PATHWAYS FOR SUSTAINABLE HOUSING TRANSFORMATIONS: AN INTERNATIONAL COMPARISON OF RETROFITTING STRATEGIES FOR (SOCIAL) HOUSING

Paula Femenías, Ph.D[1]
Anke van Hal Prof.[2]


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[1] Department of Real Estate and Housing, Faculty of Architecture, Delft University of Technology, The Netherlands/Department of Architecture, Chalmers University of Technology, Sweden femenias@chalmers.se
[2] Department of Real Estate and Housing, Faculty of Architecture, Delft University of Technology, Delft, The Netherlands/Chair of Sustainable Building and Development, Center for Sustainability, Nyenrode Business University, the Netherlands J.D.M.vanHal @tudelft.nl

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Abstract

The importance to address Europe's large stock of aging, deteriorating and highly energy inefficient housing stock in order to reach goals for climate change and sustainable development is today widely accepted. This recently initiated research project will review cases of sustainable housing transformations in existing post-war housing stocks in Europe and other developed countries (i.e. USA, Canada, etc.) in which both environmental and social issues are addressed with an emphasis on affordable living. The focus is on process issues and on prime movers among housing associations and their role as construction clients in driving self-sustaining innovation processes to reach more sustainable housing transformations: how they support and drive innovation, learning and implementation in relation to this issue, and if their strategies are replicable for a larger selection of housing owners in an international perspective.

This paper presents preliminary findings based on two case studies of prime movers among housing associations, one in the Netherlands and one in Sweden, that have carried out sustainable housing transformations. Based on literature on environmental innovation in construction and on a model to change individual behaviour in planning interventions by Green and Kreuter (1999) we have developed a framework for analysis of housing associations' behaviour. This tentative framework singles out: predisposing, enabling, reinforcing, responsive and inhibiting factors as well as factors that will support the transferability and replicability of results. The findings will be used for the further development of the framework to be used in the continued research in which more cases in Europe and internationally will be studied and analysed.

1. Introduction

This project has it starting point in the need to address existing housing stocks in Europe in order to deal with sustainable development of the built environment. The scope is housing built between 1950 and 1990, and a system limit to the neighbourhood scale, owned and managed by housing associations with and emphasis on dealing with environmental and social issues in sustainable housing transformations.

We rely on a large body of existing research that underlines the relationship between social and physical aspects in housing transformations, as well as the need to take into account residents' opinions and population dynamics (e.g. Ouwehand, 2006). Social factors have large importance for the sustainability of housing areas (e.g. Brown and Bhatti, 2003; Ouwehand, 2006). Several studies point to the synergetic effects that can be reached when a social renewal process is linked to retrofitting strategies for increased energy efficiency and other environmental issues (e.g. Stenberg *et al*, forthcoming). Sustainable transformations of the large stocks of post-war housing are frequently brought up in political statements as a strategy to solve at the same time urgent environmental issues and socio-economic issues on a broader societal level (e.g. Lundqvist, 2004; The Swedish Green Polictical Party, 2008)

1.1 Housing associations: important actors in sustainable housing transformations

In the Netherlands almost 70% of the existing housing stock needs envelope upgrading to reach national goals for climate change (Hal van 2008a). Recent retrofitting projects of existing housing around Europe show the possibilities to reach considerable reductions of energy use through envelope upgrading and changes of heating system etc. There are large needs for physical upgrading of these stocks caused

amongst others by neglected maintenance (BQR, 2008). With a retrofitting cycle of 30 – 40 years we now face *the occasion* to deal with energy efficiency in large part of the post-war stock of housing not to be missed. Swedish authorities claim that the pace for retrofitting of existing housing has to increase from 20.000 – 25.000 apartments per year to 65.000 in order to address energy efficiency and climate goals as well as to counteract depletion of assets (The Swedish Green Political Party, 2008).

From a Dutch perspective, the retrofitting of post-war urban districts is directly connected to the role of housing associations. Dutch housing association owns and manages 37% of all social housing in the country and regarding early post-war urban districts, Dutch housing associations have a share of over 50% and sometimes nearly 100% of the market (Priemus, 2006). The ownership of housing is similar in Sweden where 50% of all housing built between 1965 and 1971 are owned by Municipal Housing Companies. Municipal Housing companies together owns 20 percent of the total housing stock in Sweden and about one third of all Swedish dwelling units in multi-storey houses (www.sabo.se). Most Swedish Municipal Housing Companies are owned by municipalities. They combine commercial aims with social responsibility for and reinvest the profit they make in the company to keep it consolidated. The similarities between The Netherlands and Sweden which both have large social housing sectors and where housing associations are strong and influential actors provide a good basis for comparisons between the countries (e.g. SABO, 2008).

1.2 Aim and approach

The complex issues of relating the built environment and sustainable development calls for a holistic and broad research approach. The research has a qualitative approach and the discussions in this paper are based on two qualitative empirical case studies of prime movers among housing associations, one from the Netherlands and one from Sweden. These two organisations have been awarded for their work with sustainable housing transformations focusing on environmental and social issues. Data for the case studies have been collected through documentation, reports, interviews with key actors and visits on the spot.

The approach to retrofitting used in both case studies can be referred to as 'pimping' that can described as a external upgrading where the residents live in during a relatively short retrofitting project (Hal van, 2008a). The advantage of the 'pimping' approach in relation to a 'stripping' approach, a more radical retrofitting which involves the total or partial stripping of the structure and the need for residents to move out during the process, are lower costs and fewer nuisances for the existing residents.

This project focuses on process issues of sustainable housing transformations i.e. how these transformation processes are initiated, motivated, implemented and diffused. Housing associations have a decisive role in implementing sustainable housing transformations and energy efficient retrofitting. However, this must still be regarded as innovations for most housing owners. The term innovation is here used as 'an idea, practice, or object that is perceived as new by an individual or another unit of adoption' (Rogers, 1995). This means that the innovation can be new for the adopting organisation but not necessarily new for everybody. The innovation can also be a package of technological solutions and refer to process and management issues.

Our focus is self-sustaining processes for innovation as a means to find strategies applicable by a broad range of clients in different contexts and without the need for large governmental support programmes to initiate and sustain change. More specifically we will study the role of the housing association as construction client driving innovation processes aiming at more sustainable housing transformations in which both environmental and social ambitions are dealt with. The overhanging research question is: how self-supporting and replicable are the strategies used by prime movers among housing associations? We do not single out costs, naturally a strong enabling or inhibiting factor for action, as the main issue. Instead we focus on understanding the relation between different kinds of factors that will enable and support actions taken by housing associations and relating to knowledge and learning. Specific research questions are:

1) Why and in which situations do housing associations engage in innovative projects for sustainable housing transformations and under what circumstances?
2) How do the housing associations identify and define innovative sustainable housing transformation projects, how are the information, knowledge integration and innovation managed?
3) How can we define the role of the housing association in relation to other actors in the project organisation and as well as to contextual limits?
4) What is the relation between the innovation project and the permanent organisations? How is knowledge integrated and implemented in the permanent organisations of the housing association?

This paper develops a tentative framework to understand housing associations behaviour. We have used earlier findings in the field of environmental innovation and diffusion and adapted models by Green and Kreuter (1999) and Egmiond *et. al.,* (2005), which determine factors for organisational behaviour. In the continued research this framework will be further developed and further cases will be added to the study in order to seek larger generality and applicability in an international perspective.

2. Theoretical assumptions: Innovation related to sustainable housing transformations

The building sector has often been described as conservative and reluctant to change. A study from the UK highlights that innovation occurring within construction is hidden from conventional measures and statistics (Barrett *et al*, 2008). This innovation takes place on a project level driven by consultants and other project actors in problem-solving situations. These processes are step-wise and incremental types of innovation processes and are not sufficient to maximise progressive innovation (ibid). In order to reach current radical goals to fight climate change and environmental depletion, there is a need to speed-up the innovation processes and diffusion processes of successful innovations in construction to attain higher goals.

2.1 Diffusion of environmental innovation in construction

Sustainable housing transformation concepts will only have value if they are adopted and used, preferably on a large scale. Studies in the field of diffusion of innovation conclude that many innovations are adopted only by the first-adopting segment of a target group, the so called prime movers or early market actors (Rogers, 1995). Innovations hardly reach the vast majority of the target group, the mainstream market or majority actors. The majority group is much more pragmatic than the prime movers that in turn are more vision-driven. A third segment of the target group is the laggards which will be the last to adopt an innovation and usually do not do so if not forced to. A recent study from the Netherlands shows that environmental innovation in construction is impeded by two chasms. A first chasm is found between the early market actors and the majority actors, and a second chasm between the majority actors and the laggards (Hal van, 2008b).

The diffusion of environmental innovation in new housing has been studied by van Hal (2000). van Hal emphasises four factors with determining influence for diffusion of environmental innovations: the quality of the innovation, the organisation of the demonstration project, the organisation of the information transfer of results, and the influence of governmental support. Regarding the organisation of the demonstration project van Hal found four factors to be important: first multi-disciplinary cooperation in the project organisation, second the involvement of an innovation champion, third the support of an influential person to attract interest and create confidence of results, and fourth the determining influence of external factors.

Research from a Swedish perspective regarding client driven innovation and diffusion of environmental innovations in construction point at additional factors with determining influence for innovation and diffusion (Femenías and Edén, 2009): a motivated client with skills to select consultants, contractors etc.; means to support co-operation in the project team (extra time etc.); and the benefits from long-term exchange with research institutions to develop skills and knowledge in the field of environmental innovation. The questions of reliability and transferability must be stressed in diffusion of environmental innovations and consequently both the application of the innovation in a real project must be studied as well as receiving context of adopters (e.g. Femenías, 2004). For a review of knowledge and learning aspects on information transfer and diffusion of concepts in demonstration projects, please see Hal van (2000) and Femenías (2004).

2.2 Focus on housing associations as drivers for change

Consequently, the focus on housing associations in this study relates both to their behavioural predisposing 'culture' in the permanent organisation and on their behavioural response to innovation in a project situation. The exchange between those involved in a temporary project organisation and the permanent organisations will be of importance for the internal learning and implementation of results but also for the external diffusion.

2.2.1 A 12-step model for sustainable housing transformations

The Swedish Council for Building Quality (BQR) has initiated a project to support municipal authorities and housing association in housing transformations with the special aim of combating social problems and create better living environments for residents. The result of a focus group in 2007 which involved experienced professionals from varied knowledge fields (architects, researchers, housing associations etc.) is a 12-step model to support sustainable housing transformations (Boverket, 2008) (see Table 2). The 12-step model is in this project used as a reference to understand holistic approaches in the two case studies.

Table 1: A Swedish 12-step model for sustainable housing transformations (Boverket, 2008)

1	**Owner motivation**	The importance of the owner's insights that transformation and renewal will take time and resources.
2	**Knowledge**	Transformation needs to have a solid base of knowledge on the history of the area and its residents. This knowledge needs to be shared with consultants, constructor and managers.
3	**Holistic perspective**	Should be the basis for the transformation connecting social renewal and physical retrofitting.
4	**New ways of thinking on management and organisation**	Transformation needs an active management and new working methods and engaged employees. The organisation should guarantee a close contact to customers.
5	**Renewal/retrofitting**	The existing environment should be renewed and neglect of maintenance needs to be taken care of
6	**Physical changes**	Should give surplus value to the housing association and to their residents
7	**Connect with the city**	Both physically and socially. Give all residents the same conditions and services.
8	**Identity what gives self-confidence**	Highlight values that give the area a special character. Let the residents feel proud over the transformed area. It is important that the area is re-valued better in the eyes of the surrounding world.
9	**Control of effect**	The residents should valuate and give marks that show the effect of the transformation. Measurements and valuations should be done on a yearly basis.
10	**Communication**	Information about plans and the actual transformation work should be spread generously through the whole process to create participation and to gain accord on goals among all stakeholders. Formulate a vision and make it known.
11	**Mobilisation and participation**	The active participation of residents is not self-evident. This process needs to be stimulated through active mobilisation, information meetings, home visits, common tours around the area etc. Without the residents participation there will be no real transformation.
12	**Economy**	The economical possibilities to realise long-term ambitions/transformations.

2.2.2 Developing a model for analysis of the behaviour of housing associations

Dutch housing associations and their behaviour related to energy conservation have been studied by Egmond *et. al.* (2005; 2006). Through a survey of 234 housing associations in the Netherlands Egmond *et. al.,* (2006) concluded that about 23% of the housing associations can be referred to as early market actors

and 77% as mainstream actors. In a strategy developed by Egmond *et. al.,* (2005) to encourage housing associations to invest in energy conservation, they used Green and Kreuter's (1999) model of behavioural change. Green and Kreuter (1999) describe three general categories of factors that make up the determinants that will affect behaviour and environment, each with a different influence on behaviour:

1) *Predisposing factors* are internal antecedents to behaviour adherent in the organisation. These will include socio-demographic factors such as size and wealth but also awareness, knowledge, norms, attitudes as well as the organisation's perception of its own capacity.
2) *Enabling factors* are external antecedents belong to the situation. They are conditions of the environment that facilitate the action: new skills, financial and technical resources e.g. expert advice and subsidies.
3) *Reinforcing factors* are consequences of an action which determinates the positive or negative feed-back. This includes status, recognition, financial rewards and reactions of costumers.

The model of Green and Kreuter (1999) has been adapted to be suit the purpose of our research. The model of Green and Kreuter has a policy intention and lacks of categories that describe how the organisation can respond and act in order to reach new goals. This we call responsive factors. The model of Green and Krueter also lack of attention to potential inhibiting factors. In addition, in our analysis we need to emphasize on factors that will have influence on the diffusion the innovation e.g. relating to costs and objective evaluation of results. We have added the following categories of factors:

4) *Responsive factors:* measures applied or developed by the organisation to reach their goals
5) *Inhibiting factors* that have been barriers for the organization to reach their goals
6) *Costs*
7) *Evaluations and diffusion of results*

4. Case studies

4.1 OFW, Flevoland, The Netherlands

Oost Flevoland Woondiensten, OFW, is a Housing Association in Flevoland, in the north part of the Netherlands that manages about 4.600 dwellings (for a summery of the cases, see table 2). OFW is driven by goals to deal with energy costs, implementation of national policy in the field of sustainability, and the compulsory use of Energy labelling. Their ambition is to reduce their use of natural gas in the existing housing stock by 20% by 2018. Their approach to deal with these ambitions is designed differently for each project 'taking into consideration unique qualities and living circumstances in each locality, focusing on living costs instead of renting costs' (www.owf.nl).

4.1.1 Retrofitting of 85 terraced dwellings in Biddinghuizen

Biddinghuizen was built in the beginning of the 1960s and consists of one-family raw houses and a few blocks of flats. Over the years the social balance of the area deteriorated. A few years ago the local schools reported to the local authorities about increasing social problems in the area. OFW started a renewal process with the ambition to create a more socially coherent living area with mixed and varied forms of dwellings and services to fit the needs of the residents. In the renewal process some housing blocks are demolished and replaced by new. The dwellings are partly owned and rented by OFW and partly privately owned. The private owners have been offered to take part in the retrofitting process of the buildings some have agreed others have declined.

The project is a 'pimping' project and residents live in their dwellings during the retrofitting of the façade that takes about three weeks. In addition to envelope upgrading and changes of installations for heating and ventilation the residents can choose to raise the standard of their dwelling with kitchen and bathroom retrofitting on their own expenses. The investments for the envelope upgrading do not affect the residents if they are tenants. Instead they will benefit from lowered running costs for energy.

OFW use three ambition levels to reach their energy goals: the first level is to reach energy efficiency, the second to minimise the use of fossil fuel, and the highest not to use any fossil fuel. These ambition levels have been translated into technical retrofit packages in four levels: The type of package one is to upgrade the envelope and windows, seal joints and install efficient individual gas boilers for heating and hot water. The type of package two adds extra insulation to the first levels package. The type of package three includes passive details for more energy efficiency: solar shading, zoning, etc. Finally the type of package four includes heat exchangers, solar collectors, PV cells and also water saving measures.

A social project with local job creation to construct garden fences has been related to the renewal process of Biddinghuizen has not reached expected results. It was found that unemployed residents in the area did not want to join in order to be exposed to the neighbours. '

4.2 Gårdstensbostäder, Göteborg, Sweden

The municipal Housing Association Gårdstensbostäder (GB) was established in 1997 with the task to regenerate and develop the district of Gårdsten in the north-eastern suburbs of Göteborg. GB is owned by Framtiden AB, which is the corporate body of housing companies owned by the municipal authority of Gothenburg. The company owns a total of 2,700 flats, which is 90% of the property in the area. There are today 7.500 inhabitants in Gårdsten, 83% are of non-Swedish origin.

4.2.1 The transformation process of Gårdsten

Gårdsten was built 1969 – 1972 as part of the Swedish political million homes programme to solve post-war housing problems. The dwellings in the area are mainly in multi-family housing. The area declined almost from the start and in 1996 Gårdsten was one of the most socially deteriorated living areas in Sweden characterised by health problems, unemployment and large vacancies.

GB sat up an action plan for the regeneration of Gårdsten with a holistic view of urban planning based on resident's participation and with the goal to get a mixed population, to attract and retain employment and to develop public and private services in the area. One of the first issues they dealt with was to persuade the governing bodies to set up a direct bus line to connect Gårdsten with the city centre, a main lacking service. Between 1998 and 2006, GB created more than 870 local employments and initiated training programmes. In their procurement of construction and maintenance work, GB gives priority to contractors that employ local workers thus show that it is possible to combine its role as construction client with social commitment.

The transformation of Gårdsten has stretched over a decade. In order to maintain the continuity of the enhancement of the social structure, it has been important to keep the vision alive. GB has focused on the continued direct dialogue with the residents, a process in which they have had to surmount language barriers. As part of this strategy a majority of GB's board members are tenants. In 2006, GB received the National Award for the Enhancement of the Social Structure in Gårdsten. The motivation says that Gårdsten has "developed from having been one of Sweden's most problem-filled suburbs to an attractive residential area with major social and environmental qualities".

4.2.2 The Solar Houses

As a way to boost the regeneration of Gårdsten, a demonstration project was initiated in 1998. The Solar Houses aimed at decreased energy use and the use of renewable energy in combination with social issues (e.g. resident's participation and meeting places i.e. green houses). The concept was designed by a local architect with experiences from earlier successful sustainable housing transformations and a researcher at Chalmers University of Technology. A European demonstration projects grant was already approved to the project when presented to GB. This became a strong enabler to initiate and carry through the project.

The Solar house project was carried out in two phases which both were granted with European projects. In the first phase, tenants were moved out during the retrofitting process but only 4 of 10 apartments were occupied at the start of the project. In phase two, residents stayed in during the retrofitting. The technical retrofit package of phase two is similar to that of phase one but the green houses from phase one were left out partly due to costs.

Table 2: Basic data of the two case studies: the housing association and the housing transformations.

Housing Association	**Gårdstensbostäder (GB), Göteborg, Sweden**	**Oost Flevoland Woondiensten, OFW, Dronten The Netherlands**
History	Founded in 1997 with the specific task to manage, develop and regenerate Gårdsten.	Founded in 1969
Stock they own and manage	2698 dwellings which represents 90% of the total of dwellings in Gårdsten, northeast of Göteborg	About 4600 dwellings in Dronten (and garages etc.) in the northern part of the Netherlands
Organisation	~30 employees, together they speak 23 languages	~ 60 employees
Housing Transformation/ Demonstration project	European SHINE-project and Regen-link project called the Solar houses, phase 1 (255 apartments) and phase 2 (243 apartments).	Biddinghuizen, 85 dwellings in total. Some existing apartments are demolished and built new, one-family raw houses are retrofitted
Originally built	1969 - 1972.	1964.
Retrofitting project	1998 – 2000 phase 1, 2001 – 2003 phase 2	2007 – 2009
Energy saving and social retrofitting packages	-Improved thermal envelope partly new windows -solar heating combined with city heating -pre-heated in-air through glazed balconies. -individual meters for energy/water -Green houses (phase 1) as social meeting places	Four accumulative levels of packages: 1. sealing, new efficient boilers; 2, improved thermal envelope; 3, shading, zoning; 4, solar heating, PV etc.
Residents participation	- work-shops with pre-designated themes -resident are involved in the continued management of the area; 6 out of 7 members of the board of GB are residents in the area.	-Focus groups with residents were made in the early stages of the planning process.
Other socio-economic regeneration measures	-Local job- creation -Better public transport -support development of local services and retail -mobilise/engage the residents	-Gardening programme -Local job-creation (not so successful)

5. Analysis of the case studies

What are the lessons that can be learnt from the strategies applied by the housing associations in the case studies? We use the analytic model set up in paragraph 2.2.2 and the determinants that will help us explain the behaviour of the housing associations and the results of the projects (for an overview see Table 3).

5.1 Determinants of the behaviour of the housing associations in the case studies

Predisposing factors are for both housing associations: an engaged director and a decentralised structure. The flat organisation has made the decision-making process smoother and also supports information exchange between individuals. The organisational focus on social renewal in the Swedish case and the energy focus/affordability focus in the Dutch are implemented on all levels of the organisations. The new task to regenerate Gårdsten and the new organisation are factors that probably have had positive influence in the Swedish case, leading to the engagement of all involved and resulting in a good quality project.

Enabling external factors in the Swedish case were first of all the mission itself from the city to regenerate and lift a heavily stigmatized area. GB was also given subsidies from the city during a period of 10 years for that mission. In addition, the Solar House retrofitting project was granted a European project that was a strong enabler of the project as well as grants from the Swedish Energy Agency. The European project also brought in expert skills from the architect and a researcher that were necessary to carry through the project. Enabling factors in the Dutch case has so far been identified as mainly financial in the form a larger grant and a better loan situation as OFW is part of a co-operation of housing associations.

Among the responsive factors used by the Swedish GB to deal with sustainable housing transformations we find the use of a very divided contract. This way of contracting was first used by GB in the Solar Houses retrofitting phase two (31 contracts were used in the retrofitting project phase two) as a responsive to the high bids that were given in the bidding of all-in contracts made initially. The experiences that GB had achieved in phase one (this was an all-in contract) of the Solar Houses made this way of working possible and resulted in less contract costs for phase two and better control for the client. The very divided contract procurement is also used as a way to push the local job creation. Another responsive factor in the Swedish case is the development of skills to build up a dialogue with the residents. The aim to create a more mixed population and attract new residents from other parts of the city has resulted in a rental policy that has been criticized for creating social exclusion e.g. of residents that has a crime record or are dependent on social money (Borelius and Wennerström, forthcoming).

In the Dutch case, procurement has also been detected as one main response to deal with sustainable housing transformation. The model of procurement and contract used by OFW is short contract periods for one phase at the time (limited to 10-15 houses). This has also permitted OFW to increase the goals for energy efficiency in each phase of the retrofitting project. The result of the contract form is that the same contractor has won the bid in each phase as this company has had the advantage of having all material on site and the experience. In addition, OFW uses systematically energy labeling as a way to increase the energy performance of their stock, a system that is also related to rental costs. OFW have also developed a model with different retrofitting packages that links ambitions and costs. The dialogue and trust of the residents have been important also for OFW and this has resulted in a smoother process.

The reinforcing factors have been strong in both cases. The Swedish case has gained large national and international attention with several awards. The Solar Houses has resulted in more than 40% less energy use and 30% less water use. The project won the prestigious UN Habitat Award in 2005. Gårdsten is today almost fully let and scores high on 'satisfied-tenant-indexes' in Göteborg. Reinforcing factors in the Dutch case are: large national attention, several national awards and satisfied tenants.

Regarding inhibiting factors, which normally have a strong influence over outcome in sustainable building projects (e.g. Femenías, 2004), at this stage of the research project there are not many detected. In the Swedish case the construction of green houses in the second phase of the Solar Houses was inhibited on the one side by costs and on the other side as the commune washing areas for residents had already been retrofitted in phase two before the start of the project. In phase one the green houses were made part of the retrofitting and improvements of the commune washing areas for the residents. The fact that the building blocks in phase two had already partly been renovated before the start of phase two also resulted in a less comprehensive use of the technical energy package and consequently phase two has a reported a slightly higher energy use than phase one (Interviews with key actors).

5.2 Diffusion and implementation of results: factors that supports transferability and replicability

Costs are a strong determinant to the transferability and replicability of successful building projects. The organisation of the information and experience transfer is another (see discussion in paragraph 2.2.1).

The reported costs of the Swedish project is in phase one (The Swedish Green Political Party, 2008): contract costs ~7,8 million €[1] or 418 €/m^2, total costs 10,5 million € of which 1,8 millions for energy related measures, 0,4 million € or 30% of the energy related costs (5% of the total costs) from grants (EU and the Swedish Energy Agency). Cost of Phase two: Contract costs 4,1 million € or 284 €/m^2, total costs 4,6 million €. In comparison: cost for new built in Sweden were 1588 €/m^2 in 2000 and 1710 €/m^2 in 2003 (brut total building costs of new multifamily buildings in Göteborg, www.scb.se). Information on extra costs in the Dutch case are reported to be about 15.000€ per dwelling (interviews with actors).

[1] 1 € has been set to the equivalent of 10 SEK

An economic evaluation made on demand by GB (Lind and Lundström, 2008) points to large societal gain from the transformation of Gårdsten in terms of new employment and lowered crime rates. The study states that this kind of project can not be economically viable on a project or a business level.

Regarding the external diffusion of results, the Swedish case, as being more or less *the* national example of sustainable housing transformation, has been the object for several evaluation from different perspectives: technical, economical and social (e.g. Pavlovas, 2006; Lind and Lundström, 2008; Boreluis and Wennerström, fortcoming). The external diffusion in the Swedish case is supported by monitoring and evaluations carried out by research institutions, a large number of study visits, media attention and the architect and the researcher working as 'ambassadors' for the knowledge transfer. The participation in the European demonstration project and the awards have also supported the knowledge transfer.

The formal internal learning procedures at the Swedish housing association, GB, have not been completely revealed. GB has in the continued renewal of Gårdsten had more a focus on attractive dwellings than on energy efficiency. However, the energy question is still present, for example in the aim to get a wind power station to Gårdsten (2 MW) actually realized, and GB's work with the policy that all new built in Gårdsten should have passive house standard (i.e. buildings with controlled air-flow and very small heating needs).

In the Dutch case, the internal learning process is supported by regular feed-back meetings and internal evaluations. The strong focus on energy efficiency in all the actions that OFW undertake make the experiences from Biddinghuizen and pre-ceding projects important. Regarding external diffusion the large national attention is supportive. One architect involved in Biddighuizen has transferred the way of working with procurement to a new project he was involved with. No monitoring (programmed to be the energy bills of the residents) or external evaluations have so far been made of Biddinghuizen. OFW is part of a national innovation group which probably will be a good forum for knowledge exchange.

5. Discussions and concluding remarks

The large scale of the housing stock addressed in this study as well as the homogeneity of that stock has often been said to indicate a potential to search for optimal retrofitting packages with large replicability. This is a technical view of the problem and this study supports the view that there is a need to take a process view on the issue in order to understand how such technical packages can be implemented and diffused, and how the chasm between prime movers and the mainstream market can be bridged. Errors of the past should be avoided. This includes short-term thinking and a bias for technical solutions in energy efficiency retrofitting projects of the 1970s.

In the discussion we return to the research questions posed in the introduction. So how self-supporting are the strategies that these two cases show? As highlighted in the Swedish 12-step model for sustainable housing transformation (see Table 1) our initial idea not to focus only on costs gains support. The 12-step model is based on experiences and shows that other issues than costs are important in order for housing owners to success with sustainable housing transformations e.g. motivation, knowledge, feed-back, resident's participation etc. This has also been confirmed by the case studies in this paper.

Our first specific question is why and in which situations housing associations engage in innovative projects for sustainable housing transformations and under what circumstances? As we can see in both case studies, this is linked to predisposal factors e.g. the strong engagement of the director and the fact that the engagement for a policy in question has been settled at each level of the organisation. The Swedish case also shows the example of a retrofitting project that was supported by circumstances at a specific time.

The Swedish case, even though seen as successful, did not get any follow-ups in the years that followed the completion. This is now starting to change. The large attention to energy efficiency in Sweden in new buildings is also starting to reach the retrofitting projects. The economic evaluation made of Gårdsten (Lind and Lindström, 2008) points to the large societal values of such investments but also the extra costs for the individual housing association. This indicates a need to evaluate the need for governmental actions to support this kind of transformation processes for the larger societal gain. This research project has so far not studied the allocation of costs between energy efficient investments, learning costs, and costs relating to mobilisation of resident's etc. The 'pimping' strategy is defended by actors in the Swedish case as a less expensive strategy than 'stripping', less expensive than demolishing and building new and thus a way to deal with larger parts of the existing housing stock.

Transcending the knowledge issue, our second question deals with how housing associations identify and define innovative environmental retrofitting projects, how they find and integrate knowledge? It is revealed in both cases that the housing associations needed external advice from skilled consultants especially for energy issues and other technical questions. According to key actors in the Swedish case, the involvement of research institutes can not been seen as a necessary condition for planning and carrying through the project but is clearly valuable for evaluations and monitoring.

This leads us to our third question which deals with the role of the housing association in relation to other actors in the project organisation and as well as to contextual limits. In the Swedish case we can make a distinction between the issues relating to environmental issues and the social renewal process. The social mobilisation and the contact with the residents have been driven by the housing association, also regarding issues relating to the design of the retrofitting. In the Swedish case, the retrofitting process of the existing buildings has been driven by the social renewal process that is in the centre of the actions. The Dutch case has a somewhat different procedure. Here the social processes are more supporting the main process of retrofitting the existing housing that in turn of course will produce social benefits.

Finally, our fourth question on the relation between the temporary project and the permanent organisations regarding decision-making and knowledge transfer.

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Table 3. Determining factors for the innovation and diffusion of the housing transformations in the cases.

Housing Association	Gårdstensbostäder (GB), Göteborg, Sweden	Oost Flevoland Woondiensten, OFW, Dronten The Netherlands
Predisposing factors	-The engagement of the (former) director -Decentralised organisation -A newly employed enthusiastic staff at the start	-The engagement of the director -Emphasize on affordable living and heating -Matrix (flat) organisation, decentralised
Enabling factors	-The mission from the city -Grants from the head office for the regeneration -The European SHINE project -Skilled consultants/The engagement of all involved	-The 500.000 € a grant -A better credit level due to the A-rating of their project (the co-operation of HA is the guranatee)

	-Grant from the Swedish Energy Agency	
Responsive factors	-The use of very divided contract in phase 2 -Getting the resident's approval -Developing skills in resident participation -Focus on local job-creation -New policy for rentals	-Short all-in contracts for each phase to control costs, evaluate learning, and set higher goals in -Energy labels make efficiency tangible -Getting the resident's approval -Initial brainstorming sessions with consultants
Reinforcing factors	-40% less energy use, 30% less water use -Positive feed-back from residents -High score on the 'satisfied-tenant' index -A fully let area -A large national attention and several awards - International attention and UN Habitat award 2005	-Energy award 2007 -Urban planning award 2009 -25.000 € award -National attention
Inhibiting factors	-No green houses in phase two due to costs -some technical features not applied in phase 2 due to earlier retrofitting	-Not identified so far
Costs	Phase 1: Contract costs 7,8 million €, total costs 10 million € (1,8 millions for energy related measures, 0.4 millions of the total costs from grants: Phase 2: Contract costs 4,1 million € , total costs 4,6 million €	About 15.000 € more expensive per house than a normal retrofitting
Evaluation	Many studies have been made, a selection: - Energy/water monitoring by Chalmers University -Economic evaluation Royal Institute of Technology -Social evaluation University of Göteborg	No studies are known of so far
Internal implementation	-Lessons from phase 1 were used in phase 2 -Continued focus on energy efficiency and social mobilisation	-The focus on energy efficiency and affordability is dominating in all their projects
External diffusion	-Reports, Web-pages -Study visits -Often reported in mass media -The architect and researcher as ambassadors	-Web-page -Through the consultants -OFW are part of an innovation head-group