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Sustainable Building Operation – Experiences from Danish Housing Estates

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Abstract

Energy saving in the existing building stock has become a main goal of national and international policies. Often focus is on building-renovations, whereas the potential of sustainable building operation has to a large extent been neglected. Nevertheless, international research as well as practical experiences from Danish housing estates indicates that there are large potentials for energy savings by focusing on the operation of buildings. We suggest that in order to achieve sustainability in the existing housing stock, renovation and operation should be seen as integrated parts and that sustainable building operation can pave the way for sustainable building renovation.

This paper discusses the use of sustainability building operation in Danish housing estates: What tools, methods and technologies are being used, where are the barriers and where are the potentials? We define sustainable building operation as an 'umbrella' for various ways of reducing flows of energy, water and waste in the daily operation of buildings, for instance by regularly monitoring the consumption, by using 'green accounting', by applying policies for sustainability etc. The paper is based on case studies of sustainable building operation and a survey amongst building administrators from the private and the social housing sector.

Our results shows that there are many good examples of sustainable building operation in Danish housing estates, where local building managers, residents etc. have gained impressive results. In the broader sense, however, there is a limited use of available methods and technologies. Barriers for the use of sustainable building operation have been identified, and related to different types of ownership (social housing, private rented, owner-occupied and private co-ops). The survey indicates that the social housing sector has better conditions for implementing sustainability goals in their building management compared with other types of ownership and that a considerable expertise has been generated in the sector. Our study raises questions on how to spread this knowledge to other actors in the sector and how to overcome barriers for sustainable building operation.

Introduction

There is a growing interest in integrating sustainable measures in building operation; more and more facility managers and building owners show an interest in sustainable issues. It is increasingly acknowledged that facilities managers and 'building operators' are key actors in implementation of sustainable measures in the building operation [1]; [2]. Facility managers need to develop a 'sustainable strategy' that can fit into the organisation's financial management, where new management tools such as Total Cost of Ownership (TCO) can be an important tool for promoting sustainable building operation [1]. However, it has also been stressed that there is often a gap between the environmental benefits that users demand of building operation, and the services delivered by the facility management. For example, customers have too little knowledge of the environmental services that facilities management operators are able to deliver, or facility managers have too little knowledge of user demands [3]; [4]. Also, these services can be very diverse, as there are big differences between facility managers and administrators concerning the environmental themes that are considered essential [5]. Some of the barriers for implementing sustainable measures in the building operation are the limited data on local consumption of energy, water etc., lack of incentives to create routines related to environmental issues, limited knowledge about environmental themes in the housing organisation, and that housing administrators have too little time and too few resources [5].

Other studies conclude that the organisation of housing companies have great importance for their environmental performance [6]. Brunklaus identifies a wide range of studies showing that there are several technical options for reducing environmental impact, but that an offensive attitude amongst owners and administrators is missing, and that limited resources within the organisation and lack of long-term maintenance are significant barriers to environmental performance [6]. The results of a

survey of consumption data over 10 years in two residential areas in Gothenburg suggest that a housing organisation based on flexible planning and control are better able to absorb new energy- and environmental requirements than an organisation built of more rigid procedures. Therefore the local organisation and the housing management are crucial factors for the implementation of sustainable measures, possibly leading to a 25-30% difference in energy and water consumption [6].

In a Danish context the thesis on how organisational structures influence sustainable building operation is highly relevant, mainly in relation to different types of ownership; in relation to implementation of sustainable measures in new buildings, the social housing sector has for many years been leading, compared with other types of ownership (private renting, co-ops and owner-occupancy). Although we expect that this is also true of the building operation due to the generally well-organised organisational structure of the social housing sector [7], we have so far not had any significant picture of the differences between different types of ownership on how and to which extent sustainable measures are being implemented in the building operation.

The Danish context: Buildings, ownership and environmental regulation

In the project that this paper is based on [8], our goal was to focus on what happens in the daily and ordinary operation of the buildings, and to discuss possible implementation of different sustainability measures. This includes only multi-storey residential buildings, where there is often professional operation services related, making concepts for facility management and sustainable building operation relevant.

As the political focus on energy use in buildings is increasing, the role of the existing building stock needs to receive more attention. Hitherto research, development and public regulation related to energy in buildings has primarily focused on new buildings, although new buildings represents, at best, only 1% of the total building stock (per year). Reducing energy use in buildings will have a very long-term perspective, if focus is only on new buildings.

The existing building stock has to a much smaller extent been an objective for research, development and public regulation. One main reason for this is that regulation and technological development of existing buildings is complicated, as the buildings are in use, with owners, residents and a physical structure that it might be difficult and problematical to change. Moreover, there is a widespread discourse on 'energy renovations' as a way to improve energy efficiency in existing buildings generally, although it is rather obvious that 'energy renovations' is a purely theoretical concept which hardly exists anywhere in real life. There are renovations of the existing building stock, but in the oldest part of the building stock, they are mainly related to the renewal of the dwelling (e.g. new kitchens, new bathrooms, merging of flats etc.), and less to the building itself [9], making it less relevant to include sustainability measures, for instance external insulation, low-energy windows or more effective energy management systems. In the social housing sector that consists mainly of buildings from the 1960-1980s there is much renovation going on, supported by the National Building Foundation. This includes not only the dwellings, but also the whole buildings. However, so far the policy of the National Building Foundation has been that sustainability measures should only be implemented if it does not involve extra costs that will raise the rent for the residents; in practice there are often limited economic benefits related to investments in energy saving measures that go beyond 'standard'. This means that although the renovations often include external insulation of the buildings, and possibly more energy-effective buildings, very few sustainability measures have been included, and certainly no 'energy renovations'. All in all, 'energy renovations' is a nice concept, but so far it has had very little reality. For building owners, residents and administrators, there are other and more practical problems and purposes related to the renovations: Improving the standard of the flats, attracting new customers, changing the image of the properties etc.

On this background, we find it essential to focus on the building operation. Sustainable building operation involves both residents' behaviour, use of the building and overall organisation of operation and maintenance. Both practice and research in the field show that environmental performance is linked to how knowledge, resources and local organisation are present locally and that significant energy and water savings can be achieved through building operation. We also see indications that owners who focus on sustainability in the building operation are more willing to include sustainable measures in building renovations. However, there is limited knowledge about the extent to which the various forms of sustainable building operations are carried out in practice and what is perceived as a barrier to use them.

Danish housing estates and the environment

There are about 1 million multi-storey dwellings in Denmark (2006), representing 38% of all dwellings in the country. Due to their relative small sizes (on average 79 m²), they represent only 27% of the residential area. There are about 87,000 multi-storey buildings for housing in Denmark. They have in average 12 dwellings per building, and an average floor area of 923 m². There are however differences amongst the different types of owners (Figure 1):

- Private renting and private co-ops. In private rented dwellings, the building operation is mainly decided by the owner and residents have limited influence. For private co-ops, the residents buy a share of the co-op which gives them a right to rent the dwelling and the right to vote at the general assembly, where all decisions about the co-op are made. In recent years a large amount of private rented dwellings have been transformed to private co-ops, as new legislation gave the residents the option of buying the building when it was going to be sold. This has been very popular amongst the residents, who get much more influence on their dwelling and building as co-op sharers. Private renting and private co-ops each represents 14% of the dwellings in multi-storey buildings. They are dominated by many small buildings (100-1.000 m²) with a limited number of dwellings.
- In social housing, the residents rent a dwelling in a social housing department, which is an independent organisational and economic unit. It is typically administered by a larger administrative social housing organisation. The residents have the right to vote at the general assembly of the housing department, which makes all important decisions relating to economy, maintenance, election of the local board etc. This is the essence of the extensive 'residential democracy' in the sector. Social housing represents 36% of all dwellings in multi-storey buildings, and has a relatively high proportion of buildings ranging between 1,000 and 5,000 m².
- Owner-occupied dwellings are dwellings in multi-storey buildings individually owned by the residents. Here, the common decisions concerning the building are made by an organisation between the owners. The owner-occupied dwellings represent 21% of the all dwellings in multi-storey buildings. Like for private rented and private co-ops, the owner-occupied dwellings are dominated by many small buildings (100-1,000 m²).

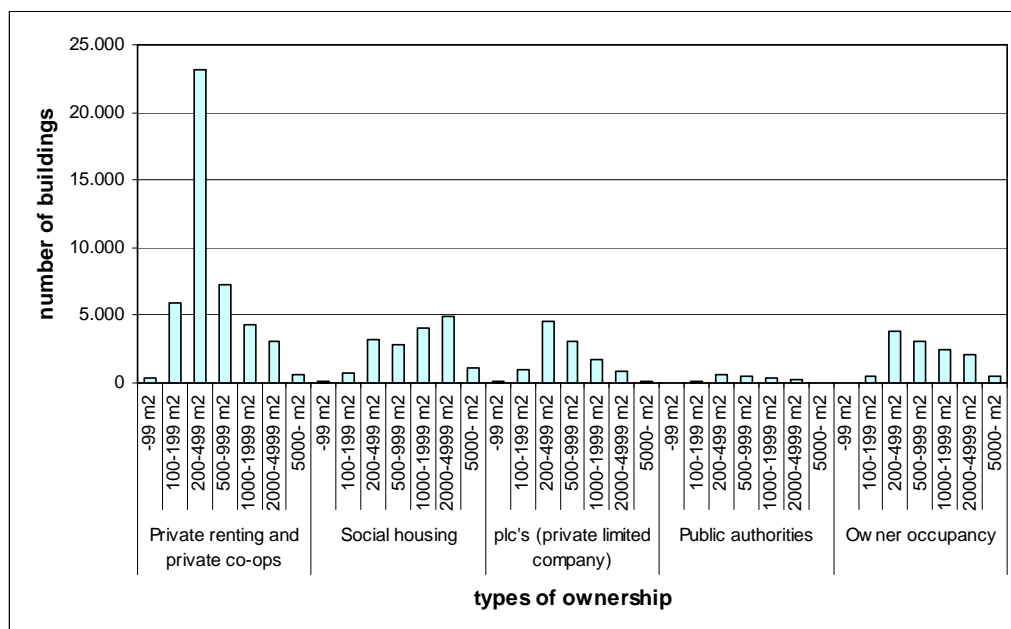


Figure 1. The number of multi-storey buildings in Denmark (y-axis), divided by size of building (m²) and type of ownership (x-axis).

Source: Statistics Denmark.

The other types of ownership, private limited companies and public authorities represent a total of 12% of the multi-storey dwellings, but have been left out of this research.

Type of ownership as well as size of the buildings is relevant for the way they administered and managed. The different types of ownership give different influence to the residents, and different ways of making decisions. The many small buildings in private rental, private co-ops and owner-occupied dwellings mean that there are many small owners and administrators in this sector, whereas in social housing there are many relatively large housing organisations that take care of the building operation and facilities management for the different local boards. Table 1 gives a brief overview of the characteristics of different types of ownership.

Table 1. Characteristics of the building operation under different types of ownership

	Social housing	Owner-occupancy and private co-ops	Private renting
Manager	Housing organisation	Private administrator, or self-administration	Private administrator; can be smaller or larger
Residents influence on building operation	Residential based democracy. Residents selects local board and decides on local budgets	Residents select local board and decides on local budgets	Limited formal influence (for instance to veto decisions)
Organisational unit	Local department board	Local board	local renters organisation (optional) with very limited influence
Owner	Local housing department	Owner-occupied (residents) or by a co-op	Private landlord
Operation staff (janitor, inspector, gardener etc.)	In-house and employed by the housing organisation, limited service from the outside	Service from operators (contracts and ad-hoc), and from DIY work.	Smaller administrators have no operation staff (owner must arrange service-operators). Larger administrators have in-house staff

Regulation and tools for sustainable building operation

Sustainable building operations is used in this project as a collective term for the variety of environmental projects and initiatives that deal with the daily building operation - including the ongoing maintenance, monitoring and maintenance of installations and heaters, etc. Parts of this concerns mandatory arrangements due to public regulation, part of it concerns voluntary tools, arrangements and initiatives.

In 2007 the Danish government proposed an ambitious energy plan, 'A visionary Danish energy policy', advocating for energy conservation of 1.25% per annum for the period 2006-2013. In February 2008 it was re-decided and with the even more ambitious goal of 1.5% savings of the final consumption of energy until the year 2020. This approximately 3 times more than what has been achieved with up to date energy-saving efforts. However, the actual initiatives launched in order to achieve the goal have been few so far. In the plans, the main potential is seen in 'energy renovation' of existing buildings, and in initiatives related to Energy Labelling of Buildings. The Energy Label, which requires an energy review of the building at every sale or as minimum each 5th year, has been widely criticised by building owners, residents, administrators and consultants for being too costly and causing too few changes in the owners' practice. The Energy Labelling of Buildings in 2007 substituted a former arrangement, where energy consultants each year made a review of buildings over 1,500 m² where they noted the energy consumption of the building and suggested ways to improve the energy efficiency of the building. Although this arrangement was also criticised for not being efficient, it has the quality of delivering annual registrations of the energy consumption, which many owners and administrator are missing today with the Energy Labelling of Buildings. A recent evaluation of the Danish energy saving initiatives rated the Energy Label of Buildings as the worst initiative, in terms of efficiency gained in relation to costs [10]. As this is the primary regulation tool for existing buildings, the present action plan on energy savings is rather un-ambitious in relation to the operation of existing buildings.

Concurrently with the mandatory regulation, a number of voluntary tools and methods have been developed to systematically manage sustainable issues in buildings. This includes for instance green accounting for residential buildings: This is a programme for a standardised consumption monitoring of a building, for calculating CO₂ emissions and enabling the comparison of key figures with similar buildings [11]. Another example is the 'Green Diploma', an environmental management scheme developed for social housing departments by the National Organisation for Housing Associations. It requires that the housing department establishes an action plan to reach a number of self-defined environmental targets. The scheme has recently been opened for other types of ownership, private co-ops being the most relevant.

In addition to these schemes there are a number of other well-known methods, for instance Energy Management, a method for monitoring and visualising energy flows in a building, making it possible to react quickly if consumption rises, or improving the basis for investments decisions in energy-efficient building technologies. Through building operation and ordinary maintenance there are a number of smaller initiatives and investments that can improve the environmental performance of the building, for instance by using technologies as low energy windows, low flush toilets, low-energy bulbs on shared spaces etc. To realise these potentials however requires skills, knowledge and competences amongst the operation staff, as well as a determined building owner and dedicated residents. Sustainable building operation therefore acknowledges that behaviour and use of the residents are as important factors as the purely technical qualities of the building.

Methodology

The aim of this research project was to identify how and to what extent sustainability issues are integrated in the operation of buildings, with different types of ownership and in different organisational contexts. The methodology consisted of different parts:

- A workshop on sustainable building operation was held with a range of leading practitioners and researchers in the field. A number of examples of environmentally controlled building operation from practice was presented and key issues in the area was discussed, including the potentials and barriers for further learning.
- A questionnaire survey to about 350 private and public housing administrators. The questionnaire included on the one hand general questions on the administration and on the other hand questions about specific environmental actions in the operation and detailed questions about particular barriers to integrating environmental aspects into operations.
- Finally, five case studies of practical examples of sustainable building operation were conducted, based on document studies and interviews with key persons.

One of the main questions behind the survey was whether the implementation of environmental and sustainable issues depended on how the housing is owned and organised. This included the types of organisational resources, the knowledge, competences, the structure of the housing type and the ways decisions were made.

Survey on sustainable building operation

The questionnaire included three groups of questions:

1. General questions about the administrator and relations to the customers
2. Questions on the implementation of sustainable measures in the building operation
3. Additional questions about sustainable building operation

The questionnaire was distributed to 196 public housing administrators and 161 private administrators via email. Overall, there was a response rate of 31% for the study as whole, broken down to 42% for the social housing administrators and 17% for private administrators.

The social housing administrators in average managed 57 housing departments as customers, with almost 4,200 dwellings. The average private administrator managed 58 clients, with approximately

2,100 dwellings. This difference reflected the larger number of dwellings in each building in social housing (see also Figure 1).

In the following tables, answers are divided between 'social' and 'private' administrators, referring to the dominant types of ownership administered by the managers: Social administrators managed mainly social housing departments, and private administrators managed mainly private rented, owner-occupied and private co-ops.

Provision of tools for sustainable building operation

The first question referred to the environmental services that the administrator provided, either as a regular part of the administration or as a service that it is possible to buy (Table 2).

Table 2. Services related to sustainable building operation from social and private housing managers.

	Administration of heating and water accounting		Energy management		Green accounting		Support on sustainability issues on renovation projects		Support on green procurement		Information and campaigns aimed at residents and staff	
	social	private	social	private	social	private	social	private	social	private	social	private
Is a part of ordinary administration, %	73	70	67	16	25	0	29	0	53	6	59	11
Can be delivered as an additional service, %	14	10	9	21	17	12	21	28	6	17	14	17
We do not offer this service, %	13	20	24	63	58	88	50	72	41	78	27	72
Total, %	100	100	100	100	100	100	100	100	100	100	100	100

The answers shows that social housing administrators as part of the general administration includes various environmental services to a much larger degree than private housing managers does. For instance, energy management is a part of the overall administration for 67% of the social housing administrators, but only for 16% of the private administrators. Private administrators generally offer very few environmental services as standard, but more are available as supplementary services. However, this does not preclude private customers finding these services elsewhere without contacting the administrator.

Another question referred to the emphasis that managers themselves put on providing environmental services. Among the social housing managers a larger share (71%) answers in the affirmative that they put emphasis on acquiring and provide environmental competences, than among private housing managers (33%).

In contrast, 62% of the social housing managers fully or partly agreed that their customers do not demand the services, where the number is only 45% amongst private administrators. One might see it as expressing that the social housing managers are more settled in their assessment (there are fewer 'do not' than among private) since many social housing managers have tried to offer their customers various environmental services, while relatively few private housing administrators had gained experience in this area and therefore 39% answers 'do not know'. Another interpretation of these answers is the social background of the residents; residents in social housing often have a shorter time-horizon and less attachment to the place than private administrators' customers (residents in private renting, owner occupancy or co-ops).

A final and major difference between the social and private administrators is their own perception of their role. A total of 72% of the social housing managers disagreed that environmental benefits are not relevant to offer as an administrator, while the private total is 28% - and vice versa: 17% of the social housing managers wholly or partly agrees that it is not relevant to offer, whereas 55% of the private managers wholly or partly agreed on this. There is a significantly different view of the administrator's role among the public and private. The social housing managers offers many environmental services and see it as an important part of their administration, well knowing that the residents only to a limited degree demands this.

Implementation of environmental measures and initiatives in the building operation

The administrators were asked what environmental measures were implemented in the properties they manage. This included 4 areas:

- Cleaning and care of shared outdoor and indoor spaces
- Operation and maintenance of buildings
- Operation of heating and water installations
- Information and capacity-building amongst residents and staff

The questionnaire gave the administrators' options to estimate four ranges of implementation (0-25% of all buildings, 25-50%, 50-75% and 75-100%) of environmental measures in the properties they manage. The reason for these options was that it could be very difficult for a housing manager to say exactly how many properties certain measures had been implemented in, as the measures were adjusted to local conditions, especially the standard and economy of the building, and the residents' preferences.

Although there were some variations amongst the four themes, and in the various sub-questions, the overall picture is that environmental measures are to a much wider extent implemented in the social housing properties. In relation to the operation of the heating and water installations, there is a much higher degree of monitoring, controlling and optimising boilers and monitoring consumption in the properties with social housing management, compared with the private managed properties (Table 3). For instance, 77% of the social housing managers have monitoring routines for the boiler system of most of their properties, whereas only 32% of private managers have such routines. For a similar monitoring of the energy and water consumption in the property, 72% of the social housing managers have regular monitoring routines of this in most of their properties, compared with 26% of the privately managed.

Table 3. Implementation of measures related to operation of heating and water installations

Implemented in percentage of properties managed	Monitoring and optimisation of boilers etc.		CTS control of heat supply		Monitoring of consumption in the property		Energy-saving pumps		Night-reduction of temperature	
	social	private	social	private	social	private	social	private	social	private
0-25%	0	32	44	21	9	21	7	16	38	21
25-50%	4	11	14	21	6	16	18	16	19	26
50-75%	19	26	14	5	12	21	26	26	19	11
75-100%	77	32	18	5	72	26	41	11	20	11
Do not know	0	0	11	47	1	16	7	32	4	32
Total, %	100	100	100	100	100	100	100	100	100	100

For the use of administrative tools for sustainable building operation, the picture is the same; the answers suggests a more widespread use of such tools amongst social housing managers compared with the administrators on the private part of the housing market. However, the administrative tools for sustainable building operation is generally used relatively little, for instance the 'Green Diploma'. Although it has been launched by the Danish Social Housing Association and heavily promoted amongst social housing administrators for several years, 'no knowledge' of the tool accounted for about one third of the administrators' answers to why it is not being used. This indicates the problems of communicating information on sustainable building operation from the top of an association to the floor of the administrators, and probably also reflects that housing administrators have a number of other and often higher prioritised agendas than sustainable building operation.

Table 4. Implementation of administrative measures related to sustainable operation of the building

Implemented in percentage of properties managed	Green accounting		Energy management		Green diploma		Danish Standard for building operation		Key figures from Danish Facility Management Network	
	social	private	social	private	social	private	social	private	social	private
0-25%	69	65	32	35	78	65	66	40	67	45
25-50%	3	0	9	30	3	0	7	5	3	10
50-75%	1	0	8	15	0	0	10	10	5	5
75-100%	10	5	42	10	0	0	2	5	8	5
Do not know	16	30	9	10	19	35	16	40	17	35
Total, %	100	100	100	100	100	100	100	100	100	100

Energy management can be quite an effective way of monitoring the consumption in the property, to keep energy consumption from escalating, and to prepare owners to implement measures to reduce energy costs. Therefore, it is surprising that only about 10% of the private administrators have implemented it in their management. Their reasons for not doing so is not related to lack of knowledge (only 7% said they do not know it), but rather to lack of relevancy and motivation (more than 50%) – this is in line with the large amount of administrators who do not see it as their role to promote sustainable building operation towards the clients.

Motivation and barriers

Administrators were asked different questions on their motivations and barriers to use measures for sustainable building operation.

Table 5. Administrators' motivations for including sustainable measures in the building operation.

	Economic benefits		Common sense		Concerns for sustainability		Requested by residents		Related to other improvements		Not relevant for us as administrators	
	social	private	social	private	social	private	social	private	social	private	social	private
Totally agree	37	33	55	56	41	17	0	6	28	17	0	11
Partly agree	46	44	42	39	46	61	28	33	55	44	9	17
Do not know	6	0	1	6	9	17	24	28	9	28	16	33
Partly disagree	9	17	1	0	4	6	38	22	7	6	27	33
Totally disagree	3	6	0	0	0	0	10	11	0	6	49	6
Total, %	100	100	100	100	100	100	100	100	100	100	100	100

The two groups of administrators generally agreed on 'common sense' as the most important factor for motivation, general concerns for sustainability and economic benefits as the most important factors – and that requests from residents counts relatively little. The social housing managers more frequently see the sustainability measures in relation to other improvements, which might reflect a higher level of building renovation on the social housing sector, compared with the private. Interestingly, the largest disagreement concerns the administrators' role in relation to sustainable building operation: as noted before, a high proportion (28%) of private administrators do not see it as their role to suggest and implement sustainable measures for their clients, whereas this is only the case for 9% of the social housing administrators.

The question about where the initiative to include sustainable measures typically comes from reveals some differences between the two groups (Table 6). Whereas both types of administrators agreed that legislation was the most important single reason for implementing sustainable measures, the social housing administrators generally appointed greater responsibility to local actors (residents, building inspectors, owner and administrator) to taking the initiative, than did the private administrators. This suggests that bottom-up initiatives for sustainability measures might play a more important role in the social housing sector, than in buildings from the private sector.

Other questions shows that there is also significantly more influence of residents and staff in the social housing sector through information, campaigns etc. – according to the questionnaire, 1/3 of the social housing administrators says that this takes place in most of their properties, whereas this is only the case amongst 5% of the private administrators. Therefore, the initiatives for sustainable building operation are not just a matter of bottom-up or top-down, but also a matter of mutual encouragement.

Table 6: Where does the initiative to include sustainable measures come from?

	Legislation		Residents		Building inspector/ janitor		Owner		Administrator	
	social	private	social	private	social	private	social	private	social	private
Totally agree, %	37	39	12	0	26	0	22	5	23	0
Partly agree, %	56	50	41	44	57	67	52	53	45	68
Do not know, %	3	11	12	22	4	17	10	32	19	26
Partly disagree, %	3	0	29	28	10	11	13	11	13	5
Totally disagree, %	1	0	7	6	3	6	1	0	0	0
Total, %	100	100	100	100	100	100	100	100	100	100

Although the administrators and other stakeholders might be motivated to take up initiatives for sustainable building operation, they encounter different barriers. For instance, it is a well-known problem in the private rented sector that due to the legislation, only some building improvements can be 'put on the rent', meaning that the residents actually pay for the improvement. In other cases, the owner has to pay for the improvement himself, although the residents get the benefits resulting from the improvement. This is also true of improvements related to sustainability (for example new windows with better insulation): The owner will have to pay for the majority of the investment, but the residents get the benefits in terms of a reduced heating bill and a better indoor climate. For many owners of privately rented property, this is regarded as a main barrier to implementing sustainable measures. This question was also raised in the questionnaire, although it is primarily a problem amongst private administrators, which is also reflected in the answers. In spite of the often used argument in the Danish debate, other barriers were rated equally high amongst private administrators in the questionnaire – including the lack of environmental potential in the existing solutions, and scant interest from the owners (clients). However, the private administrators are more sceptical towards the environmental and economic potential of existing measures for sustainable building operation than their partners from the social sector; and again, the social and private administrators have very different views on the role of the administrator.

Table 7: What are the major barriers for sustainable building operation?

	The residents get the benefit, the owner pays		Small environmental potential		Small economic benefit		Owners are not interested		Administrators do not have the competence		Not relevant for us as administrators	
	social	Private	social	private	social	private	social	private	social	private	social	private
Totally agree, %	11	19	3	12	11	12	8	12	3	6	4	12
Partly agree, %	16	44	39	65	35	47	52	53	26	25	11	18
Do not know, %	13	19	16	18	22	35	23	24	18	44	13	41
Partly disagree, %	23	19	27	6	22	6	11	6	39	13	38	24
Totally disagree, %	36	0	15	0	10	0	5	6	13	13	36	6
Total, %	100	100	100	100	100	100	100	100	100	100	100	100

Practical examples on sustainable building operation

A brief comparison of two case studies on sustainable building operation illustrates some of the differences between social and private housing in terms of implementing sustainable measures. This relates especially to the different organisational forms, and the organisational environment of the initiators.

Example 1: Valby Bakkegård, a private co-op

The private co-op Valby Bakkegård consists of 48 dwellings (3-4 rooms) with a total area of 4.500 m². It is located in Copenhagen, in a 5-storey building from 1954. This is rather typical for the private co-ops, private rented buildings and owner-occupied buildings in Denmark (figure 1).

The local Board of Valby Bakkegård consists of five residents, both older and younger residents. As the board members are all laymen, they have limited expertise. The administration is carried out by a small law firm, who takes care of bookkeeping, collection of rent, housing court cases and other personal service. A caretaker is attached to the property. He comes a couple of hours three times a week, and takes care of waste discharge from the property, adjustment of heating system and other related functions. A main part of the building operation is based on the knowledge that the members of the board gather over time. When this is not enough, they turn to outside consultants, for example energy and engineering consultants. The board-based building operation however is vulnerable due to exchanges in the board; the knowledge and competences acquired by one board-member is suddenly lost when the member moves.

The present chairman has been the initiator for a number of different sustainability initiatives. This includes better insulation of the property, using energy-saving bulbs on shared spaces, a better sorting of the waste, and less use of chemicals for the green areas. Although the initiatives have been relatively successful, there have been a number of obstacles: The residents are rather reluctant towards the sustainable initiatives. This means that the suggestions often are changed and compromises have to be made, reducing the environmental efficiency. Also, this frequently leads to conflicts between the board and the rest of the residents. Finally, it is difficult for the board to plan and manage the building operation in a professional manner that integrates sustainable solutions in the ordinary building operation. For instance, when a kitchen is being renovated, and afterwards the board afterwards discovered that the floor could have been isolated to save energy – which however will require an entire new kitchen. The example illustrates that although there might be plenty of ambitions to improve the environmental performance of a small co-op, the organisational conditions might not be sufficient to fully implement the measures.

Example 2: Brændegårdsparken, a social housing department

Brændegårdsparken is a social housing department with 324 dwellings, built in 1966-68. It is administrated by a social housing organisation (Fruehøjgaard) that includes 20 housing departments,

with a total of 1.430 dwellings. Three staff members are permanently employed in Brændegårdsparken, moreover they can use the staff (carpenters and painters) from the housing organisation. The housing organisation Fruehøjgaard has employed an environmental coordinator, who has been working with environmental initiatives in the various departments. In Brændegårdsparken she has been a main reason why the department has achieved the Green Diploma, a sustainability scheme for social housing departments (see also p. 5). This includes that a sustainability policy, an environmental plan and a green accounting should be outlined and communicated to the residents, in order to promote savings on water and energy. As an example, their goal in 2007 for the environmental theme 'water' is to save 2.5% of their consumption, compared to 2006. In order to reach this goal the water meters will be read once a month, and from this 4 pillars will be designed, illustrating the water consumption in each of the four parts in the department. It is expected that this will motivate the residents to reduce their water consumption. Already within the first year with the Green Diploma (from 2005 to 2006), the water consumption dropped by 13,2%, due to various initiatives. Other projects include use of LED-lights on shared spaces, which has reduced the electricity consumption with 9.5% from 2005 to 2006.

The initiative to make the department apply for the Green Diploma came from the environmental coordinator. As there were several environmentally interested board-members in Brændegårdsparken, the department decided to apply for the Green Diploma. According to the board, the initiatives are based on a combination of the voluntary work carried out by the board members on one hand, and the paid work carried out by the housing organisation, including the staff and especially the environmental coordinator. Also, the department has collaborated with other local actors and organisations, for instance the local 'Energy Center' and the municipality of Herning. But the board members also use their professional background in the environmental initiatives. For instance, one of the board members is a former plumber, which has been very useful in the initiatives for water savings. This case illustrates how the organisation of the housing department is able to initiate and maintain initiatives that the local board is receptive towards, and thereby support a local interest in sustainable building operation to actually complete a number of measures.

Comparisons and conclusions

Compared with the example from the private co-op Valby Bakkegård, there are more technical and administrative resources available for the board members in Brændegårdsparken. This has proven to be crucial for the implementation of the environmental initiatives, as the board members in Brændegårdsparken – as well as in Valby Bakkegård – are both voluntary and laymen. As indicated in the survey, top-down initiatives might often support or encourage local bottom-up initiatives, where residents, staff and board members in the department get the necessary support (knowledge, expertise, administration etc.). In Valby Bakkegård there was also local interest as well as initiatives, but very limited support from the administrator or others.

There are similarities in the way that the local board in both examples is a central actor for the environmental initiatives. The difference is however, that the knowledge, experiences and competences gathered by the group of people working with the environmental initiatives in the social housing department, including the board members, will to a much greater extent be 'embedded' in the housing organisation, in contrast to the private co-op, where the knowledge and competences gathered by the individual board member more or less disappears from the co-op when the person moves.

These differences suggest a reason for the differences we see in the survey between social housing departments and owner types administrated privately. The answers from the questionnaire suggest that it is especially the social housing departments that use sustainable building operation, while other types of ownership exhibit a greater reluctance. The examples illustrate the organisational differences between a private co-op and a social housing department, and the necessity of having local resources at an organisational level to support and encourage voluntary initiatives and activities from the local boards. From the survey it is also clear that the private administrators define their role very differently than the social housing administrators: They do not see it as their role to provide support on sustainable solutions to the clients – whereas the social housing administrators have the opposite opinion. The consequence is that residents or board members in a social housing department has a much better offer for support from the administrator on sustainable initiatives, than residents with a private administrator.

This is partly due to structural and historical reasons; traditionally, administrators on the private market are lawyers, providing the primary service of collecting rent and taking care of the complex regulation between landlords and residents. Therefore, in the prevailing efforts for environmental improvements and energy efficiency in the existing building stock, it is not enough to launch traditional types of regulation, for instance economic incentives. A more profound understanding of the background for the problems is necessary and new innovative incentives that could overcome these challenges. This could for instance include initiatives to establish ESCO arrangements in multi-storey-buildings, or to find arrangements where the knowledge and experiences from the social housing sector could be exploited by other types of ownership.

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