Transition towards low energy housing: Implementing energy efficiency in a large-scale refurbishment project

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Abstract
Refurbishment for reduced energy consumption in post-war residential areas is a hot topic. There are policies promoting transition towards low-energy consuming buildings and demonstration projects that show how to achieve these refurbishments. In most cases, it is not a matter of technical difficulty. However, policies for energy efficiency and the demonstration of related measures and practices often fail when it comes to realizing large-scale refurbishment projects. Why does this happen? In order to understand and overcome the gap between high national energy efficiency goals and their implementation in real refurbishment projects, we must look more closely at local planning practices and implementation processes. This will also shed light on the social context.

This paper draws attention to an ongoing large-scale, low-energy refurbishment process in a residential area with 600 dwellings in Gävle, Sweden, which has a goal to implement energy-efficient technologies. What are the factors for success and implementation in this case? Preliminary results from extensive current empirical work emphasize joint collaboration with municipal authorities, which facilitates the decision making needed to overcome institutional barriers. The process is also characterized by user involvement based on a model for end-user participation.

Introduction
It is widely accepted that energy efficiency is necessary in order to reduce greenhouse gas emissions. The Swedish government follows European policy makers and has established goals to reduce energy use by 20 per cent by 2020 and by 50 per cent by 2050 (SOU, 2008:25). The building sector is important in this sense because the sector represents more than a third of total energy use (Swedish Energy Agency, 2012). Post-war blocks of flats compose a large amount of all housing in Europe. Sweden is no exception and has an especially large amount of housing in multi-storey dwellings that date from the 1960s and 1970s. This building stock is a high priority for energy efficiency measures and is on the agenda of the Swedish government (SOU, 2008:25).

It has, however, been considered hard to actually achieve energy-efficient housing. The pace of refurbishment and implementation of energy efficiency in post-war dwellings is also considered too slow (SABO, 2009). The building sector in general in Europe is considered slow to change and is not adapting to new requirements for energy efficiency and sustainability. Technically, it is possible to refurbish and make buildings much more energy-efficient, but the technical change required may violate existing construction and building maintenance practices (Quitzau, Hoffmann, & Elle, 2012). Existing practices are often locked in stable and dominant socio-technical regimes that persist in the building sector, making them hard to change. Construction companies are blamed for not identifying a demand for energy-efficient buildings; they do not offer to construct energy-efficient buildings or suggest new and innovative energy-efficient technologies to developers (Rohracher, 2001).
Despite several policy recommendations directed towards energy-efficient buildings and initiatives for refurbishing post-war dwellings to become more energy-efficient, only a few real projects without governmental financial support are actually put into practice on the local level. Plans and ideas for energy-efficient buildings often fail when incorporated into existing practices for building and construction on the local level. There seems to be a gap between visions, policies and national energy goals for energy-efficient buildings, on one hand, and the implementation of energy-efficient technologies and measures in practice on the other (Quitzau et al., 2012).

Energy systems and the organization of them have often been considered straightforward and more a matter of technical challenge, but existing and new conditions and constraints of an economic, ecological and institutional character create new challenges for meeting the demands for energy efficiency and sustainability (Hodson & Marvin, 2010). For example, the re-regulation of the housing sector in Sweden in the 1990s, which removed the opportunity to obtain governmental loans for housing construction, has affected the construction of housing in market terms. Municipalities have also been accused of prioritizing high revenues and high income households and for putting less effort into energy and environmental goals in large-scale housing projects (Green, 2006).

In order to meet the demands for energy and climate change challenges, the reorganization and creation of new forms of planning and implementation at the local level within cities and local governments, towards a more holistic and management-oriented approach, have been emphasized as important and preferable to focusing on singular instruments of change. New forms of organization or instruments, initiatives and experimentation can provide an opportunity to pave the way for energy-efficient buildings and sustainability (Bulkeley, Broto, & Maassen, 2011; Quitzau et al., 2012). That makes it important to gain further understanding and shed light on local refurbishment processes of blocks of flats where energy efficiency is on the agenda in order to put energy-efficient housing into practice.

This paper presents early results of a study of a refurbishment and renewal process where energy efficiency measures are implemented on a local level. The paper examines the case of planning and constructing energy-efficient buildings in a local process of housing refurbishment. What are the local practices for overcoming problems and reaching refurbishments for energy-efficient post-war buildings in this case, and what have been the success factors so far? The paper is based on work in progress in studies of the urban district Östra Sättra in Gävle, Sweden, where a process for energy efficiency refurbishments is taking place. Östra Sättra was built in the 1960s and is a part of the larger urban district, Sättra, on the outskirts of Gävle. More than 600 flats in Östra Sättra in 20 buildings are planned to go through large-scale refurbishments where energy efficiency will also be implemented. The blocks of flats will roughly halve their energy use, and the buildings will be more energy-efficient than the requirements of the national building code (The Swedish national board of housing, 2011). The project is not supported either by national initiatives for creating demonstration projects nor has it received any financial subsidies for investment.

### Background

This paper describes a planning and implementation process that develops new configurations for energy-efficient post-war buildings through housing refurbishments. Swedish housing stock fits well into a European context with a large amount of post-war housing. Some 870,000 dwellings, or 37 per cent of all existing dwellings in Sweden, were built between the years 1961 and 1975 (SABO, 2009). This was enabled by a government housing policy that provided beneficial credits and loans for construction of housing, framed by a clear social objective to provide housing for all people, regardless of income (Lindén & Femenias, 2010; SABO, 2009; Viden & Botta, 2003).

About half of all post-war dwellings are owned by municipal housing companies (SABO, 2009), often founded in the post-war era and regarded as important instruments for social, economic and geographic structural change (Lindén & Femenias, 2010). Municipally owned housing companies in Sweden cannot be compared to social housing in a European context. Instead of providing housing only for low-income households, municipally owned housing companies in Sweden provide housing for all social groups, regardless of income. The housing companies have a somewhat double role, responding both to demands for being profit-oriented and to making a social commitment in the municipality to provide housing for all at a reasonable price (Borelius & Wennerström, 2009). This role makes these companies similar to housing associations in a European context (Priemus, 2006). A strong market-oriented approach in housing, with little government involvement in housing policies, has given more freedom and control to municipalities in setting local housing policies (Lindén & Femenias, 2010). However, municipal politicians seldom steer the direction of municipally owned companies even if they can (Palm, 2004). There are no extra government rules or regulations on energy efficiency for housing owned by municipal housing companies compared to privately owned housing, as compared to, for example, social housing in France (Villot, Gondran, & Laforest, 2011).

Post-war multi-storey dwellings in Sweden are in need of major refurbishments and are often judged as low-standard buildings with insufficient technology and poor energy performance according to modern standards (Lindén & Femenias, 2010; SABO, 2009). According to building regulations, new buildings should use a maximum of 90 kWh/m²/year for heating, hot water and use of electricity for collective purposes. Blocks of flats from 1960–1970, however, use in average about 140–150 kWh/m²/year (Swedish Energy Agency, 2012). Transforming and refurbishing post-war housing to reduce energy consumption is an important target according to national energy efficiency regulations (Governmental Bill, 2008/09:163). In theory, technologies make that goal possible (Berggren, Janson, & Sundqvist, 2008), and there are examples of low-energy refurbishments of post-war buildings (Jansson, 2008). Policy instruments offering government grants have been directed towards post-war buildings where sustainability and energy efficiency have been important targets. However, policy targets for energy efficiency in buildings often fail to become effective instruments (McCormick & Neij, 2009).

The rate of renovation that would greatly improve energy performance for post-war buildings is also slow (SABO, 2009).
The problems of translating policy instruments and implementing energy efficiency in the building industry have been explained by the existence of barriers to innovation and implementation (Ryghaug & Sørensen, 2009). The building sector is to some extent accused of not being willing to change current practices towards better energy efficiency or to test new technologies. The building sector instead implements experienced technologies already well-known and well-used by construction companies and developers. (Borgbrant, 2003; Landin & Lind, 2011) Studies have concluded that it is often politicians and authorities that set low energy goals for building projects without involvement by the construction companies. That may result in the construction companies not following set energy goals later on in the construction process (Green, 2006). A low-energy construction project is also unique in the sense that the ideas, innovations and knowledge created during the project are tied to that project and to the people working with it. Similar ideas do not have to be successful in other construction projects with other people involved and in another time and space (Glad, 2006). A culture with a conservative building industry unwilling to take responsibility has been one side of the coin, but public authorities could also play a more active role being a role model for builders, emphasizing energy efficiency, and providing initiatives that could contribute to the diffusion of knowledge about energy efficiency in the building industry (Ryghaug & Sørensen, 2009).

Building refurbishments are a special case for low-energy construction, considering that tenants already live in the buildings – which makes it important to take them into consideration in the refurbishment process. The most successful refurbishment projects for post-war buildings from a social point of view are also those that involve the tenants in becoming active project participants (Viden & Botta, 2003). Tenants and tenant behaviour are also important factors in designing and using low-energy buildings to achieve a reduction in total energy use in buildings (Glad, 2012; Isaksson, 2009). Combining energy efficiency and issues of sustainability in refurbishments with societal demands and tenant participation has previously been difficult (Lindén & Femenias, 2010); for example, government-led local investment programs in the 1990s and early 2000s gave financial support to refurbishments of multi-storey dwellings with the goal of linking energy efficiency, environmental sustainability and social sustainability (Stenberg, Thuander, & Femenias, 2009). Some of the projects receiving investment support were partially successful in achieving energy efficiency and used fewer resources when evaluated (Glad, 2011; Stenberg et al., 2009). However, linking environmental and social aspects was difficult, and the projects often lacked processes of organizational learning that could have acted to diffuse experiences and knowledge (Stenberg et al., 2009). Many projects also failed in communication and in citizen participation (Baker & Eckerberg, 2007).

**Methodology**

To study the issue of energy efficiency in buildings and, in this case, to create input for a deeper understanding of a local planning and implementation process for low-energy refurbishments of post-war housing, a complex socio-technical system perspective is needed. This perspective includes social and technical elements of constructing low-energy buildings that cannot be separated but are dependent on each other and are studied together (Rohracher, 2001). A socio-technical system includes different actors and their actions, market structures and models, innovation systems, supplier–user chains, institutions of governance, engineering practices, and so on (Ryghaug & Sørensen, 2009).

This paper examines the transformation of the urban district of Östra Sättra. Östra Sättra in the city of Gävle, Sweden, is a typical post-war urban district in a middle-sized town (by Swedish measures) with about 70,000 inhabitants. The buildings in Östra Sättra are owned by the Gävle municipality housing company Gavlegårdarna (“the housing company” or “the company” in this account), which is the largest provider of rented flats in the city (15,500 flats). The study centres on the planning process and the refurbishment process towards energy efficiency buildings in Östra Sättra, making case study analysis a useful approach (Yin, 2008). The technical change of the buildings in the urban district is studied from the perspectives of the individual actors, users and organizations associated with the process of refurbishment. These are all stakeholders in the process, and their practices are important in order for new systems to be implemented and used (Glad, 2011).

The case is based on an empirical study in progress, consisting of various data collection methods including interviews and observations. Observations were made of process meetings in the refurbishment project. Interviews were conducted with employees in the housing company, municipal officials and politicians, the adult liberal education association, the tenants’ association and residents. Interviews included questions about the background of the refurbishment project, the process so far, the energy efficiency work and individuals’ experiences during the refurbishment. The aim of the interviews was to explore the planning and implementation process of the refurbishment on the basis of the actors’ experiences and practices in the process. Employees with various titles and positions were interviewed in the housing company and municipal organization to elicit a range of different reflections and experiences of the process. Of the 20 interviews were conducted, all were face-to-face and followed a semi-structured guideline; they lasted between 40 and 90 minutes and were transcribed and analyzed to sort out practices and sequences that affected, enabled or impeded the refurbishment process. The ongoing nature of the project reported in this paper makes it impossible to entirely predict the full outcome of the future process or to present results and energy statistics of the eventual outcomes of the refurbishments.

**Perspectives on implementing energy efficiency in buildings**

Energy systems can be conceived as socio-technical systems embedded in a social context with a focus on societal actors such as constructors, policy makers and building users (Rohracher, 2001). A socio-technical system consists of a socio-technical regime with institutions and rules providing stability that can create path dependency and lock-ins for existing systems and practices (Bulkeley, Broto, & Maassen, 2011). According to the theoretical framework of this multi-level perspective, it is possible to alter existing socio-technical regimes if they are destabilized and open to nonstop disturbance. That is de-
dendent on movements in regimes and from pressure at the macro level such as political destabilization and questioning of existing regimes and shocks (for example, shortage of the oil supply) that might change the existing landscape (Geels, 2002; Geels & Schot, 2007; Rotmans, Kemp, & van Asselt, 2001). Socio-technical regimes can be altered by new or alternative technical configurations created in niches. Niches are spaces protected by key actors functioning as shelters where innovations can emerge. In niches there is room for experimentation and learning about new ideas and alternative configurations. The configurations can eventually have the potential to compete and possibly replace established technologies and current systems in existing regimes (Markard, Raven, & Truffer, 2012). A socio-technical system view is useful in understanding the complexity in scale of energy transitions and the stability within socio-technical regimes (Bulkeley, Broto, & Maassen, 2011).

Theories reflecting on socio-technical change often highlight transnational or national transitions, but a common critique is that they do not give enough attention to where the transition is taking place (Coenen, Benneworth, & Truffer, 2012; Spåth & Rohracher, 2012). There is a growing literature about spatial dimensions and the notion that neighbouring cities and regions may have different roles in changing and transforming socio-technical systems (Bulkeley, Broto, Hudson, & Hodson, 2011; Spåth & Rohracher, 2012). It raises questions about where a transition is taking place (Hodson & Marvin, 2010) and where niches can be found on a geographical scale (Bulkeley, Broto, Hudson, et al., 2011). All of which makes it important to emphasize local attempts at change and to give further attention to the issue of where a transition is taking place.

It has been claimed that transitions can be managed and that governments can steer and influence ongoing transitions to get them to be more sustainable (Rotmans et al., 2001). However, this has been questioned as to its somewhat normative and simplistic implications, neglecting the complexity of politics and power involved in a process of transition (Meadowcroft, 2009; Shove & Walker, 2007).

A complementary approach that emphasizes, not the possibilities of managing niches, but rather the spatiality of transitions and the collective learning from socio-technical experiments is the bounded socio-technical experiment (BSTE) (Brown & Vergragt, 2008; Castán Broto, 2012). A BSTE is a project attempting to introduce new technology bounded in space and time. It is a collective quest driven by a coalition of diverse actors and by visions for solving societal problems. It is not about solving a specific problem but rather achieving higher-order learning through experiments and the experience gained from the experiments. As a result of the experimentation, good and bad experience can constitute a source of knowledge and an opportunity for social learning (Brown, Vergragt, Green, & Berchicci, 2003; Castán Broto, 2012). Higher-order learning can be found in two types: (1) interaction and learning among the participants in the experiment and (2) learning in the diffusion of ideas from the experiment. BSTEs are important components in implementing a transition for energy efficiency and can create new configurations for technology or service which might be starting points for further innovation. BSTEs can also develop new social arrangements, and the experiments are characterized by openness to unexpected developments and new ideas that change the problem definition and ways to work in the experiment (Brown et al., 2003). BSTEs, however, are slow in pace and take time, which demands flexibility and a high tolerance for uncertainty from the participants, but the sense of urgency in the project when it is essential to solve a problem or find a solution can be an effective driver for learning. It forces the participants to take risks and keep on trying to solve the problem (Brown et al., 2003; Brown & Vergragt, 2008).

The BSTE concept is used for understanding the planning and implementation of the refurbishment process of buildings in Östra Sättra. This paper focuses on understanding the emergence of energy efficiency refurbishments in the Swedish context: a national pressure to transform post-war buildings into low-energy buildings, a construction sector slow to adapt to energy efficient housing, a re-regulated housing market and a situation for municipal housing companies. In the empirical analysis, the paper concentrates on experimentation in the planning and implementation of configurations for low-energy refurbishments in the local context where experimentation and creating new configurations, developing new social arrangements and learning processes are crucial. The next section uses this focus in presenting the planning and implementation of the refurbishment process in Östra Sättra.

### The process of configuring low energy refurbishment through BSTEs

The following sections describe the process for planning and implementing energy efficiency. We start with a brief history of how conditions for the refurbishment were created, and then describe the initial phases and emerging problems and how they have been solved up to now in the process. The project has so far been quite successful in bridging gaps between plans and ideas for energy efficiency and the implementation phase which will be further explored in the next sections.

#### Creating Factors for Learning Important Points of Departure

The refurbishment process in Östra Sättra was planned to be a new way to work with energy efficiency in building refurbishment for a housing company that had not particularly worked with energy issues in housing refurbishments before. The refurbishment of Östra Sättra, however, was preceded by that of another urban district (Öster) with buildings owned by the same company and which provided a useful learning experience for the project in Östra Sättra.

The Öster project in the early and mid-2000s was the largest refurbishment project for the company before Östra Sättra. Öster was in need of not only physical refurbishment but also social regeneration to create a friendlier urban district, and to get rid of its bad reputation and lower the crime rate. To solve the societal problems, a new model for refurbishment and renewal of urban districts was developed and implemented through a process of experimentation. The project was driven by the idea of working with end-user participation, that is, involving tenants in the building refurbishment and raising their level of concern regarding the care of their flats. The ideas for widening the scope of refurbishment and not just working with technical components were mainly initiated by municipal planning authorities; these authorities were already working with projects aiming at strengthening the civil society and lowering social exclusion in other urban districts within municipal operations. The concept...
was that planning for the refurbishment should involve tenants’ perspectives and their wishes of what they wanted for their housing and surrounding environment. The intent was not to proceed in the usual way, where the work would be based on already defined refurbishment plans – redefined maintenance plans or visions of what should be done and how to do it.

In the beginning, the housing company was not open to changing their ideas of how to work with maintenance and refurbishments of their buildings, but a major reorganization within the company created a window of opportunity for collaboration with municipal policy makers in the project. A close cooperation developed between the company and the municipal strategic planning department and with other parts of the municipal administration and local interest organizations in the city. Municipal politicians were also tied to the project from the perspective that it was important to have them closely involved so as to be able to take quick decisions and find shorter paths between stages of decision and implementation. The aim of the refurbishments was not only to listen to the tenants, but also to create a continuing dialogue during the whole process of refurbishment, which has been acknowledged as a success in this respect (Oresjö, Blomé, & Pettersson, 2011).

The new way of working met internal resistance in the company in that it threatened existing regimes for building refurbishments. The project had a slow start, but that gave time for creating the dialogue with tenants and finding ways to communicate and organize the handling of these large housing refurbishments. This tested the tolerance for uncertainty in the company as it was not able to fully plan the direction of the project in advance but had to redirect it during the process to align with the wishes and involvement of the tenants.

When the company started to plan the refurbishments in Östra Sätra, those in the planning process still had in mind started with the good experiences from the experimentation in Öster. Even if the Öster refurbishments had not encompassed energy issues that were planned for Östra Sätra, Öster had created an experience and constituted a place for social learning for involved company employees in how to work with refurbishments in general, which would be of value when the Östra Sätra process was initiated.

**DESTABILIZATION OF THE EXISTING REGIME OPENS THE WINDOW FOR NEW SOLUTIONS**

The buildings in Östra Sätra were in urgent need of refurbishment. According to both district caretakers and building tenants, they had for several years been in need of both inside and outside refurbishment due to deterioration and technical failures as well as tarnished facades. Positive experiences of the company from Öster project had created a momentum for the importance of working with end-user participation in the Östra Sätra refurbishments. The starting point was to continue the work begun in Öster into the new project and refurbish the Östra Sätra buildings according to the needs of existing tenants. A low demand for housing in the city did not allow high rent increases to accompany the refurbishments; the planning of the Östra Sätra process started with this in mind.

The initial planning process for Östra Sätra overlapped with increasing discussions related to energy efficiency. A growing internal debate in the housing company about energy issues was accompanied by a larger public debate about energy efficiency in buildings. The company, for example, participated in a government project in sustainable refurbishment of post-war buildings, and this created a window of opportunity to consider energy efficiency issues in the Östra Sätra refurbishments as a vision for solving societal problems associated with unsustainable post-war housing.

The planning of the refurbishments was driven by a coalition of actors who were able to push for energy efficiency in the process. The head of the technical department at the housing company was identified as being dedicated to energy issues and committed to promoting energy efficiency measures and new solutions for renewable energy technologies. He was one who in the initial stages promoted energy issues in the company and pushed for committing the company to set high overarching energy goals; these were set higher than the national building regulations for all their buildings and construction projects in order to work with energy efficiency across the business.

The head of the technical department also had close connections to the local energy company, and there was an ongoing collaboration on new solutions for making the district heating already used in Östra Sätra more energy-efficient. Critical steps for energy efficiency to become an issue of importance were taken by the company’s technical department and the municipality’s strategic planning department which together created a vision of energy efficiency linked to the Östra Sätra refurbishments. Together, the two departments created an orientation document with proposals for making Östra Sätra a low-energy urban district. The head of the municipal strategic planning department said that proposing high energy goals for Östra Sätra was a strategy in their persuasion process to “test how far the municipal politicians and the management at the housing company were ready to go”, and they were ready to back off a bit in order to reach desired energy efficiency goals. The concept of putting energy efficiency on the agenda for Östra Sätra was received positively by the housing company board and highlighted discussions about how far the Östra Sätra project could go in terms of energy efficiency.

Different options for improved energy efficiency were investigated through several processes of calculations and evaluations of various energy solutions, including renewable energy technologies such as solar power, in order to engage the direction of the company and municipal politicians. Gävle University was consulted for different types of energy solutions, and consultants were hired to make comprehensive calculations about expected results on the energy balances in the buildings. Eventually, the company committed to overarching energy efficiency goals set at 80 kWh/m² for refurbishments (later adjusted to meet new building regulations). In the plan to reach an energy goal that would result in approximately halving the energy use in Östra Sätra, no impairment of the indoor comfort and temperature in the buildings would be allowed.

**INITIATING THE PROCESS AND LEARNING CONTINUED IN THE COALITION**

The initial planning process started in 2007–2008 and lasted a couple of years, broadly following developed procedures for building refurbishments. Because of resources and capacity, the building refurbishments started with three buildings with a total of 75 dwellings. A steering group was created with representative board members and project managers from the housing company and officials and politicians from the municipi-
pality. The financial plan for the refurbishments, also used in Öster, was to finance them from accumulated resources in the company, reserved for building refurbishment, and from the rental incomes from their entire housing stock. The company also had accumulated capital from selling parts of their large housing stock in the 2000s.

The work of tenant involvement in the Östra Sättra project started with meetings where all tenants were invited to start a dialogue with the housing company, to participate in the project and to relate what they wanted to be fixed and refurbished in their housing. These dialogues were not about energy saving issues but rather about the standard of the dwellings and buildings; about what tenants appreciated in their dwellings and what they wanted to be changed in the refurbishment. To create a general dialogue with the tenants was considered important by the company project manager in order to refurbish the buildings according to the tenants’ needs:

The tenants are experts in living in their dwellings. And we are good at taking care of the buildings. If you put these experiences together, you will get a good concept. (Company project manager)

Even if the refurbishment plans were to be based on tenants’ wishes, the company already had plans for what they wanted to be fixed within the project. The wish list from the tenants largely conformed to the refurbishment plan from the company. However, the tenants did not talk about energy issues during the meetings, and the company did not ask about what the tenants thought about the importance of energy efficiency in buildings. The plans for working especially with energy efficiency in the refurbishments were not, to any large extent, presented to the tenants. The tenants were not expected to be actively involved in a user-developed process for developing energy-saving solutions in the buildings which otherwise might have had a positive effect on the use of energy technologies (Ornetzeder & Rohracher, 2006). The company’s belief was that tenants do not think about energy issues and do not ask for energy efficiency measures.

The work for end-user involvement was driven by the housing company; a project leader initiated a new social arrangement with a local group open to all tenants, schools and day cares, special interest and social activity organizations in the district. The group had monthly meetings trying to tie tenants, municipally led organizations and interest organizations into the process of renewal, encouraging and supporting them to create small social projects and events in the district for tenants in order to increase the social quality of the district. A small community centre was also established in Östra Sättra as a meeting place for the local groups; it functioned as a place for learning and where tenants and project staff could share experiences. The centre also included a small café operated by co-workers from an adult liberal education organization, and it was financed by the housing company together with local union of tenants and the adult liberal education organization.

**URGENCY AND STRONG VISION FOR SOLVING SOCIETAL PROBLEMS SUPPORT PROJECT SURVIVAL**

In the final stages of the planning phase when the projection for the first buildings was done, a government investigation into new regulations for municipally owned housing companies was presented; this altered the financial conditions for building refurbishments in Östra Sättra. The original plan for how to finance the refurbishments was rejected by the company, which considered that the original calculations no longer completely corresponded to the new regulations (SFS, 2010:879). The meaning of the new regulations and how to interpret them was generally seen by the company as very vague. The interpretation of the new regulations by the company so altered the financial calculations that it led to the conclusion that the refurbishments should only be financed by accumulated resources for the maintenance of these buildings and of rental incomes from specific buildings and not, as before, from the company’s entire housing stock. The company assumed, based on existing financial calculations, that it was impossible to implement all the planned energy efficiency measures such as solar heating, to heavily refurbish the buildings according to their plans, and to fulfil the tenants’ wishes, and at the same time meet the new regulations for municipally-owned housing companies.

The company had to stop the refurbishment planning process and face the new challenges. The project itself could have been stopped at this point in this process.

However, the new regulations started an internal discussion in the company as to whether they could work with extensive energy efficiency refurbishments in Östra Sättra at all. The buildings were in urgent need of refurbishment – an effective driver for solving problems with the project. The company had good experiences of experimentation in refurbishment processes and had committed itself to working with energy efficiency in the energy goals for refurbishments. It showed a high level of tolerance for uncertainty as to how to work with the refurbishments and started to renegotiate the original plans. The project had to take several steps back to re-evaluate the refurbishment planning process to find new solutions to get out of the impasse and actually refurbish the buildings and implement energy efficiency in the process.

The company’s technical department had to start over in planning the low energy refurbishments. Planned solutions for making the buildings energy efficient with extra insulation, new energy-efficient windows, a heat-exchanging ventilation system, solar heating, new laundry rooms, and new and bigger balconies requested by tenants, were again evaluated and calculated in order to evaluate the measures and see if they were financially viable without doubling the rents. The company’s technical department worked out alternative strategies for calculating financial costs for refurbishment measures in cooperation with the financial unit. By changing the refurbishments, the company was able to confirm that they were not disobeying the new regulations, while still following their energy efficiency goals. However, some interior refurbishments, such as changes to kitchens and stairwells were removed from the plans as not being financially viable.

This whole process of addressing the new regulations took almost two years and postponed the refurbishment process. This delay created some annoyance among employees committed to the project and among the building caretakers. The company, nevertheless, was persistent in continuing the work with user participation, which was considered a cornerstone of the process. During the re-evaluation of the refurbishment projects, the social projects could continue as they required very little financial support from the company. However, it was
difficult to keep motivating tenants to stay involved as there was nothing happening in Östra Sättra that they could actually see. Accordingly, a couple of projects involving changes to parts of the outdoor environment were put into practice to demonstrate that the project was still running. The project, however, lost many participating tenants and has not been able to get them involved again in the project.

Gradually, as the planning process for Östra Sättra proceeded, wider sustainability issues than energy efficiency were discussed to gather diverse actors in a somewhat shared vision for solving different problems in the Östra Sättra neighbourhood. The housing company acknowledged that it was vital to mobilize more local actors to be involved so as to gather other competences and abilities that the company did not possess for performing an extensive refurbishment of Östra Sättra. The tenants, for example, had wanted a renewal of the outdoor environment in the neighbourhood, and it was realized that the company could not perform or finance this kind of work. Most of the outdoor environment was owned by the municipality, not by the company. To extend the scope of the project and work further with sustainability issues was a way to align more local actors, for example, with the local waste recycling company and the municipal park administration. The housing company tried to create a common understanding of the importance of the direction towards energy efficiency and sustainability in Östra Sättra and invited heads of different municipal departments to take part in presentations of the refurbishments and to collaborate further.

The project plans also met opposition from a national and municipal process that transformed the urban district of Östra Sättra to a protected area and a national heritage site of interest. Östra Sättra is considered to have architectural qualities important to protect and was appointed a site of national interest for heritage protection with the result that only very small changes to buildings could be accepted. Planned measures with new façade colours were not allowed by the municipal building permissions unit as they would change the exterior of the buildings. It is quite common for older buildings in some European countries to be protected from changes that may prohibit energy measures like exterior insulation (Villot et al., 2011). The protection of post-war buildings, however, is not that common as they are not considered old enough. The nomination of national cultural heritage interest further postponed the building refurbishments but through close, in-depth discussions between the housing company and the municipal antiquarian at the building permissions unit, a halfway compromise solution was reached: the buildings could be redesigned to meet the cultural heritage rules for the buildings and still be energy-efficient according to the existing plan. The company also turned the cultural heritage nomination into a resource by using it to market and signpost Östra Sättra as highlighting the district’s historical and cultural heritage and values and the importance of conserving the district.

When the refurbishment project reached the implementation stage, problems emerged in the procurement process; this further postponed the project, but the company once again prevailed by identifying ways to do the implementation. The procurement specified energy efficiency conditions that several tenderers could meet technically, but at a much higher price than expected by the company. That price may have been affected by the performance requirements set out in the procurement for energy-efficient buildings. The proposals suggested for the refurbishments broadly exceeded calculated costs, which the company could not cover with their new method of financial cost calculation. At this point, the technical department went back to their desks and made new considerations and calculations. Internal negotiations resulted in a decrease in magnitude of the energy efficiency measures and the removal of the solar panels from the project as not being considered profitable enough on a business scale. Most energy efficiency solutions, however, were kept in the project even though all single measures could not be counted as entirely profitable. In a new procurement, the refurbishment was divided into inside and outside refurbishment, which was supposed to lower the costs. The new procurement attempt was successful and the building refurbishment finally started in 2012.

Conclusions
This paper describes the experience of a local refurbishment process where, after overcoming many problems, energy efficiency has been implemented in the project and may be on its way to succeed in bridging the gap between visions and the implementation of energy efficiency in refurbishments of post-war buildings. The Östra Sättra project is a local example contributing to the understanding of low-energy refurbishment processes in such buildings. The housing company seized the opportunity for energy efficiency when technical refurbishments in the buildings had to be done; it made necessary decisions and set up goals for energy efficiency in the refurbishment project which were important for the continuing process. The creation of an internal learning process in an experimentation project for implementing post-war low-energy buildings in refurbishments constituted an important factor for reaching the implementation stage of energy efficiency. In the context of a growing importance of energy efficiency but with a slow building sector not meeting the demands for low-energy buildings, the Östra Sättra project succeeded in creating an environment of experimentation that emphasized learning. The project had the time to figure out how to design and plan a refurbishment project in order to implement energy efficiency despite many hindrances that could have ended the project. An urgent need to refurbish the buildings also proved to be an effective driver for action.

Local experimentation and collaboration can result in new forms of political organization and new local initiatives and designs (Bulkeley, Broto, & Maassen, 2011). A bounded socio-technical experiment is a project that attempts to introduce new technology in a certain place and time by visions of solving societal problems and gaining experiences from experiments (Brown et al., 2003; Castán Broto, 2012). Changes in problem definitions for BSTEs occur (Brown & Vergragt, 2008). In this case, the project participants at first got together and defined energy efficiency as a problem providing a focus for the refurbishment project and shared an understanding that energy efficiency was important. The problem definition was later renegotiated in order to involve larger issues of sustainability.

The importance of gathering actors through collective visions for the importance to solve societal problems, which was acknowledged in the Östra Sättra neighbourhood as social and
environmental sustainability, is also emphasized as an important part for BSTEs to be counted as successful. The problems do not have to be the same for all actors (Brown et al., 2003). In this case, the municipal organization was tied to the project with different approaches and visions, including the opportunity to reduce societal problems or the opportunity to work with the gardens in the area. Including wider issues of sustainability and not only energy efficiency raised the possibility of committing more actors with different interests, thus widening the coalition for the process, further increasing the capacity to act and possibly diminishing the risk of narrow groupings steering by self-interest (Hodson & Marvin, 2010). A few enthusiasts from the company and the municipal planning department succeeded in capturing the opportunity to intervene in the development of the refurbishment process and mobilized the company to get energy efficiency on the refurbishment agenda. Municipal policy makers can also play an important role in construction of low energy housing (Quitzau et al., 2012).

The importance of handling uncertainty and being prepared for disorders is essential in big low-energy refurbishment projects to be able to meet continuing challenges and readjust the project according to surrounding influences. Working with end-user participation has been difficult in refurbishment projects and was also somewhat disturbed in Östra Sättra. The project was on its way to test a new form of low-energy refurbishments with tenants involved in the process before it was really ready for the open market, but it partly failed in that respect when the new regulations constrained the project's ability to experiment and lost the engagement of the tenants' perspective. The capacity to spend time capturing experiences and learning processes was important in this case for the professional participants; it created forms of higher order learning. This meant processes of learning about how to handle refurbishment processes such as changing the energy system of the building. The end-user participation, however, suffered from the long time span of the project, and the housing company only partly managed to keep tenants involved in the process. The diffusion of refurbishment ideas to the tenants was not completely achieved at their level of engagement in the process. This loss of end-user participants in the process might affect the outcome of the process from the tenant perspective and is an important issue to continue to study in the process. It is also important to evaluate whether the process is able to retain established practices for building refurbishments in the neighbourhood and can develop a concept for energy-efficient refurbishments of post-war buildings.

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