collected concerning renovation needs, quality of maintenance etc. The “energy expert” system is one possible way to organise this on an ongoing basis (Savolainen & Savolainen 2000).

The third type of value chains for residential buildings consist of the activities of households in their daily lives, for example using their block heaters in cars (Kalenoja *et al.* 1999) and using the common laundry (Reisbacka 2001). It also includes daily habits by which heating, ventilation and water are used.

Municipal buildings

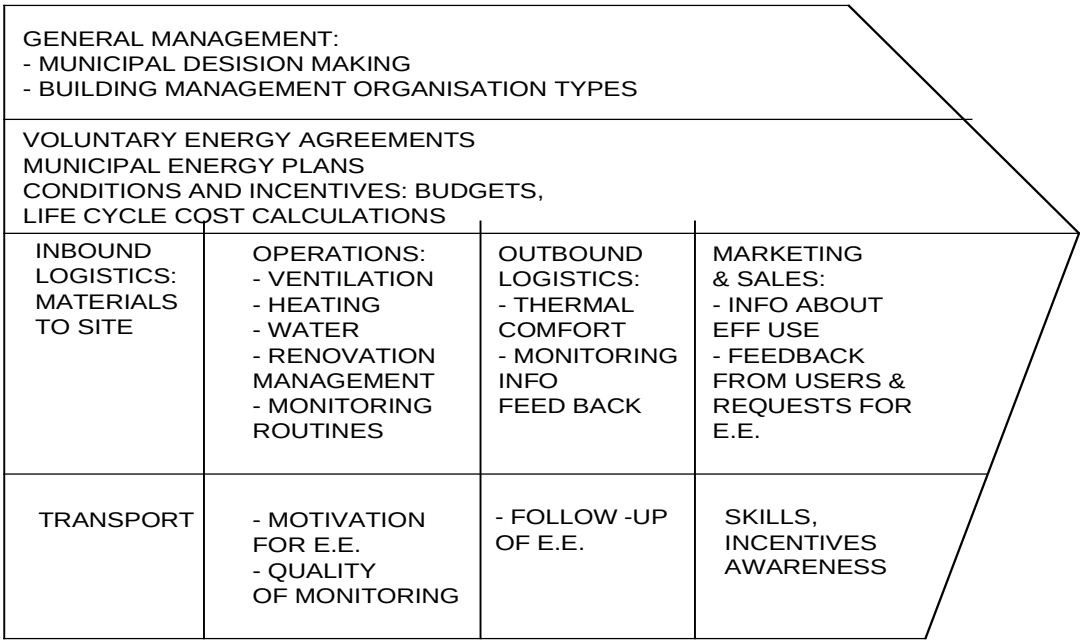
The value chains relevant for the energy efficiency of municipal buildings, preceding the activities in the buildings, include energy audits pointing out efficiency improvement possibilities. Erkiö (1999) suggests supportive actions to increase the rate at which production plants and service facilities on the whole are audited in Finland. Auditing activities had been flourishing through the economic recession of the early 1990's but received less attention as core business started to grow in mid-1990's. The main way adopted by the Finnish government to encourage auditing is in the framework of voluntary energy conservation agreements, in which energy audits are specified as necessary actions to fulfil the agreements. At the other end of the value system, the value chains consisting of the services that are produced in municipal buildings, such as health care or education, are discussed in chapter 7.

Figure 6. System of value chains for municipal building maintenance



To determine the conditions for energy efficient building maintenance, municipal decision making is important. There are also different building management organisation types which come with different sets of possible conditions and incentives. In her study Haakana (2000) suggests some common conditions that apply in all organisation types. Voluntary energy agreements would provide a common framework for municipal energy efficiency, and monthly energy monitoring should be started. Relevant departments and municipal councilmen should be informed about energy auditing. Education and bonus systems should be set up for caretakers and other actors in practical building management. Other important issues on these general levels municipal energy plans, budgets for energy efficiency, and the way in which life cycle costs are understood and followed in municipal building maintenance.

Figure 7. Value chain: building maintenance



Holopainen and Leskinen (2001) have found that the planning stage of renovations is crucial for suggesting energy efficiency improvements. The planners should be given energy efficiency improvement goals and they should be made aware of available efficient solutions.

Within the primary activities of building maintenance, the materials and necessary parts have to be brought on site. We have not studied the energy efficiency of the inbound logistics. The operations stage takes care of ventilation, heating and water on a routine basis. All this is usually the task of caretakers of the building or the larger organisation. The caretakers need to be motivated for energy efficiency, as suggested by Haakana (2000) above. This can be achieved by a combination of education, bonus systems and monitoring. Hakala and Hottinen (1998) discuss ways in which the energy efficiency culture can be improved in schools. It is important overall to allow flexibility in professional roles and to develop trust within the organisation. The key is to make wider use of the expertise and tacit knowledge of school caretakers and to show more respect to their work.

The operations stage also manages renovations in which outside actors are usually involved. Within the routine use of the building, monitoring is necessary to collect basic information about energy consumption and changes in the condition or use of the building. This is studied by Koski (2001) and Heljo (2001) based on a framework developed by Koski and Siitonen (1999). They pointed out that energy indicators for buildings based on annual energy consumption and the volume of the building do not well describe the energy efficiency and the annual changes in the efficiency of consumers. The main challenge is to find a balance between the feasibility of the monitoring system in practical use and its information content and accuracy. At least, information on the annual changes in the services and building activities have to be gathered and taken into account. Data forms were developed to enable the building personnel to provide these data. - On a national level, Kara and Kolttola (1998) suggested indicators to follow the specific consumption and energy efficiency in SME and service sectors.

The outbound logistics in this case can be interpreted as delivering thermal comfort to the providers and users of municipal services. The monitoring routines of operations should feed into feedback measures to identify improvement possibilities and needs. The framework for following the energy efficiency changes of municipal buildings, developed by Koski and Siitonen (1999) and Koski (2001) and Heljo (2001) is meant for this purpose. As regards renovations, Holopainen & Leskinen (2001) study the changes of energy efficiency of municipal buildings, due to renovations. A common outcome is a decrease in heating energy use and an increase in electricity use.

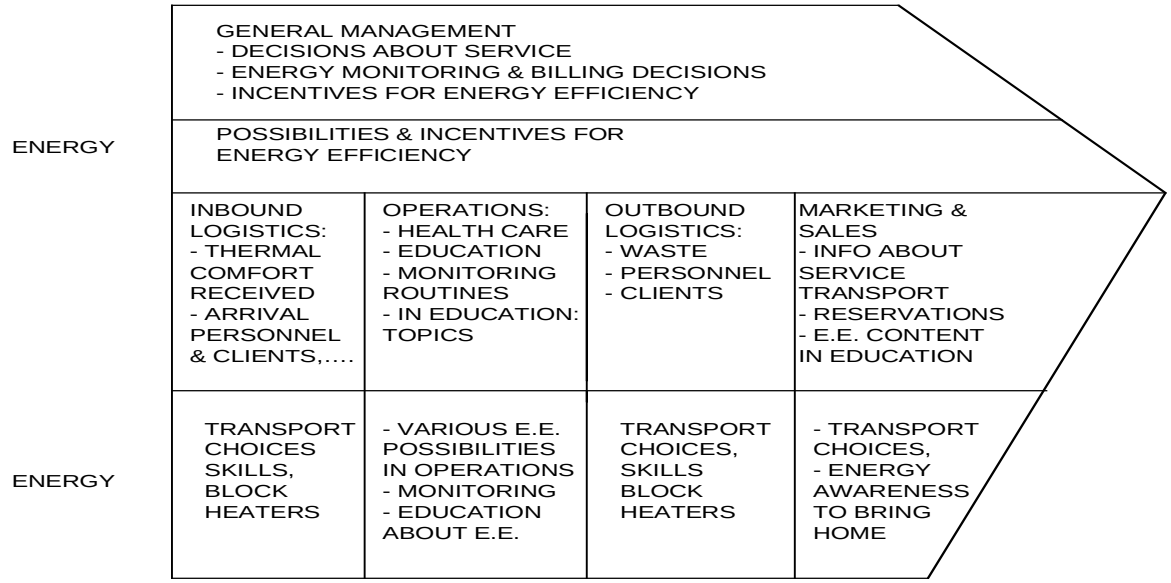
Finally the marketing and sales stages can be interpreted as informing the users about energy efficient ways to use the building and the services, as well as feedback and requests from the users to the management. Depending on how the energy use is billed, it can be to the user's advantage to insist on energy efficient renovations and maintenance. (Haakana 2000).

7. VALUE CHAINS FOR MUNICIPAL SERVICES

The decisions about municipal services, the ways in which energy use is monitored and billed, and the incentives for efficiency are structured differently in a number of different municipalities. The actual operations of municipal services are influenced by these issues on the general level (Haakana 2000).

The inbound logistics provide the space with its thermal comfort (discussed in chapter 4, section entitled "Municipal Buildings") as well as special equipment and food for pupils of schools, patients in hospitals etc. These logistics include also the ways in which the personnel and the clients arrive at the service building. As a detail of personnel logistics, we have studied the provision of network outlets for block heaters of cars, to avoid cold starts when driving home from work (Kalenoja & Lahti 1999). To increase the number of preheaters in the vehicle fleet, the most efficient means are recommendations to drivers concerning preheating, and including the pre-heater in the standard accessory set in new passenger cars. The activities studied by Wahlström (2000) included teaching economical driving habits to Helsinki bus drivers, resulting in 10% fuel savings. Pekkarinen (1998) studied the long term effects of the teaching of economical driving in driving schools. While it is difficult to isolate the impact of teaching on attitudes, intentions and actions, the experience in driving schools has been positive and economical driving is now a standard part of the education towards a driver's licence.

Figure 8. Value chain for using municipal buildings for services



The actual operations, such as health care or education, all have their own possibilities to increase energy efficiency. It is in each case important to develop monitoring routines to keep track of changes.

Education is a special case, because energy efficiency can be made a topic in the education itself. The idea in a SAVE project (Laitila 2000) is to combine the energy management of the school building with teaching about energy efficiency. Within this project and otherwise, Motiva (Energy information centre) has prepared teaching material for schools, to help teachers combine energy topics with various subjects. Jylhä (2001) has shown how a local support person can be useful in making this material more accessible to teachers. Leino and Jalarvo (1999) have studied how teachers used energy-associated material in physics teaching in comprehensive schools. Various ways to improve the marketing of the available materials were discussed.

Outbound logistics include getting waste out of the buildings, and moving both personnel and clients. Transport choices are relevant in terms of energy efficiency, as well as the avoidance of cold starts of cars.

Marketing and sales can be interpreted as the information about the services and the reservation arrangements as well as transport options. Also energy relevant, the content of the education can be marketing material for energy efficiency. If the students take their energy awareness home it could become a part of the household value chain, hopefully making changes in the ways energy is used in the household.

8. CONCLUSIONS

In conclusion, we can note the importance of choosing the correct step for influencing energy consumption. The main conclusions to be made from the results of LINKKI 2 projects concern the consistency within each value chain, reaching to the steps before and after the value chain as well. We have much less to say about the energy conservation potential due to breaking or mixing value chains.

The experience with the energy labels and their development into minimum efficiency standards, as well as our studies about energy efficient windows, suggest that efficiency norms – obviously – and labels are effective instruments in encouraging product development. The more efficient the supply of appliances and building components on the market, the easier it is to take the improvements further into value chains.

Our main emphasis was on the other parts of value chains, however. We found that the general management level of each value chain is of great importance, even if the actual energy consumption mostly happens in the primary activities of value chains. At the general management level, the overall goals of the organisation are set, and strategies are designed. Energy efficiency should be included on this level. To be followed through, it should

get a more concrete shape by means of internal guidelines about planning or procuring, salary and bonus policies and education of personnel.

It has been shown that clear and ambitious efficiency and other quality targets in building, renovation and maintenance do challenge planners to find the best and most cost-effective technologies.

Monitoring of energy consumption and its changes over time is of vital importance. The information should be fed back into a process that makes decisions about investments, renovations, and incentives to personnel. Billing according to use should be arranged. To develop monitoring and billing, both organisational and technical updating may be required. Eventually, the information should also go back to the strategic level to make sure that the overall goals are reached.

In some situations inefficient energy decisions make economic sense to decision makers who do not face the life cycle costs of those decisions. To avoid such situations, building management should make sure that life cycle costs of investments are faced by the same organisation that makes investment decisions.

Educated and demanding customers and residents can act to enforce and encourage the efficiency strategies of organisations. Schools educate future customers but indirectly influence also the parents of students. Educated and demanding planners can also make a difference in building and renovation.

Finally, the consumer or final user can be shown to enjoy energy efficiency improvements in many ways. Energy efficient renovations, with proper targets, bring about better indoor air quality for home, office, schools or other buildings. Savings in energy costs finally accrue to whoever pays, be it in product prices, rents or taxes if not directly in energy bills.

Better and more knowledgeable service in acquiring home appliances will improve the match between the household's needs, budget and appliance choice. Through correct installation and maintenance, safety is also improved. Building energy efficiency into value chains can shape them up considerably in other aspects as well.

The consistency of the energy efficiency goals, strategies and instruments throughout value chains starts from government policies. Climate policy goals set the overall challenge. In order to communicate this challenge to various organisations, the Finnish Ministry of Trade and Industry has a policy of voluntary energy conservation agreements with a large number of sectors. This approach is compatible with our conclusions. The agreement should be the obvious starting point of an organisation's own energy relevant strategy. Leino and Holopainen (2001) have studied the agreements in the energy sector and suggest numerous improvements to the agreement system in order to get the full advantage out of the agreements. Examples of suggested improvements are sharpening the goals and the measurement of how the goals are reached, and better guidelines for carrying out the agreement and reporting about it.

Finally we can make some points about crossing and changing value chains. First, it is well known that efficiency improvements do not result in reduced energy consumption if the volume of the activity increases enough. Questions about life style changes are therefore raised – less travelling, fewer appliances etc are called for.

Less radically, for the consumer to be able to choose an energy efficient habit such as using block heaters or using a common laundry instead of buying appliances home, the decisions to provide these alternatives must have been made by the real estate management and followed through planning stages and construction. In the example of laundry, it is a question of lifting the customer from one value chain (the appliance store) to another (residential building).

Within an organisation, flexible ways to cross between value chains can result in improvements on all sides. In schools, bringing the education to "visit" the maintenance can be an important motivation to the maintenance, and bringing the maintenance to "visit" education can provide content that motivates the education, to everybody's advantage.

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