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The design of energy efficient everyday practices

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Abstract

Activity-centred design has been proposed as a way to encourage energy-efficient practices. This approach suggests that "good" designs can improve communication between the sender and receiver of a message, for example, "save energy". The approach also concerns recent advances in research into how objects can be inscribed to steer users in certain directions. The approach has been expanded to include not only the use of individual things but the practices of everyday life. This paper examines design issues related to everyday practices and reports on findings in three household domains crucial to efforts to influence household behaviour to promote energy-efficient everyday lives: a bright and comfortable home (lighting, heating, and cooling), food and entertainment (storing food, cooking, Internet, and TV), and personal appearance (clothes washing and self-care). The findings are based on qualitative data from Swedish research in which three household domains were explored by visiting 32 homes and conducting 32 in-depth interviews. To complement the user perspective, observations and informal interviews with staff members of a public housing company were also included. Results indicate that conscious designs were seldom used to influence user practices; instead, general written information and regulations were more common tools for addressing users. Written information is not an efficient tool, and regulations are not perceived positively by households, which try to by-pass them. Current designs, instead of communicating energy efficiency, convey random messages unaligned with energy-efficiency objectives. This confuses users and makes it difficult for household members to take the "right" actions in everyday life. Recommendations to housing companies are to focus on both product and organizational designs to better target energy efficiency goals.

Introduction

Design has been promoted as an effective tool for reaching energy-efficiency goals (EU Directive, 2005, 2009). Legislation such as the Eco Design Directive has focused on appliances and products. The current research has users' perspectives on design and the starting point is rather the activities of people than appliances and products. Norman (2013) introduced *activity-centred designs* as a perspective to focus on high-level structures such as "care of clothes" rather than "using the washing machine". Norman proposes a user perspective on design that requires knowledge of the user and communication skills on the part of the designer. This knowledge should be based on a deep understanding of how activities and tasks are performed, or fail to be performed in everyday life situations. Shove et al. (2007) also focus on high-level structures but suggest a broader perspective from things to encompass practices and the complexity of people's sayings and doings, includes things but treats them in context. In turn, the focus on practices has inspired many researchers in the field of energy use and households. Among them are Stephenson et al. (2010), who propose an energy culture framework for studying energy efficiency related to homes. The energy culture framework was used in the present research to guide the methodology and data analyses. Energy-efficient practices in this case has been defined as the "doings and sayings" in line with energy-efficiency goal of the

property owner. This goal is set to 25 per cent savings between the years 2011 and 2025.

Another approach that inspired this research is the general idea of everyday life. Everyday life has been suggested as a starting point for research into how and why household energy efficiency is implemented or not (Ellegård, 1999; Ellegård & Palm, 2011). Learning about how people organize their everyday lives, what activities they are involved in, and what technologies they use to perform various activities and projects can foster insight into energy-efficiency opportunities and challenges. Research into and analyses of everyday life improve our understanding of the important micro level of energy efficiency. Connected to everyday life is the growing body of literature applying practice theory (Shove, 2003; Shove et al., 2005; Røpke, 2009). The everyday life approach and practice theory have previously been applied in energy use research in Sweden (Karresand, 2013).

The background to this research is interest in energy-use activities and practices in residential buildings owned by municipal housing companies. Compared with other European countries, in Sweden rental housing is common, constituting 37 percent of all housing. In the rental sector, municipally owned housing companies have a 45 percent market share, making studies of energy use in this sector important.

This paper presents the results of research into tenants' everyday activities and practices in rented flats. More specifically, the presentation considers whether spaces and products are designed and configured to facilitate more energy-efficient activities and practices. The research questions guiding the data collection and analyses are: How do tenants use spaces and products around their homes when they perform everyday activities and practices? Do these spaces and products facilitate or hinder energy-efficient tenant behaviour? The next section presents the methodology, data collection, and analytical method. The sections after that present findings organized according to the various domains of activities and practices: a bright and comfortable home (lighting, heating, and cooling), food and entertainment (storing food, cooking, Internet, and TV), and personal appearance (clothes washing and self-care). The last section presents recommendations and conclusions of this research.

Methods and data

The presented research was a case study of tenants and flats in a medium-sized town in Sweden (cf. Bryman, 2012). The flats are owned by a housing company that is wholly owned by the municipality. The case study methodology allowed a focus on similar conditions in terms of plans, white goods, and heating. The flats have been subject to the same refurbishment and renovation policies. The case study applied a qualitative approach and aimed to collect in-depth information about tenants' activities and practices at home. The data collection also included information material available on the internet. This information included both text and videos recorded by the property owner.

Previously, selected tenants had received a questionnaire by mail, and in replying they nominated themselves for follow-up interviews. Tenants with phone numbers publicly available on the internet received a phone call from the university requesting face-to-face interviews in their own homes. Because the initial number of respondents agreeing to interviews was insufficient, additional tenants received a letter by mail containing information about the research project and stating that they could expect phone calls about interest in participating in the study. The interviews started during the Swedish winter and were continued until they yielded little new information. In total, 32 in-depth interviews were performed face-to-face in tenants' homes. This approach allowed a thick description of the phenomenon, i.e., energy-related tenant activities and practices. Interviewee selection attempted to recruit a variety of household members in terms of size, age, gender, and background. Eighteen interviewees were women and 14 men. In some cases, respondents were interviewed as a couple.

Before the interviews started, several test interviews were performed; these interviews were semi-structured and the interview guide was assessed and somewhat revised after the test round. The structure of the interview questions was shaped by the various household domains we decided to explore. To explore these domains properly, the interviewer asked the tenants to show him/her around the flat, so all domains were asked about in the associated spaces; for example, questions about food storage, food preparation, and dish washing were asked in the kitchen. The interviews lasted normally 30–60 minutes. To complement the user perspective, observations and informal interviews with staff members of the property owner were also conducted. The observations included two weeks of observations of customer service, one week in summer and one week in winter.

All formal interviews with tenants were recorded on a digital recorder and transcribed verbatim (cf. Fejes & Thornberg, 2015), a 60-minute interview resulting in around 500 text lines. After transcription, all interviews were coded in NVivo. The codes were structured according to seven themes: heating, lighting, laundry, bathroom, consumer electronics, cooking, and energy costs. Each theme had subthemes focusing on socio-material aspects of the responses, aspects emanating from a theoretical perspective on material cultures, energy practices, and cognitive norms (Stephenson et al., 2014). Although the general approach used here stressed the complexity of everyday life and the tight intertwining of the social and material in tenants' everyday activities and practices, the activity and practice aspects were distinguished for analytical reasons. Under the six subthemes was a level of sub-subthemes. For example, under the heating theme, material culture subtheme, were another six sub-subthemes as follows: radiators, external heating sources, building envelope, built-in ventilation, supplementary ventilation/air conditioning, and thermometers. The coding of a 60-minute interview typically resulted in 150 codes and 470 references. The interviews were then analysed as texts about the three household domains, and the responses were assembled to create a rich description of how tenants talk about their everyday activities and practices. Because the format of this paper permits little in-depth result presentation, the results discussed here are based on an overview of the rich data. This is the first step before exploring the data in more detail, which will require other theoretical perspectives and concepts and might result in theoretical development indicating how and why certain activities and practices are performed as they are. This paper focuses on the design of spaces and products in order for tenants to have the prerequisites for energy-efficient activities and practices.

Results

This paper examines design issues related to everyday practices and reports findings relating to three household domains crucial to efforts to promote energy-efficient everyday lives: a bright and comfortable home (lighting, heating, and cooling), food and entertainment (storing food, cooking, Internet, and TV), and personal appearance (clothes washing and self-care).

DESCRIPTION OF THE FLATS

The flats all have essentially the same equipment, as the equipment policy of the property owner is that their 14,300 flats should all meet the same basic Swedish household standard. This basic standard is in some regards regulated in laws and national standards, for example, the regulation that property owners must provide laundry equipment. The property owner supplies all basic white goods, such as a fridge, freezer, stove, and, nowadays often, a dishwasher. The exhaust fan over the stove is also included in this equipment and normally has an integrated light. Several other lighting sources and fixtures are basic flat equipment that tenants normally do not own or maintain themselves. This is true of most kitchen lighting, such as strip lighting in the kitchen ceiling and the integrated light source in the exhaust fan, and bathroom lighting, such as the ceiling lamp and the integrated light source in the bathroom cabinet above the bathroom basin. This means that most kitchen and bathroom lighting is installed and maintained by the property owner. Tenants are asked to replace light sources when they burn out, but as the lighting fixtures are chosen by the property owner and previous tenants usually leave the light sources in place, tenants have limited influence on the number and type of light sources. In the bathrooms they have no influence, because all the lighting normally needed is already installed. In the kitchens, tenants usually have their own lamp over the kitchen table, and some might want a lamp in the window to create a homey atmosphere. Access to laundry facilities for tenants is regulated by law. These facilities might be located in the flat's bathroom, but are usually found in the vicinity of the building, either on the ground floor or in a separate nearby building. Lighting in the laundry premises is provided by the property owner. Lighting in the entrances, staircases, lifts, and corridors is owned and maintained by the property owner. Consequently, most lighting fixtures in and around the flats cannot be influenced to any great extent by tenants. The only spaces where tenants normally have sole influence on lighting are the hall, living room, and bedrooms. Swedish lighting culture is similar to that of Norway (Whilhite, 1996) and has been examined in recent studies of lighting practices in Sweden (Bladh, 2011; Bladh & Krantz, 2008). This lighting culture usually includes several lighting sources with mainly decorative purposes resulting in many small lamps for example in windows, on tables and walls.

Tenants have even less influence on the white goods because they are almost all part of the basic flat equipment. The process of determining what white goods are installed is complicated. First, the property owner must follow the national building code. The property owner in this case must procure white goods in accordance with the Public Procurement Act. This is an overarching prerequisite for all major purchases and greatly influences the equipment finally installed. Another part of the complicated and often time-consuming process is the property owner's own policies for purchasing white goods. The procedure from planning how the flats will look until the flats can be occupied is time consuming. Crucial to good procurement is purchaser knowledge and expertise of how to formulate the procurement documents. The outcome of procurement processes is something property owners and tenants will have to live with for many years.

Nearly all 14,300 flats have central heating, and the buildings are connected to a district heating system owned by a municipal energy company. The two public companies owning the buildings and the district heating system are closely connected (Palm, 2004; Magnusson, 2013). The energy system, consisting of combined heating and electricity generating plants, pipes and ducts are owned and controlled by the energy company. Other parts of the energy system, such as boilers, pipes, and radiators located inside the buildings, are owned by the housing company. Both companies have the same owner, the municipality, but different managements and boards of directors. The close connection in terms of both physical heating infrastructure and organizational aspects has created lock-in effects, meaning, for example, that is it difficult to alter the existing system and change its design.

The central heating is distributed by water circulating through pipes and radiators in the various rooms of the flats. This heating system has various pros and cons with respect to energy efficiency. The design of the system and radiators gives the tenants very limited guidance on how to maintain a comfortable indoor temperature while saving energy. The central heating system with its radiators has been subject to very little product development when it comes to user friendliness and user interfaces. The radiators look essentially the same as when they were invented and patented in Russia in the mid nineteenth century. Thermostatic radiator valves are attached to the radiators (see Figure 1).

The design of these valves has been the same for many years, though their function and use have changed. The initial idea was for tenants to have some control over space heating and

Figure 1. A typical radiator fitted with a thermostatic radiator valve. (Source: Author's collection.)

indoor temperature. Over the years, such tenant control has gradually been reduced, shifting control to the housing company and its technicians. Now, turning the thermostatic radiator valves attached to the radiators to maximum or an open state does not necessarily change the flat temperature, which is determined at a sub-central accessed only by technicians. The indoor temperature is decided on in negotiations between the housing company and the tenants' association.

A BRIGHT AND COMFORTABLE HOME

This property owner has several opportunities to influence the energy used for heating. It owns most of the systems inside the buildings and heating is included in the rent, the temperature being regulated by agreements between the property owner and the tenants' association. The present agreement states that the temperature should be 20 degrees measured at least one meter from a window and one meter above the floor, in the so-called dwelling zone. Because of these arrangements, tenants only have to consider certain guidelines regarding furnishing the rooms and airing the flats. These guidelines are communicated to the tenants in writing in an information folder placed in each flat. This folder also has information about other matters, for example, how tenants can conveniently clean the flat interior, including the parquet flooring. The guidelines for arranging the furniture so that the heating and ventilation systems work as intended and deliver the indoor climate agreed on between the tenants and the property owner are conveyed in writing and graphically. The texts and images show both what to do and what not to do; for example, big sofas should be placed at least 10 centimetres from the radiators, not directly in front of them (see Figure 2).

Images illustrate how heat should be able to circulate from the radiators into the rooms and how this is hindered by a sofa located in front of and too close to the radiator. Similarly, images and text show how window curtains should be arranged so that heat from the radiators is not hindered from circulating. Big and thick curtains containing a lot of fabric should not be placed in front of or too close to the radiators. Staff of the property owner witnessed the practice of airing the flat by opening a window or a door to the balcony. If the radiator is still on, the thermostat on the radiator near the window or door will signal to the system that the temperature is decreasing, allowing more heat to flow through the system and radiators. This will increase the energy used for heating, as the flats are being heated and cooled at the same time. This practice is difficult for the property owner to influence because tenants can open and close the windows and doors to the outside.

Figure 2. The space between radiator and sofa should be at least 10 centimetres, according to the information provided. (Source: Author's collection.)

In addition to using information as a tool to inform the tenants about what practices are suitable from an indoor comfort perspective, the property owner organizes training for staff who receive complaints about flat temperatures or other indoor climate issues. Every autumn in recent years, customer service staff have undergone training in an empty flat. The training is supervised by staff from the heating and ventilation company and contracted by this property owner. A group from customer service spends one hour inside a flat, being shown what the heating and ventilation interfaces look like and learning technical basics about how the system works. Before the training, members of the customer service group were asked to list questions that they had received or might receive from tenants.

In addition to the indirect communication with tenants via printed material left in the flats and via direct conversations between customers and customer service staff, the property owner communicated in the newsletter that each household received with the monthly mailing containing the rental invoice. The property owner had little control over how this information was received or put into practice. Another source of information for the tenants, over which the property owner had even less control, is the Internet. On this public website, the property owner provides both text and a three-minute YouTube video. The text on the open website includes the following on temperature:

To maintain a comfortable temperature in your dwelling, you can start by putting a thermometer at eye level on an interior wall. Then, you can always track the temperature in your dwelling. If the temperature is below 20 degrees and the radiator is cold, try turning the thermostatic radiator valves between the open and closed states 10–15 times. Then put the valve in the fully open position. When you furnish your flat you should make sure that there is space in front of the radiators. Furniture should be placed at least 10 centimetres from them, to ensure sufficient air circulation and heat diffusion. Also bear in mind not to have curtains hanging over the thermostatic radiator valve. In addition, do not leave balcony doors and windows ajar (Property owner, 2015).

The YouTube video conveys a similar message. The video is entitled "Comfortable temperature – heating and ventilation" and is part of series of "Dwelling tips" videos from the property owner on various aspects of living in these flats. One of the property owner's local area managers is interviewed in the video and talks about what tenants can do to obtain "as good an indoor environment as possible". The first piece of advice is to use a thermometer to check the indoor temperature. The property owner provides the tenants with thermometers if they do not have their own. The area manager also gives advice about how to furnish the flats. In this case, however, the advice is that sofas should be placed "at least 20 centimetres" from the radiators. The advice to repeatedly turn the thermostatic radiator valves is reiterated in the video, but instead of refer-

ring to the closed and open states, the wording is "minimum to maximum" (see Figure 3).

The information for tenants about how the thermostatic radiator valves work and how to operate them is confusing. The design of the thermostatic radiator valves confusingly indicates that tenants can choose different levels of heat supply via the radiators.

Advice from the area manager in the YouTube video on ventilation suggests that tenants should think about not closing or covering the air intake. Many air intakes in the flats are located above the windows or in the ceilings, and for the ventilation to function properly, they should be kept open. There is usually a closing device attached to the intake, so the tenants have the option of closing it. The area manager talks about issues tenants might experience with the intake, for example, draughts and noise from outside. Then he states how important open intakes are for indoor comfort, to allow the air to circulate properly, but because the intake design allows tenants to regulate the incoming air, they will likely try to do so. These flats are usually ventilated via exhaust ventilation, the design of which requires a certain amount of circulating intake air. If air cannot enter the flat via the intakes, it will enter uncontrolled through leaks in the facade or through the mail slot in the front door, causing even more problems for tenants, such as draughts. The area manager also gives advice on how to clean the exhaust ventilation filters in both the bathroom and kitchen exhaust units. The area manager concludes that if tenants have followed all advice and still have issues, then they can call customer service.

During two weeks of customer service observations, it was noticeable that staff tried to make tenants take some responsibility for the issues they called about. If the issue was temperature, customer service would advise the tenants to review the steps described in the written information and in the video: check the temperature, turn the thermostatic radiator valves from minimum to maximum, check the air intakes, and clean the exhaust filters.

Several tenants interviewed believed they had more influence over heating than they actually did via the thermostatic radiator valves with levels ranging from 0 to 6. One tenant said that she could make the radiator become lukewarm:

> When it is too hot, I will turn them until I think … Sometimes I turn it off completely if it is really hot and sometimes I turn it down until it is a bit lukewarm. When it is cold I turn it up a bit … I use the thermostat … not all the time, [but] when I think it is needed. (Lisbeth)

Some tenants find it difficult to maintain good indoor comfort in the various rooms of their flats, some of which become too hot while others are too cold:

> Sometime I get so hot that I have to sleep with the window open. Twenty-four hours a day. But now that it has snowed [it is closed]. (Olof)

Other practices include manipulating the ventilation intakes, which some tenants experience as a cause of low indoor temperatures:

> There is a draught … I had to put a duvet cover over the window [in the bedroom] because the draught comes straight in, and that is something I have to do here [i.e., in the kitchen] too when it becomes colder. That is something I do in winter. (Barbro)

Figure 3. The design of a thermostatic radiator valve showing a range of 0–6 levels. (Source: Author's collection.)

This tenant covers the air intakes because she feels a draught, which she manages using the means she has available. This practice by tenants is known from previous research. Tenants try to block the air intakes because it seems to be a logical way to eliminate draughts. Most tenants who checked their indoor air temperature said that it exceeded the agreed-on 20 degrees. In most cases, the temperature varied between 21 and 23 degrees, but several tenants complained about cold floors in winter.

As mentioned earlier, the lighting design in these flats is somewhat controlled by the property owner. Lighting is not the focus of the information provided to tenants in either printed material (i.e., the flat information folder and the newsletters) or videos. Only on the website does energy-saving advice target lighting. This advice concerns replacing conventional light bulbs with low-energy bulbs and turning off the lights when leaving a room. Earlier studies demonstrated that Swedish lighting culture generally includes many different light sources used not just for visibility but to create a warm and cosy atmosphere during the dark time of year. In Sweden, energy used for lighting is the second largest share (23 %) of the total electrical energy use of households living in rented flats (Zimmerman, 2009), while the largest share (37 %) is energy used by the refrigerator/freezer. Consequently, attention could usefully be directed towards the types of energy use making up the largest shares of total energy use, in an effort to influence household energy costs. In reflecting on how they use lighting in their flats, several tenants commented on the perceived problems with using low-energy light bulbs: the "cold" light and the extended delay between switching the light on and obtaining light:

> I had one [low-energy light bulb] in the hall. But it took too long before there was light. … I want there to be light when I'm putting on my clothes and leaving the flat. Not for it to take five minutes for the light to come on. (Mats)

Most interviewees said they turned off the lights when they left the room or flat to save energy. Several tenants said that they learnt this habit during the energy-saving campaigns of the 1970s. If the household has several members, it is sometimes

difficult to know when everybody has left the flat for work or school. It is a courtesy to leave the lights on if people are still in the flat, according to some of the tenants; also, one does not turn off the lights when going to bed if other family members are still awake. Sometimes parents have to get out of bed and check that the lights are out.

FOOD AND ENTERTAINMENT

The property owner provides most appliances for food storage and preparation, such as the refrigerator, freezer, stove, kitchen exhaust fan, and sometimes a microwave oven and dishwasher. All white goods are electric, as is usual in Sweden. Other appliances, such as electric kettles and coffee-makers, are bought and owned by tenants. This property owner has replaced old refrigerators and freezers and around 3000 flats have new, energy-efficient white goods. The property owner provides energy-saving tips and also sells meters to measure the energy consumption of appliances and home electronics. The tips on the Internet are presented as a list of "Six ways to save energy in your flat": do not use stand-by mode; use a multi-outlet extension cord with an on/off switch to turn off all electronics at the same time; keep the refrigerator/freezer at the "right temperature", i.e., +3–5 degrees and -18 degrees, respectively, and vacuum behind it once a year; use an electric kettle or microwave oven instead of the stove when possible; use pots and pans that fit the stove burners (see Figure 4); and the last tips is about lighting: exchange old light bulbs to low-energy bulbs and turn off the lights when leaving a room.

There is a general tendency for households to own an increasing number of appliances that are rarely used (Karresand, 2014). One man had a microwave oven but was not happy with it:

> I use the microwave oven far too seldom. I don't know why I have it at all. I hate the microwave. … It has always been that there should be a microwave, but I seldom use it. (Göran)

Several of the interviewees had rather old white goods in their kitchens. Most tenants have stoves with cast-iron burners and refrain from upgrading because they would then have to pay extra each month according to the rent scheme for flat upgrading:

> Often when I'm cooking I use the stored heat because I have an ordinary stove top. Because I don't want one of those [glass-ceramic] hobs. [I: No?] Then I would have to pay an extra 40 crowns [~€4] per month. And then I think that is forever – that is how I think. It is not that if you have paid for the new hob or stove yourself, they will lower the rent. They don't do that and you have to pay 40 more crowns forever, regardless of how long you live there. Then I think that I will keep an ordinary stove and it costs nothing. But I often use the stored heat, when I fry, when I boil potatoes, cook vegetables. They stay hot for such a long time, so it works great. (Birgitta)

Several interviewees told of how they make best use of the relatively inefficient energy performance of, for example, old stoves, and use the heat stored in the cast iron burners. It makes sense for tenants to use what they have, and try to make their practices more energy efficient, rather than to upgrade the equipment and pay extra for as long as they stay in the same flat. Several tenants used an electric kettle to preheat water, which they then poured into a pot placed on the cast-iron burner.

The demand for home electronics for work and entertainment has also exploded in recent decades (Karresand, 2014). Some home electronics, such as TVs and computers, are considered standard in Swedish households. Such equipment is not provided by the property owner, but a few years ago all flats were equipped with a box for Internet access and TV. The installation was followed by a campaign on the "Future of TV". The property owner's idea was that it could provide Internet-based services, spreading information via this device and making communication with tenants more interactive. All households were offered a visit by technicians who would install the boxes and teach the tenants how to use them. However, as the provider of this technology decided to stop offering the "Future of TV" platform, the boxes will not serve as a communication channel between the tenants and property owner as planned.

All interviewees owned a TV. In the interviews, some tenants described their reaction when they learned that new TVs are always on standby, unless they are unplugged. Some talked about how, when they purchased home electronics products, energy efficiency did or did not influence their decision on what to purchase:

Figure 4. Use the right-sized pot for the burner: this is an example of a pot that is too small. (Source: Author's collection.)

> The process when I bought my TV and when I bought my computer, it was kind of everything should go quickly, because it was needed. So in that process you didn't think 'hmm I should have an energy-efficient TV – can you help me with this?' My body went into 'overdrive' and I only thought 'now I will buy it, just go home, plug it in, put it up', kind of. I can say that – and I'm not alone in that. (Oscar)

Some purchases must be made quickly because an old TV or computer stopped working. The practice of unplugging home electronics when tenants leave the flat to go away over the weekend or on holidays seems quite common.

PERSONAL APPEARANCE

This domain of results includes various ways of caring for one's appearance, for example personal hygiene activities and doing the laundry. Here we focus on laundry. Interview results indicate great variation in household laundry routines, though the routines seemed stable within each household. The various activities found in the interview data included reusing (i.e., not washing after every use), airing, washing, drying, and storing (clean, but also already worn) textiles. All these activities in one way or another involve the use, or non-use, of energy. The white goods used to perform laundry activities are usually provided by the property owner. In one case, the tenants had bought and installed their own washing machine, which is fine as long as the installation is professional and there is no risk of dampness issues. Tenants usually use facilities such as laundry rooms and washers and dryers installed by the property owner. There is a scheme to charge additional rent if tenants ask the property owner to install washing machines in their flats. The property owner has several opportunities to influence tenant clothes-washing behaviour because it controls the purchase and installation of most washing equipment. This control operates at several levels. At an overarching level, the property owner controls access to the machines. If tenants have washing machines in their homes, the property owner tries to control the installation. The tenants are also offered the additional rent scheme, which might be attractive to tenants who do not want or cannot afford their own washing equipment. The property owner is in charge of the exact brand and model of the washing equipment, though the purchase of the equipment is still subject to procurement and the associated regulations. Another way the property owner controls tenant washing behaviour is through access to common laundry rooms. This property owner has 470 common laundry rooms serving 14,300 flats. The laundry rooms are equipped with machines for washing and drying, and in some cases also mangles and irons. In recent decades, laundry equipment providers have increasingly emphasized energy-efficient machines. In the 1970s, a typical common laundry room would be equipped with two washing machines, one spin-dryer, one tumble dryer, one drying cabinet, one drying room (with a fan blowing heated air), one mangle, an iron, and an ironing board. The general view then was that different fabrics needed to be dried in different ways, which is why all this equipment was installed.

> But when I'm thinking of that, yes, I use the drying room, so that I don't need the drying cabinet. But possibly the tumble dryer for 60-degree laundry. (Inga)

In the 2010s, new fabrics and the call for more time- and energy-efficient ways to do laundry encouraged the property owner to close most of the drying rooms, install more efficient washing machines with better spin cycles (reducing the need for separate spin dryers), and install tumble dryers that are both more energy efficient and treat various fabrics more gently. However, the new technologies are not always intuitive to use or adapted to household routines. The new tumble dryers, for example, are very similar in appearance to the old ones. With the old dryers, it was possible to open the door to the machine and feel whether the fabrics were dry – an option often used and appreciated by tenants. With the new machines, however, it is inadvisable to open the door during a drying cycle because then the entire cycle will have to start from the beginning. The new technology was not compatible with the old practices. With the new machines, tenants must trust the technology to dry the fabrics enough, and stop the practice of using their sense of feel. Several tenants expressed frustration at how the new technologies forced them to change their routines:

> Yes, but that is what is bad. We had four new washing machines and tumble dryers a couple of months ago. The problem with rental flats is that you have nowhere to dry your things. Or, yes you have, but then you cannot do much laundry. You cannot hang to dry three fully loaded washing machines [of laundry] in this flat. One machine is possible. But then it becomes very, very difficult to do the laundry if you can only wash one load at a time until everything is dry. Then you use the tumble dryer and the tumble dryer sucks nowadays. It will not dry. So we use the drying room instead. It doesn't dry there either. … [Regarding the time slots:] Either you get three hours or you get five hours, and for the drying room, you can have an additional hour. … But this is actually something we have to think about: It doesn't feel environmentally fantastic with these gigantic drying machines that heat up the entire room. Tumble drying, equally, doesn't feel good but in comparison … I don't really know what to do about it. But the old tumble dryer worked better. This one is for sure great in a thousand different ways and I don't think they purchase stuff just to mess with me – I don't think they have the time to do that. But I don't know. These are smaller and I'm sure they are more energy efficient and all that, but if they don't work perhaps they are worthless anyway. (Eva)

> So far we haven't figured out how it works. Plus, they have sent a cryptic information letter about stuff, miscellaneous stuff, and among the miscellaneous stuff was something very cryptic about whether people had thought about the tumble dryers … though it was not feasible to change them at the moment. [laughter] So I don't think we are the only ones who think this sucks. … I more or less stopped [using the tumble dryer] this spring and bought a clothes horse. But there is not an inch left to put up the rack. It is in my bedroom. It doesn't work if there are two of us, but when it is only me, it works. I thought it was hard to tumble dry, to that extent. So I stopped. After having done that for around two years. [I: What do you mean by "hard"?] I feel it uses a lot of energy. It is much warmer. It gets really hot. And it takes a lot of time, so I figured it takes a lot of energy too. (Ulla)

In Sweden, laundry rooms have always been the subject of debate between tenants and between tenants and property owners (Lund, 2009). Everybody has an opinion about these spaces. Several rules are associated with the spaces, many of which are informal and not clearly communicated. These rules include how one books time, cancels bookings, how many times per week one can use the laundry room and what time of the day. What causes most conflict is the state of the laundry room after one finishes doing laundry. Knowledge of how Swedish laundry rooms are cleaned has been considered an important part of Swedish culture, as the wrong behaviour might upset neighbours and result in angry notes on the door or phone calls to the property owner. This culture has even been the subject of books and exhibitions (Lund, 2009). Today communalism is not embraced in the same manner as previously. One way to overcome debates and potential conflicts is to give up the communal idea and simply install washing facilities in all flats. The relatively low price of washing machines and tumble dryers makes that option attractive to property owners. Another option for property owners is to take more control over access to common laundry rooms. Gradually, restrictions on the laundry rooms have increased. Electronic booking and tags instead of keys make it easy for the property owner to monitor the use of these spaces. The advantages for tenants are that they have sole access during the time booked (so the time slots can be more efficiently used), they have less contact with neighbours (if that is considered an advantage), and clothing theft might decrease. Digital booking and tags give the property owner another opportunity to monitor the tenants. Such systems give information about who enters the room, how long they stay, and when they leave. Some property owners have even installed CCTV cameras in laundry rooms. Another technology used to control tenant behaviour is automatic dosage of laundry detergents. It is generally understood that tenants often use too much detergent (Naturvårdsverket, 2004), and the property owner has long tried to inform tenants about how much detergent is appropriate. Information signs have been posted in the laundry rooms next to the washing machines saying: "In this building the water is soft and you can reduce the amount of laundry detergent used". Such measures to change behaviour were insufficient, making automatic detergent dosage an option. Automatic dosage will stop detergent overuse and give the property owner control over what and how much detergent is used. In addition, this measure will also stop tenants from adding other chemicals, such as bleach. In this case, the property owner has installed automatic detergent dosage and other control measures where several problems have arisen in the common laundry rooms. One problem was non-tenants using the facilities to do laundry for commercial purposes. This caused overuse of the machines and energy, which the tenants had to pay for in the end when the energy bills rose and the machines broke down.

Previous studies of households and laundry have found that households use lower temperatures but wash more often today than ten years ago (Arild et al., 2003; Laitala et al., 2012). For the tenants studied here, it seems counter intuitive to use the more energy-efficient washing cycles:

> You know I skip that now. I skip "eco" [cycle]. I thought I would go for eco, but it takes one and a half hours, almost two hours to do a 60. Instead, it is half the time for 60 and 40. So I thought it was better to go for that, if the washing machine didn't take so much time. This is what I thought. And that is why I do 60 and 40. (Agneta)

Tenants associate "time consuming" with "energy consuming", and tend to prefer time-efficient washing. They reason with themselves and find it more logical to choose a less time-consuming cycle. Washing machines with digital displays often have a standard 40-degree cycle as their default, i.e., the first cycle shown in the display. The general impression was that the tenants tended to choose the default mode cycle. The drying of washed items is the activity most associated with how the space is used, as drying can require a lot of space if air drying is preferred. Previous research has found that new houses are not designed to accommodate air drying and other laundry activities (Karresand, 2014), and neither new nor old flats are designed to accommodate washing lines or clothes horses.

Recommendations

The practices discussed in this paper consist of products and activities that can be improved regarding energy-efficiency. It is advisable to focus on practices as wholes, but they can also be broken down into elements of products and activities to enable property owners to start with concrete parts of practices. As they work on making improvements, property owners should move between practices as wholes and the elements of practices. Practices should be considered during the entire improvement process, and property owners could structure their work by starting with practices, moving to products and activities, and then going back to practices and assessing improvements of products and activities in relation to practices.

One practice that could be analysed in more detail from the property owner perspective is the comfort practice resulting in simultaneous heating and cooling of the flats. When looking in detail into how tenants perceive and use the air intakes, it becomes apparent that the design of intakes can be improved to enhance both user-friendliness and indoor comfort. The default mode cycle, that is, the first cycle presented as an option when users switch on equipment such as a washing machine, could be altered to steer tenants towards more energy-efficient options. The current default mode in the laundry facilities discussed here is usually a high-temperature cotton cycle. As other research finds that the trend is for users to wash at lower temperatures, and that new fabrics should be washed at lower temperatures, a low-temperature default mode would be better overall. The default modes generally hold potential for improvements and could be analysed as part of practices.

Designs of organisational practices would also benefit from a more thorough analysis. A recommendation is to use an energy-efficiency "lens" and go through all possible different interactions with tenants. How can they be improved from an energy-efficiency perspective? Would it be possible to incorporate energy-efficiency into most of the practices, making it a normal and taken-for-granted perspective? One example where the energy-efficiency "lens" could be used is the optional upgrades to more energy-efficient household white goods, where the economic incentives are not supportive of such upgrades. Another example is in the communication with tenants.

When using communication to achieve a shift in behaviour it is important to use modes of communication that facilitate interaction and dialogue rather than information directed from the property owner to the tenants.

Conclusions

Property owners with a large share of the housing market have various opportunities to influence energy use: they can focus on the buildings themselves and on tenant behaviour. Physical and social environments are often more intertwined than they seem at first. Building design and the appliances installed influence tenant perceptions and usage patterns, and specific usage patterns could be more or less energy efficient. Property owners can exert more influence on energy use patterns by working more consciously on the design of spaces and equipment. Where appliances are installed and how their default modes are set could well affect energy use.

Design can be used at various levels, including the design of things, information, schemes, practices, and spaces. Results indicate that conscious designs were seldom used in attempts to influence user practices; instead, general information and regulations were more commonly used to address users. Information is not an efficient tool, and regulations are not perceived positively by households, which try to by-pass them. In current designs, instead of communicating energy efficiency, the messages are random and not aligned with energy-efficiency objectives. This confuses users and makes it difficult for household members to take the "right" actions in everyday life.

References

Arild, A.-H., Brusdal, R., Halvorsen-Gunnarsen, J.-T., Terpstra, P.M.J. & Van Kessel, I.A.C. (2003) An Investigation of Domestic Laundry in Europe-Habits, Hygiene and Technical Performance. National Institute for Consumer Research, Oslo.

Bryman, A. (2012). Social research methods. (4. ed.) Oxford: Oxford University Press.

Bladh, M. 2011. Energy efficient lighting meets real home life. Energy Efficiency 4:2, 235–245.

Bladh, M. and Krantz, H., 2008. "Towards a bright future? Household use of electric light: a microlevel study." Energy Policy 36 (2008): 3521–3530.

Ellegård, K. (1999) A time-geographic approach to the study of everyday life of individuals – a challenge of complexity GeoJournal, 48 (1999), pp. 167–175.

Ellegård, K. and Palm, J. (2011) Visualizing energy consumption activities as a tool for making everyday life more sustainable, Applied Energy, Volume 88, Issue 5, May 2011, Pages 1920–1926.

Fejes, A. & Thornberg, R. (Eds.) (2015). Handbok i kvalitativ analys. (2nd Ed.) Stockholm: Liber.

EU Directive 2005 Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council.

EU Directive 2009 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related product.

Karresand, H. (2013) Creating new energy orders: Restrictions and opportunities for energy efficient behaviour. In eceee Summer Study Proceedings, p. 2147–2158. Stockholm: eceee.

Karresand, H. (2014). Apparater, aktiviteter och aktörer [Elektronisk resurs]: lågenergiboende som resurs och restriktion för energiordningar. Diss. Linköping : Linköpings universitet, 2014. Linköping.

Laitala, K., Klepp, I.G.1 & Boks, C (2012) Changing laundry habits in Norway. International Journal of Consumer Studies 36 (2012) 228–237. Blackwell Publishing Ltd.

Lund, K. (2009). Tvättstugan: en svensk historia. Stockholm: Nordiska museets förlag.

Magnusson, D. (2013). District heating in a liberalized energy market: a new order? planning and development in the Stockholm region, 1978-2012. Diss. Linköping : Linköpings universitet, 2013. Linköping.

Naturvårdsverket (2004) Kort om miljön och vår konsumtion – för upphandlare och inköpare. Stockholm, Naturvårdsverket.

Norman, D.A. (2013) The design of everyday things. New York: MIT Press.

Palm, J. (2004). Makten över energin: policyprocesser i två kommuner 1977–2001. Diss. Linköping: Univ., 2004. Linköping.

Palm, J. (2011). Energy Efficiency in Households. Policy, Implementation and Everyday Activities. New York: Nova Science Publishers, Inc.

Røpke, I. (2009). Theories of practice – New inspiration for ecological economic studies on consumption. Ecological Economics, 68, 2490–2497.

Shove, E., & Warde, A. (1999). Noticing inconspicuous consumption. In Reader for the summer school of 1999. Lancaster: Consumption, Everyday Life and Sustainability.

Shove, E. (2003). Comfort, Cleanliness and Convenience. The social organization of normality. Oxford: Berg.

Shove, E., & Pantzar, M. (2005). Consumers, producers and practices. Understanding the invention and reinvention of Nordic walking. Journal of Consumer Culture, 5 (1), 43–64.

Shove, E., Watson, M., & Ingram, J. (2007). Design of Everyday Life. Oxford: Berg Publishers.

Stephenson, J, Barry Barton, Gerry Carrington, Daniel Gnoth, Rob Lawson, Paul Thorsnes, (2010) Energy cultures: A framework for understanding energy behaviours, Energy Policy, Volume 38, Issue 10, October 2010, Pages 6120–6129.

Whilhite, H. (1996) A cross-cultural analysis of household energy use behaviour in Japan and Norway. Energy Policy, 24, 795–803.

Zimmermann, J.P. (2009). End-use metering campaign in 400 households in Sweden. Assessment of the Potential Electricity Savings. FELINES S/RIMANDOULE: Enertech Ingénierie énergétique et fluids.