



International High-Performance Built Environment Conference – A Sustainable Built Environment Conference 2016 Series (SBE16), iHBE 2016

Everyday governance of domestic energy systems

W. Glad*

Linköping University, Mäster Mattias Väg, Linköping 581 83, Linköping

Abstract

The proposed transition to a low-carbon society faces challenges, as it is occurring too slowly to achieve the goals set by international and national governmental bodies, and gaps are found between available energy-efficiency technologies and their appropriate use. The governance of domestic energy systems has attracted European research attention, and the findings illustrate how materials, competence, and meaning influence energy productivity in domestic settings and how accountability is enacted by connecting people and technologies. The present research cites Swedish examples of how energy efficiency has been improved by involving multiple local actors, such as consumers, energy utilities, property companies, and local governments. Examples are analysed through the lens of social change and mundane governance theory, illustrating how spaces and places often overlooked as too mundane to be considered in policy prove, when analysed in more detail, to be important for energy efficiency. The results indicate that “governance pairs” (e.g., “households/lighting” and “caretakers/heating systems”) are more or less successfully held together and influence accountability and governance possibilities. The present analyses demonstrate that, while governance is often portrayed in terms of causality, everyday practices involving governance pairs are messier and less predictable than anticipated. These results call for the upgrading of research into everyday life and for bottom-up approaches to energy studies. Accountability – crucial to closing the energy-efficiency gap and understood in the context of mundane governance – can advance our energy-efficiency thinking and action.

© 2017 The Authors. Published by Elsevier Ltd.

Peer-review under responsibility of the organizing committee iHBE 2016.

Keywords: energy systems; everyday life; Sweden; governance; accountability.

* Corresponding author. Tel.: +46-13-282-259; fax: +46-13-284-462 .

E-mail address: wiktoria.glad@liu.se

1. Introduction

Low-carbon societies are the goals of several national governments in Europe, including that of Sweden. Such societies would solve some of the major environmental and political problems acknowledged by governments today, such as climate change and fossil-fuel dependence. These national goals are directing goal-setting on local levels, and in Sweden, city councils establish the paths to a low-carbon society. City councils can use their powers to influence energy use in areas such as housing, transportation, and other services. Local governments in Sweden have several instruments with which to influence urban planning and development. One topic currently on local agendas addressing pathways to low-carbon societies is how to create residential areas sustainable in terms of, for example, domestic energy use. The instruments available for local governments include their power to regulate land use and the development of the local energy system. Land use has energy implications in terms of, for example, how a city develops in terms of density and sprawl and how low-carbon heating is encouraged by offering connections to municipal district heating or by planning city districts to facilitate individual solar energy technologies.

Both academics and practitioners have called for a transition from the current state to low-carbon societies [1]. The transition literature is vast, but often concentrates on the general level. The present research takes a detailed look at how technologies are enacted on the micro level, advancing our understanding of the political processes affecting small things that matter.

The concept of mundane governance was introduced by Woolgar and Neyland [2] to draw attention to political processes on the ontological level. On this level, one can study how ordinary things are enacted and how technologies are used in practice. Large portions of domestic energy systems can be characterized as part of the mundane for householders, building operators, and management. Householders interact with energy system interfaces during many everyday activities and perform routine projects such as controlling lighting, cooking meals, doing the laundry, and staying warm indoors by using the thermostats on radiators in their flats.

2. Theoretical perspectives

The governance of mundane domains such as domestic energy systems has recently attracted attention from European researchers [2,4]. Shove et al. [2] have theorized about how everyday practices are constructed, some becoming dominant and others changing or disappearing. Various social and technical elements of these practices stimulate each other and develop strong links over time. During the continuous reproduction of practices, dynamic stability is established. Change occurs when elements are linked in new ways or if new elements are introduced and new links are created to the new elements.

Woolgar and Neyland [5] and Woolgar and Lezaun [4] suggest that exploring ontological enactment would shed light on how and why change occurs. Their suggestion is a response to a previous emphasis on matters related to the wider context, background factors, and higher-level politics. In the ontological enactment perspective, attention is instead paid to “the practices that enable the mutual constitution of the properties of the entities involved and the relevance of the context in which they are situated” [4, p. 328]. This approach implies that morals and norms can be made visible, making it possible to critique governance in everyday life. In this case, mundane governance is very much present in the relationship between municipal housing companies, tenants, and the various parts of the energy system that become elements of everyday life. The constitution of these elements gives rise to tensions between categories of users, such as tenants, building operators, and managers. The intentions of these users vary. For example, tenants might be unaware that building operators and managers might be obliged to follow certain rules and aim for certain goals, including the energy-saving targets of the municipality and the municipal housing company. The goals of tenants can be expected to differ in type, such as living a “good life” and having good indoor comfort. The “consequential methodology” suggested by Woolgar and Lezaun [5] entails identifying relevant elements, determining how and what attributes are assigned to the elements and determining what rights and responsibilities are distributed among the elements. Woolgar and Lezaun [5] cited an example from a newspaper about a bin bag that had been attributed a “wrong” use: when a woman used the bin bag in a certain context, for recycling purposes, she was considered to be misusing the bag and was fined. Several relationships between different elements formed parts of a network and a context for defining the bin bag, with economic consequences for

the woman. Domestic energy systems might be explored using similar analyses because the use of such systems is often imbued with rights and responsibilities. In addition, several categories of users form complex networks around different parts of the energy system, networks that comprise both human and non-human entities.

Shove et al. [2] refrain from using the word “mundane”, instead stressing the power of social practices and the importance of everyday life for how societies develop. By emphasizing everyday life and related social practices, attention is centred on how various social and technical elements are interlinked. These elements are referred to as materials, competences, and meanings [2], and practices are constructed by the specific arrangement of these elements via a dynamic process. Shove et al. [2] suggest that practices emerge as they are performed, but it is also possible to view practices as entities and, consequently, to explore practices and how they change over time and space. People and technologies can move in and out of practices, intermittently becoming part of performances and entities. Shove et al. [2] propose that their theoretical practice theory framework could be used in policy development to guide social change programmes. This approach acknowledges varieties of change and concentrates on differences on detailed levels, possibly making it difficult to formulate accurate policies that address the practices of complex relationships between humans and non-human entities. In this research practice, elements and entities are used as analytical tools to help us understand empirical results.

3.Methodology

This empirically based paper analyses data from two case studies, both examining energy use in everyday activities. In both studies, the study objects were municipal housing companies, located in two mid-sized Swedish cities, and the studied housing type was blocks of rental flats. There are two obvious differences between the studies: 1) in one case, the empirical research treated a single city district of 900 flats in one case, while in the other case the company’s entire stock of 14,300 flats was studied; 2) in one case, the local energy company is municipally owned with 260,000 customers, while in the other case the local energy company is owned by one of the world’s largest private energy companies with 30 million customers. The main research methods in both cases were qualitative interviews and observations; in the study including the entire stock of flats, data were also collected using a questionnaire.

Data for this paper comprise: qualitative interviews with tenants and housing company staff; observations of flats, customer service, and staff training; and data from a postal questionnaire. Data were collected in face-to-face interviews, digitally recorded in most cases, and transcribed verbatim. The goal during the interviews was to collect information about ordinary activities and the use of energy for these activities. The tenant interviews were conducted in the tenants’ flats and usually combined with a tour of the flats to facilitate discussion of energy use in everyday life. If both the respondent and interviewer could see the technologies used in the discussed activities, it would be easier for both to be more accurate when questioning and answering. The staff members were interviewed in their offices. The staff affiliation differed between the cases: the interviewed building operation staff were part of the municipal housing company in one case and a facility service company in the other. Some of these staff members were formerly employed directly by the housing company, but when the core of the company, i.e., renting and building flats, was separated from operational services, i.e., building operation and maintenance, the staff were rehired by a private company. Operational services are normally procured every third year, and if another company wins the procurement, the staff are normally taken over by the new company. The knowledge and experience of the staff who have worked in the buildings for a long time and learnt all the peculiarities of how particular buildings function during different seasons and weather conditions are crucial for a new actor. Consequently, individual building operators might have worked for several companies over the past ten years, but in the same buildings and performing similar tasks.

Customer service and staff training were observed in order to explore the interaction between staff members of different types, for example, mostly women in customer service and only men in the building operation group. Observations were conducted in the customer service office and in flats for staff training. The office observations were performed both in summer, to observe issues associated with higher temperatures, and in autumn, to observe issues arising when the temperature drops and humidity is still high. In such conditions, the number of complaints normally rises because “the system” does not react fast enough to adapt to the new conditions; here, “the system”

refers to both the building envelope with its slow-to-react construction and the heating system. Normally, concrete construction is slower to react than is timber frame construction, and district heating with radiators in the flats is slower to react than are forced-air heating systems. Most of the flats in the two cases have radiators connected to district heating.

The observed staff training was provided for different purposes in the two cases. In the first case, the training was provided by building operators for caretakers; both staff groups were employed by the same company, all staff members had known each other for many years, and most staff members had been employees of the same company for many years. Conversation and practical interactions were easy and relaxed in this case, and the atmosphere was friendly, helpful, and egalitarian. In the second case, the staff members were employed by different companies depending on their role: customer service staff were employed by the housing company and building operators by a private company. Still, the staff members had known each other for several years in several cases, and again the atmosphere was open and the conversation effortless. In both cases, the training was performed in a flat and the building operators showed the “students” the various parts of the energy system, some visible, while others, such as water pipes and meters, were hidden behind doors. This tour of the flats, with a focus on heating, ventilation, and electricity, was followed by a question-and-answer session. In the first case, this session seemed ad hoc, while in the second case, the customer service staff had prepared questions. A general conclusion from the observation was that how the technical perspectives on the energy systems were used to explain user behaviour had to be adjusted to fit the technical systems, not the other way around.

4. Local actors

The present research cites Swedish examples of how energy productivity has been improved by involving multiple local actors, such as consumers, energy utilities, property companies, and local governments. These examples are analysed through the lens of social change and mundane governance theories, illustrating how spaces and places often overlooked as too mundane to be considered in policy prove, when analysed in more detail, to be important for energy productivity.

The local actors involved in the studied cases are municipalities, housing companies, energy companies, and tenants. In several areas, such as urban planning and infrastructure construction and use, municipalities are monopolists, with local councils largely determining what can be built and where. Both case study cities decided to build district heating systems several decades ago. Investing in district heating is expensive and is known to cause lock-in effects, as competing heating sources are held back in various ways by the district heating owner. The price of district heating might, for example, differ between customers depending on whether or not a competing heating source is available. The guidelines for new development might be influenced by the availability of district heating; for example, it is advisable to build relatively dense cities to facilitate the efficient use of district heating. District heating is path dependent in several ways, and other city infrastructures can likewise become path dependent due to the existence of district heating. A peculiarity of Swedish multifamily housing is the common laundry room, sometimes located in a separate building. These rooms are usually equipped with washing machines, tumble dryers, and drying cabinets and sometimes with irons and ironing boards. Normally, these facilities are booked in advance and every household can expect to have one 4–6-hour slot available every week. The facilities can normally be used free of charge, though some municipal housing companies have started charging to use the washing machines to prevent overuse.

Local energy companies in Sweden are often owned by the municipality. One of the studied municipalities decided to sell its energy company around 15 years ago to generate much-needed income for the local council. The other municipality still owns its energy company, and the annual earnings of this company constitute the local council’s chief income source after local citizens’ income taxes. In both cases, the housing companies are owned by the municipalities and contribute to local council income. These municipal housing companies are responsible for developing housing in their cities and for reaching energy-saving goals set by the local councils. District heating is sometimes considered an environmentally friendly alternative, though it is sometimes regarded as hindering the development of alternative, more renewable energy sources. Tenants can act both as individuals and as groups, for example, through local tenants’ associations. The tenants’ association is an important stakeholder when negotiating

rental agreements. In Sweden, one normally does not negotiate rent individually but as a group through the tenants' association.

5. Practices and mundane governance

Most rental flats in Sweden incorporate objects and technologies owned by the housing company and that are pervasive in everyday life. These objects and technologies are used in most everyday activities and influence the many activities that directly or indirectly use energy. Taken together, these activities have substantial impact on energy consumption and have the potential for better energy efficiency. Woolgar and Neyland [4] suggest that the ordinary and mundane would benefit from ontological dynamics analyses of governance and accountability [4]. In several respects, domestic objects and technologies are parts of energy systems often described as “end uses”, while the ontological dynamics perspective might lead to an opposite view. Starting with the ontology of objects and technologies, it is possible to study how social and political factors are integrated into the material and become influential in everyday activities.

What constitutes an ontological politics for the energy systems of municipally owned rental housing? Who are the users of these systems and who are the users of the energy? Who are the system designers and maintenance workers? The system users and energy users differ. Many parts of the system are governed by the facility owner and are hidden to its users (i.e., the tenants). The property owner governs the system from the early stages of design to system decommission or renovation. From the owner's (i.e., housing company's) perspective, the owner is safeguarding tenant interests, as that is part of the mission specified by the local council. In that sense, they take responsibility for the entire process from design to decommissioning, and throughout its lifespan they monitor, maintain, repair, develop, and improve the existing system.

The system is in constant flux in various ways in response to efforts to develop and improve it – another key mission for the system owner. The constant system changes should tend towards improved system efficiency and utilization. Parts of the system are constantly being changed and exchanged in an assumed improvement trajectory. The human parts of the system are, on an organizational level, subject to a regular negotiation process. Every third year, the facility services are subject to a procurement process and new employees might be engaged as system managers. In practice, existing staff members are usually retained, because it is common practice for the winning bidder and company to take over existing staff. However, procurement always opens a window of opportunity to make staff changes, dismiss current staff, and recruit new staff. Keeping the same staff is often advantageous, as facility management requires deep knowledge of the facility's constituent buildings and systems. Information about how buildings and systems function or malfunction is seldom documented in detail but rather constitutes practice-based knowledge incorporated into everyday activities as staff members monitor buildings and systems on site and get a “feel” for how to operate them in the “best way”, i.e., the way resulting in the fewest tenant complaints and minimal use of energy, in the form of electricity and heating, for system operation. This constant drive for improvement is part of a larger organizational imperative, and the maintenance personnel are often the last link in the chain connecting results to policy goals. Follow-up work is done on the individual level of buildings and the caretakers responsible for them, and fed into groups of personnel with similar work tasks. The group heads are supposed to have regular contact with the building owner and give feedback about the progress made. However these contacts seldom happen, and there is no regularity in meetings and feedback between the service organization and the property owner. Instead, staff members of the property owner conduct their own follow-up tasks, try to collect data about the energy performance of buildings, and try to identify issues related to the buildings themselves or to the various electricity and heating energy systems.

Data are acquired by meters installed in tenants' flats and connected to a computer that also regularly registers the temperature in the flats. These data are fed into a program that creates graphics visualizing how the buildings are performing over the long term. With this method, specific flats can be identified as performing better or worse than average, for example, having inappropriate indoor temperatures. It is important to the property owner that all flats should have the right indoor temperature and perform in similar ways. A graph that is repeatedly used in communicating these issues shows that most of the flats in the same multifamily apartment block perform similarly and have indoor temperatures within the range of 20–21 degrees. The problematic flats have lower or higher

temperatures, for example, 18 or 23 degrees, and need some kind of maintenance or repair, related either to the building construction or to the energy system for heating. More detailed data collection might be necessary to identify the exact cause of the deficient performance. Over a period of three years, the property owner has concentrated on getting all flats into the same temperature range, a range negotiated between the property owner and the tenants' association. The "right" temperature was defined based on a figure presented in an academic paper on what constitutes the right temperature for indoor comfort. However, this figure has been disputed in other academic papers noting that the "right" temperature depends on user perceptions and differs between individuals and cultures.

As Sweden is a multicultural country, property owners in Sweden can expect to meet a variety of needs in relation to indoor comfort. Some staff members expect tenants to learn how to use the buildings and systems. Staff members are involved in the learning process in several ways and are partly responsible for informally educating the tenants. The multicultural situation requires additional support, for example, in translating the information necessary so that tenants can live their everyday lives at home. For newly arrived immigrants, it might not be self-evident how to use facilities commonly found in Swedish rental flats. One Swedish culture-specific feature is shared laundry facilities with equipment such as washing machines that automatically dispense washing powder (provided by the property owner) or "smart" tumble dryers that do not work if one opens the door to feel whether the laundry is dry (these dryers automatically sense the dryness). It might not be obvious how to use a sit-down WC if one is not used to such toilets, and their use might have to be explained. When technologies are not used as designed, they might become damaged.

Similar concerns were raised concerning tenants who did not follow the instructions or intentions of the property owner when using the shared laundry equipment. For example, strong bleach is commonly used by some tenants and, according to some staff members, is connected to certain cultures, but the washing machines are not configured for strong bleaches. A strategy adopted by the property owner to stop the use of bleach in the washing machines was to close the manual washing powder and softener dispensers on the washing machines and instead to connect the machines to an automatic washing powder and softener dosage system. This stops the tenants from using bleach, giving the property owner control over the use of chemicals. Of course, this change in technology is promoted as a service to the "customers", who will no longer have to buy washing powder and softeners because they are already provided. The chosen washing powder has the features usually looked for in household chemical products, i.e., environmentally friendly and hypoallergenic, indicating care for the tenants and for the environment. This care for people and the planet was a response to what the property owner specifically perceived as misuse of the washing machines.

Another issue addressed by the property owner was the practice of washing business-related laundry, for example, shirts and trousers used as working clothes in restaurants owned by a tenant or a friend or relative of the tenant. This overuse of the laundry equipment caused extra wear and tear of the washing equipment, shortening its projected useful life. The property owner's response was to increase control over use of the equipment by installing electronic locks, tags, and a booking system. These control measures restricted tenant use of the laundry facilities and equipment. The property owner could also monitor laundry room use by collecting and storing data on when tenants book time to use the common laundry facilities. By means of electronic locks on the laundry facilities, tenant entrances and exits could be monitored and analysed and the owner could determine who was using the facilities, when, and how often.

It is more difficult to influence domestic activities performed inside people's homes and flats. The radiators for heating are part of the domestic energy system shared by tenants and the property owner. Much of the control over heating is in the hands of the property owner, who can stop the supply of heating to the flats. On another level, the supply of district heating to the property owner is controlled by the municipal energy company. The heating monopoly works on different levels, and while tenants are in the hands of the landlord, the landlord is in the hands of the energy company. While the property owner has the advantage of knowing the exact cost of district heating, this cost is usually completely hidden from tenants. The cost of household heating, for Swedish tenants, is usually included in the rent and not presented as a separate item on the rental invoice. By keeping tenants ignorant of how much of the rent is for the heating cost, the property owner retains control over heating supply and cost. Various options are available to educate and inform tenants of the actual cost of heating, perhaps creating some awareness of energy costs and the benefits of increased energy efficiency obtained by using energy less wastefully in the domestic

sphere.

Energy awareness campaigns could include a range of messages and activities, benefitting property owners, tenants, and the environment. Woolgar and Lezaun [5] suggest that in order to explore the ethical and political aspects of various phenomena, consideration of ontology is helpful. Ontology gives answers to questions about who governs what and what governs whom. In this case, both humans and technologies govern multiple domains in everyday life connected to domestic energy systems in rental flats. Ontology provides tools to look into the details of governance that matter in everyday life and influence how activities are routinely performed. This bottom-up perspective takes account of governance and the execution of power in taken-for-granted spaces and in hidden power relations in the mundane sphere. Everyday life as a political arena has been explored from various perspectives, but the ontological focus is novel because it tries to grasp what someone or something really is and means to someone. From this perspective, ontology also elucidates “the nature of relationships between given, stable figures” [4, p. 334], with “figures” here referring to humans and non-human entities. It is important to acknowledge, however, that even though figures might appear given and stable, they exist in constant flux. Though this flux might occur at a level, range, and speed impossible to notice, in the long run, these minor movements and their directions might be important for the general development of a more efficient and effective energy system.

Some technologies might find new directions with assistance from new technologies, especially from information and communication technologies (ICT). ICT has found its way into older technology domains such as washing machines and heating systems. Washing machines for single households can now be connected to the Internet and operated from a distance. The Internet connection also makes it possible for software updates to be downloaded and installed. Such Internet-enabled washing machines might be installed in flats and complement the shared laundry facilities. The convenience of having laundry facilities in one’s flat is preferred by many or at least is an appreciated additional service, for example, for large families with lots of dirty laundry or for disabled tenants with difficulties using laundry facilities located at a distance. For heating systems, ICT has had a greater effect in supporting the role of various professionals responsible for the operation and management of buildings.

Building operation and management has gradually evolved from being a manual job in which visits must be made to every building in order to do the job, to one that can be done from a distance. Many of the parameters that building operators must monitor can be logged, stored on servers and computers, and downloaded to operators’ hand-held devices, such as smart phones. Site visits by building operators are still common, as all buildings have their own unique set-ups of heating, ventilation, and electrical systems, meaning that only on-site assessment can give a comprehensive overview of the buildings. The opportunity to operate buildings from a distance, however, is greatly appreciated by the operators. During the interviews, the building operators demonstrated how different types of vaults could be opened and closed simply by clicking on the screen. The screen displayed a schematic of the system showing heating pipes, vaults, outlets, and other components. Using a computer or smart phone, the building operators could in theory shut down all incoming heat to a specific flat. This power over indoor comfort was not exercised, however, though the temperature of individual flats could be monitored and deviance from what was considered normal could be followed up and examined in detail. In this way, the households were under surveillance. Behaviours that could be detected in this way were the cultivation of illegal plants needing higher temperatures than normal or more people than allowed living in the flat.

In recent years, overcrowded flats have become an increasing problem in municipal housing, as an increased number of refugees and housing shortages in many Swedish cities have created a situation in which people are forced to live with their extended families in small flats. This causes problems, for example, with excess use of hot water causing increased humidity inside the flats that the buildings are not designed to manage. On the other hand, the cost of heating can be expected to decrease since bodies each produce approximately 100 W of heat, which is part of the energy balance of a building. When the housing companies discuss overcrowded flats, the number of people in the flats is presented as a problem.

Building operators normally use the possibility of monitoring systems remotely using ICT as a tool to find errors through fault analysis; the root of the identified problems, however, are often only found when visits are made to the sites and buildings. A central tool in the building operator’s job is the “curve” showing how the various parameters should be set to balance the heat supply, indoor temperature, and outdoor temperature. Managing the curve is central to the building operator’s job, and it requires the tacit knowledge that is part of being a good operator. How well the

curve is managed greatly influences the energy use for heating. Managing the curve is a balancing act: the challenge facing the building operators is to adjust the curve so that the system responds to changes in weather as quickly as possible without using excess heat and without angry tenants calling customer service and complaining about low indoor temperatures. The curve is something all building operators talk about and refer to as important in their jobs. The curve is sensitive to different building configurations and features and is unique to each building. Building operators need to learn about how different buildings perform under different conditions.

In Sweden, the weather varies considerably from season to season, and the climate varies from relatively hot and humid in summer to cold and dry in winter. Buildings must be robust enough to cope with these different climate conditions. At the same time, the tenants' tolerance of shifts in indoor comfort and temperature is relatively low, and even small changes might prompt many complaints to customer service. Both low temperatures in winter and occasional high temperatures in summer could be reasons to call customer service. In Sweden, the tenants' associations are strong and negotiate with landlords about, for example, the rent and indoor temperature. Together with national regulation of indoor temperature, this is part of the Swedish indoor heating practice. The indoor heating practice can be said to be a strong culture that has developed over the years since it was widely acknowledged that Swedish housing standards were so poor as to lead to hygiene risks. With the increased number of tenants in flats observed today, a debate on housing standards similar to that of the previous century has emerged.

6. Governance pairs

The results indicate that “governance pairs” [2] are more or less successfully held together and influence accountability and governance opportunities. Examples of governance pairs in this case are “households/lighting” and “caretakers or building operators/heating systems”. Households are generally responsible for the lighting in their flats, in terms of both the electricity supply and the light fixtures and bulbs. Lighting might seem to be a basic need, like the heating of flats, that should fall under the same practice as indoor heating, that practice being that the property owner should manage the infrastructure, energy supply, and system maintenance. All these services would be included in the rent and constitute an invisible cost to the tenants. Another logic apparently governs lighting. Householders are responsible for the basic need for light, even though winters in Sweden are not only cold but also dark, and in some parts of the country the sun never rises for two to four weeks in winter. Even so, households in municipal housing are responsible for lighting their own flats. Some light sources might be installed by the property owner, for example, lights in bathrooms, over stoves (often integrated into the kitchen fan), and in walk-in closets. Sometimes a fluorescent lamp is installed on the kitchen ceiling and comes with the other basic equipment (in Sweden, electric stoves and fridges/freezers are part of the basic equipment of flats). The tenants, however, are responsible for their own electricity contracts, so without the electricity contract, the flat might be warm, but dark. The Nordic indoor lighting culture often entails a great variety of lighting with a focus on creating a cosy atmosphere during the many dark months of winter [3]. Sweden is no exception to this culture, and lighting has been targeted by the national government and the EU as an area in need of a shift towards lower energy use. Consequently, the previously most common light source, i.e., incandescent lighting, is now almost completely banned and only low-energy light bulbs are available on the European market. According to Woolgar and Neyland [4], the relationships between tenants and lighting are crucial for mundane governance. In the case of lighting, it is not a clear-cut case of whether the pair is held together or not, and the truth could be said to lie somewhere in between. Households are responsible for lighting, but cannot be held responsible for low energy use in lighting because they are not entirely in control of all light sources. Could the coupling between tenants and lighting be made tighter in order to facilitate governance?

In the case of caretakers, building operators, and heating systems, the couplings are stronger and relationships better held together. Caretakers and building operators are responsible for the various parts of the heating system that are connected to the building. In some cases, the local energy company is responsible for some of the sub-centrals connected to the district heating system, and these sub-centrals are sometimes located inside buildings. The responsibilities of the property owner and the local energy company are strictly regulated and the property owner is responsible for all parts of the heating system inside the flats. If we draw a boundary around the flats, the building operators and caretakers are responsible for heating the flats, but they form part of a bigger system with many other

elements. The pair of entities “caretakers or building operators/heating system” is held together partly by the meaning-making of tenants, who expect such staff members of the property owner to have the needed competence to take responsibility for the indoor heating. Caretakers and building operators are also expected to educate tenants about the heating system and how it can be used or misused. An example of misuse is that the preferred furnishing of a flat might block the unimpeded heat flow from the radiators through the flat, degrading indoor comfort. A bulky sofa or heavy curtain in front of a radiator might have that effect. Under these conditions, caretakers and building operators should take responsibility for teaching the tenants about how to furnish their flat to make best use of the heat from the radiators.

These analyses demonstrate that, while governance is often described in terms of causality, everyday practices involving various governance pairs are messier and less predictable than anticipated.

7. Conclusions and recommendations

Focusing on ontology, as suggested by Woolgar and Leuzan [5], provides interesting perspectives on energy systems in general and on user perspectives at the micro level in particular. Users in the present case studies consist of lay end-users (i.e., tenants) and professionals (i.e., building operators). These user groups and the technologies with which they interact directly or indirectly form parts of the energy system and give rise to the prerequisites for energy efficiency. To improve our understanding on the ontological level, we need to study user practices and technologies in detail and consider the micro-level features and elements of practices and technologies [2]. Here, such empirical research has illustrated how technological configurations in several parts of the domestic sphere are directed more towards professional than lay end-user interfaces. Tenants are supposed to change their behaviour to fit the technology and the energy systems designed by technical professionals. In turn, the professionals’ knowledge of tenant behaviour is based on random experience and hearsay. The housing company expects tenants to adapt, for example, how they do their laundry to fit the technical configurations of the new washing machines and tumble dryers. The ontology of the new washing machines, from the tenants’ perspectives, is that slow eco-cycles and low default washing temperatures do not yield sufficient cleanliness. From the property owners’ perspective, the new laundry equipment is more environmentally friendly because it uses less energy, uses the “right” type of energy (i.e., from district heating), and increases energy efficiency. District heating is cheaper and electricity should, according to basic energy systems theory, not be used for heating when other heating sources are available. The energy density is much higher in electricity than in district heating.

On the ontological level, governance could start to concentrate on the mundane and on governance pairs such as “tenants/lighting” and “caretakers or building operators/heating system”. Instead of providing general information on how to lower energy use in various domestic areas, more focused and specific engagement with the pairs is recommended. Tenants should not be expected to take a broad approach in realizing their energy-saving intentions – if they have any. A piecemeal approach might not be appropriate when targeting energy behaviour. Instead, a deeper and more thorough approach to the materials, competence, and meaning of energy systems could be more useful. This calls for more focused work than that of previous energy-saving campaigns targeting unspecific groups with general information.

Accountability is said to be central to the mundane governance approach. Who is accountable for what, where and when? Governance concerning staff and the systems owned by the housing companies might be easier to address because building operators could be held accountable in their professional role and because procurements usually include energy-saving goals to be met during the contract period. Building operators who are part of the property owner’s own organization can also be accountable for fulfilling energy saving goals. Because of the closer relationships between these owners and operators, the work they do on a daily basis, largely addressing the mundane, might be especially visible. On the other hand, the work might be integrated into ordinary activities to such an extent that it becomes invisible and taken for granted. Minor changes might not be acknowledged even though they matter on a larger scale and in the longer run. In one of the case study municipalities the building owners have introduced a new form of meeting. Every morning there is a sharing and reflection session in which the caretakers and building operators can discuss various issues and get immediate responses from management. This facilitates learning between staff members and enables issues to be dealt with more quickly. The behavioural

changes expected of the tenants are less clear. Some tenants may be committed to changes in practice, and we can expect to find those tenants among both the questionnaire respondents and the interviewees. However, there are few means to force tenants into new heating or hot water use practices. Changes can occur when tenants feel uncomfortable because their practices have resulted in less energy-efficient use of heating. Interior design might offer a way to connect current design trends to energy efficiency. Another opportunity might be to link trends in cooking and fashion to low-energy lifestyles, such as urban gardening, community cooking, and jeans brands promoting six months of wear before machine washing in a cold eco-cycle. Early adopters of trends might be useful in promoting novelties, if they are perceived as role models in the community and forerunners when it comes to trends.

Few people reflect on the ontology and meaning of ordinary things. Research into these matters might advance our thinking about energy systems and users' perspectives on them. These results call for the upgrading of research into everyday life and for bottom-up approaches to energy studies. Accountability – an important part of closing the energy-efficiency gap and understood in the context of mundane governance – can advance our energy-efficiency thinking and action.

Several societal areas, such as climate change challenges, need help from academia to change practices that are not sustainable in one way or another. The question remains as to whether practice, theory, or mundane governance can advance policy-making processes. Lessons learnt from this research illustrate how materials, competence, and meaning influence energy productivity in domestic settings [2] and how accountability is enacted by connecting people and technologies [4]. However, to turn these theories into ontology and practice that can be used as policy tools might be too much of a challenge for academia and policy makers alike.

References

- [1] H. Rohrer, P. Späth, The Interplay of Urban Energy Policy and Socio-technical Transitions: The Eco-cities of Graz and Freiburg in Retrospect, *Urban Studies* 51 (2014) 1415-1431.
- [2] S. Woolgar, D. Neyland, *Mundane governance: ontology and accountability*, first edition, Oxford University Press, Oxford, 2013.
- [3] H. Wilhite, H. Nakagami, H. Masuda, T. Yamaga, Y. Haneda, A cross-cultural analysis of household energy use behaviour, *Energy Policy* 24 (1996) 795–803.
- [4] E. Shove, M. Pantzar, M. Watson, *The dynamics of social practice: everyday life and how it changes*. first ed., Sage Publications, Thousand Oaks, CA, 2012.
- [5] S. Woolgar, J. Leuzaun, The wrong bin bag: A turn to ontology in science and technology studies? In *Social Studies of Science* 43 (2013) 321-340.