

## Article

# Sustainable Renovation Strategy in the Swedish Million Homes Programme: A Case Study

Hans Lind \*, Kerstin Annadotter, Folke Björk, Lovisa Högberg and Tord Af Klintberg

School of Architecture and the Built Environment, KTH, Royal Institute of Technology,  
100 44 Stockholm, Sweden; kerstin.annadotter@abe.kth.se (K.A.); folke.bjork@byv.kth.se (F.B.);  
lovisa.hogberg@abe.kth.se (L.H.); tord.klintberg@byv.kth.se (T.A.K.)

\* Correspondence: hans.lind@abe.kth.se; Tel.: +46-8-790-6000

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**Abstract:** Sweden has a large multifamily housing stock that was built between 1960 and 1975. An important current issue is how this stock can be renovated in a sustainable way. The article analyses a strategy used by a suburban municipal housing company that had clear social ambitions and offered the tenants three options of renovation: Mini, Midi and Maxi. Most tenants chose the Mini alternative which meant that they could afford to stay and that there was no increase in costs for the social authorities. An investment analysis showed that the Mini alternative had a positive net present value, but that the Midi and Maxi alternatives were more profitable. Even though there was no clear environmental focus in the renovation, energy use was reduced by 8%. As a conclusion, the study shows that a sustainable renovation is possible but that there are a number of conflicts between the different dimensions of sustainability.

**Keywords:** affordability; housing renovation; sustainable renovation; million homes programme; Sweden

## 1. Introduction

### *Background and Purpose*

Many countries have a large multifamily housing stock that was built sometime between 1945 and 1975, targeting households with lower incomes. Demolition of these old buildings has been a major strategy in some countries (see e.g., [1,2]), but in Sweden demolitions are rare and controversies have instead focused on how to renovate.

During the period 1963–1973, one million new homes were built in Sweden as part of a state-subsidised program, and a large number of apartments lacking modern amenities were demolished. The goal was to reduce overcrowding and for all households to have housing with modern amenities [3]. The municipal housing companies played a large role in the Million Homes Programme but it also included private rental housing, cooperative housing and owner-occupied housing. Around 60% of the multifamily buildings were owned by the municipal housing companies. Of the 650,000 multi-family apartments left of the Million Homes Programme, almost 50% are owned by municipal housing companies. In recent decades, the need to renovate this housing stock has increased [4]. An industrial approach with prefabricated elements was often used when the houses were built, but the basic technical quality of the houses' foundations and framework are often good [5].

Another important background factor is a new law that came into effect on 1 January 2011 stating that municipal housing companies shall act according to “business principles”. As the Swedish municipal housing companies work on what Kemeny [6] calls a unitary rental market and compete directly with private companies, subsidies to the municipal housing companies meant a potential

conflict with EU legislation about state support [7]. To avoid this conflict, it was decided that the municipal housing companies should deliver a market rate of return to their owners. An important issue to study is therefore to what extent this law reduces the options of municipal housing companies when it comes to renovations.

A third important aspect is that there currently is a large housing shortage in Sweden [8]. The soft rent control system results in (longer) queues to rental apartments rather than to higher rents. The rent legislation allows for relatively large rent increases when an apartment has been renovated and the standard in the apartment has been increased to what is normal in current new construction, e.g., by replacing vinyl flooring in bathrooms with tiles. As the housing shortage makes it possible to find tenants even if rents are increased, it opens up for a “renoviction” strategy where the quality of the apartments is significantly increased, followed by high rent increases, forcing poor households to move out [9]. Both municipal housing companies and some long-term private owners are, however, looking for a more sustainable renovation policy, taking into account environmental, social and economic sustainability.

The concept of renovation strategy here covers both the process and the content of the renovation. For example, what is the role of the tenant in the decision and implementation process? What technical measures are carried out and how are they financed? Renovation and sustainability have been studied from a number of different perspectives. Several authors have developed general tools and models that can be used to evaluate renovation policies from a sustainability perspective [10–14]. Renovation issues can also be discussed from a broader philosophical perspective and in relation to theories of justice, as is done in [15,16]. How to strengthen the role of the tenant is discussed in [17].

The two main contributions of the current article are that it is a more detailed case study, an approach that is important from a learning perspective as discussed in the Method section below. It also looks at all dimensions of sustainability at the same time and tries to make a more holistic evaluation of various renovation options.

The case study presented here describes and analyses the renovation strategy of a municipal housing company located in the outskirts of the Stockholm metropolitan area. The company has tried to follow a strategy which balances environmental, social and economic sustainability. A more specific research question is whether they have been successful in balancing the different sustainability dimensions and whether they have been able to do that within the restrictions set by the new law. More general implications and lessons are also discussed.

## 2. The Concept of Sustainability in a Renovation Context

### 2.1. Sustainability in General

The most recognised definition of sustainability was stated by the Brundtland commission in 1987: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [18]. Today, sustainability is understood in research and policy as a multidimensional concept, where the ecologic/environmental, economic and social dimensions are the most accepted and most frequently analysed. Thus, sustainable economic development is about reaching (at least) an acceptable living standard—a safe and just space—for everyone within the ecological limits of the planet; the “environmental space” in which economic activity does not endanger stocks of natural resources, species and ecosystems. In a renovation context, sustainability may be analysed, for example, from a capital stock perspective (capital stocks need to be non-declining over time), from a systems perspective (systems need to be resilient) or from a functionality perspective (societies need to show some capabilities) [19]. We have chosen some aspects that are relevant for operationalising sustainability given the conditions of the case study.

### 2.2. Environmental Sustainability

To ensure environmental sustainability, economic activity needs to stay within planetary boundaries, by saving natural resources, combating climate change and safeguarding ecosystems.

For buildings, environmental classification systems like LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Methodology) can be used as the starting point, but as the location and general structure of the buildings are given in the context of renovation, the most relevant dimensions are:

- *Energy use.* The renovation of the Million Homes Programme has been seen as a “window of opportunity” for radical reductions in energy use and change to new energy sources [20].
- *Choice of materials.* There are several systems for classifying construction materials and components from an environmental perspective [21].
- *Waste management, water management.* Improved recycling opportunities and improvements of green areas, e.g., in order to improve water management.
- Environmental classification systems also include *the indoor environment*, namely how the tenants experience their dwelling, as for example in terms of lighting, noise, temperature, ventilation and moisture control.
- *Innovation.* The classification systems encourage trying new environmentally friendly solutions.
- *Management.* Some of the classification systems also assess how the buildings are managed, *i.e.*, how they are run after some time in operation.

Höberg *et al.* [20] describe three “ideal types” concerning housing companies’ environmental focus in the context of renovations. These are “The Strict Profit Maximising Company” that only carries out measures with a pay-back period of 3–5 years, “The Little Extra Company” that carries out some measures even if not strictly profitable, and “The Ambitious Company” that is willing to make investments to attain very lofty environmental goals, even if this is not profitable.

### 2.3. Social Sustainability

Social sustainability is about satisfying individual and collective human needs in which housing and the living environment play an important role in many regards. This concept also has a number of aspects and, given the housing shortage and socioeconomic segregation in the Stockholm region, there are at least two that are relevant in a renovation context (see e.g., Botta [22] for a general discussion about social sustainability):

- (1) *Affordable renovation.* A renovation contributes to social sustainability if it is carried out in such a way that households are not forced to move to other areas because they cannot afford the new rent level. There have been several critical reports in Sweden, e.g., Westin [9] argue that renovations have been more or less consciously designed to evict socially weaker households. The renovation then tends to contribute to socioeconomic segregation and probably a loss of social trust among households that are forced to move out. The renoviction strategy might be profitable for the landlords in the short run but can be counterproductive for society in the long run [23,24]. Renovation might instead be designed in such a way that it increases social capital by reducing crime and poverty among the present population by, for example, educating and employing the residents of the area in the renovation projects, and by increasing the availability of service and job opportunities [25].
- (2) Another aspect of social sustainability is that the ambition should be to *create mixed communities* with a low level of segregation between different income and ethnic groups [26]. In an area where gentrification is underway it might be beneficial from the perspective of social sustainability to try to slow this process down. In areas that are dominated by low-income households, the creation of mixed communities might instead be stimulated by measures that make the area more attractive to other social groups.

This second dimension of sustainability is problematic as the strategy comes into conflict with the first dimension above if the areas are dominated by low-income households. If a proportion of

apartment housing was renovated to a high standard in order to attract higher income groups, then some poorer households would have to move out, and given the current housing shortage in Sweden, they would have no good alternatives. In this article, the choice has therefore been to focus primarily on avoiding renovictions.

#### 2.4. Economic Sustainability

From the perspective of a housing company, a renovation project can be considered economically sustainable if it gives an acceptable rate of return on invested capital. The current legislation concerning municipal housing companies can be interpreted as saying that the company is only allowed to make an investment if it gives such a return [9], even if some minor “unprofitable” investments can be motivated from the perspective of Corporate Social Responsibility.

Economic sustainability can also refer to the effects of the renovation project on social costs paid by the public sector. If rent levels go up, part of this increase may be paid by economic support from the public sector. A process where more and more households become dependent on the welfare system can hardly be seen as an economically (or socially) sustainable situation.

#### 2.5. Technical Sustainability—A Fourth Aspect

Discussions with staff—especially the technical staff—of the company raised the question of whether there might be a fourth interesting interpretation of sustainability. In a specific situation there might be several alternatives for solving a problem. Some of these techniques might be more tried and tested and some will be newer and more risky. Some alternatives may solve the problem for a long time and some only for a shorter period. The company under study often chose a well-tested solution that was expected to last for at least another 50 years, and these solutions were often described by the respondents as a more “technically sustainable” solution. This idea was also related to taking measures before there was a real risk of breakdown, and acting proactively with preventive maintenance.

This concept of technical sustainability cannot be reduced to either environmental or economic sustainability. The more long-term solution might use more material and if the investor demands a fairly high rate of return, it might be better from an economic perspective to use short-term solutions, and also rational to wait a little longer before taking any measures.

### 3. Method

#### 3.1. Case Study Methodology in General

In a very important article on case-study method [27], Bent Flyvbjerg describes and criticises five misunderstandings about case study methodology. We have adapted the five resulting positive conclusions to the renovation context:

- (1) You cannot be an expert unless you have detailed knowledge about a number of specific cases. This kind of knowledge is not of less importance but a precondition of more general knowledge. In our context, this means, for example, that detailed case studies are necessary as a foundation for a rational government policy in the area of renovation.
- (2) Case studies can be used to test theories. This is most clear in the Popperian philosophy where science consists of conjectures and refutations. For example, our case study refutes the view that social and economic sustainability cannot be combined. Flyvbjerg even writes “formal generalization is overvalued as a source of scientific development, whereas ‘the force of example’ is underestimated.” ([27], p. 282).
- (3) From the last point, it follows that case studies are not only for explorative purposes in early stages, but also important in all stages of research.
- (4) Case studies are not more subjective than other research. In [27] it is argued that “the question of subjectivism and bias toward verification applies to all method” (p. 235). Results derived

in mathematical models and results from econometric tests are, e.g., sensitive to specific assumptions made.

- (5) Flyvbjerg summarizes his fifth conclusion in the following way: “The problems in summarising case studies, however, are due more often to the properties of the reality studied than to the case study as a research method. Often it is not desirable to summarise and generalise case studies. Good studies should be read as narratives in their entirety.” [27] (p. 241). In our case, the article format inevitably puts limitations on how much detail can be presented.

### 3.2. *The Choice of Company*

Flyvbjerg also discusses different selection methods, and our selection is what he calls an “information-oriented selection”: the purpose was to investigate the possibility of combining the different sustainability dimensions. As described in, for example [20], it is well known that companies follow different strategies when renovating their Million Homes Programme buildings. In the Swedish debate, the company studied here has been very active and has presented their renovation strategy as a more socially sustainable one. By studying more closely how they actually worked with this and to what extent they live up to their ambitions, important knowledge could be generated about how a socially sustainable renovation can be carried out—and also how the strategy is related to goals concerning environmental and economic sustainability. Looking at a case where the company seems to have tried hard to combine the different sustainability dimensions would then have the potential to generate more knowledge than more ordinary renovation cases.

### 3.3. *Data Collection*

In the third step, an interview study was designed, with open-ended questions and a checklist of questions as a starting point. Around 15 people inside and outside the company were interviewed. The interviews were conducted in the respondents’ workplace. The most common situation was two researchers carrying out the interviews together. Contacts were taken afterwards with several of the interviewees in order to clarify certain points. In addition, document studies were conducted to confirm information from the interviews.

In order to reduce the risk of bias, information was collected from several parties, and information from the company was checked by interviewing the tenants’ organization and the social authority.

## 4. Empirical Results

### 4.1. *General Background*

In a neighbourhood that the company renovated several years ago, the idea was to renovate to roughly the same standard as new construction. For a typical three-room apartment, this meant a renovation cost of almost €100,000 per apartment. The project turned out to be much more costly than expected and there were protests from the tenants. Given the suburban location and the relatively low attractiveness of the area, big increases in the rent level were also difficult to sustain from a market perspective.

When a new CEO was hired, this renovation policy was stopped for two reasons. The first was financial feasibility. Even if it were possible to increase the rent in a way that made the renovation profitable, the company judged that it would not be possible to raise enough capital to carry it out across the whole housing stock.

The second reason was the social dimension. The political majority and the new CEO believed that it was socially unacceptable and perhaps also economically risky to renovate in such a way that a considerable number of the current tenants could not afford the new rent. This would lead to households moving out and/or to increasing costs for the social authorities. Currently the housing shortage is high in the Stockholm region so it might be possible in the short run to find tenants willing to pay the high rent, but this might not be the case in a longer perspective.

Even if the goals of the renovation were changed, the renovation still demanded a large amount of capital. The company therefore decided to sell part of their unrenovated housing stock. Given the social ambitions and political goals of the municipality, such a sale could be expected to be controversial unless the right buyer could be found, but it turned out that the timing was good. After the financial crisis, several of the Swedish public pension funds started to see the real estate market as an interesting alternative. Several new real estate companies were thus started by public pension funds, and it was to one of these companies that the apartments were sold.

#### 4.2. Basic Description of the Current Renovation Strategy

The company describes the renovation strategy that has been implemented in recent years as related to three aspects.

- Technical aspects: what do we have to do in order to keep the buildings in good technical condition?
- Social aspects: participation of the tenants, possibility for the tenants to choose renovation level, and safety and security during the process of renovation.
- Economic aspects: financial feasibility and reasonable rate of return on investment.

The company did not set any pronounced environmental goals but has an environmental management system in place for its regular operations, which might be seen as guiding all activities.

It was decided that each household could choose between three alternatives. In the *Mini alternative*, the plumbing is replaced, the bathroom is renovated, and ventilation and electricity systems are replaced. The name “mini” can be questioned as these are quite significant measures, but the focus in this alternative is on what is technically necessary from a long-term perspective.

In the *Midi alternative*, the kitchen is also renovated (except the cabinet frames).

In the *Maxi alternative*, all interior surfaces (painting, wallpaper, floors) are renovated, and the renovated apartment is very similar to a newly built apartment.

The average costs and the allowed rent increases are presented in Table 1 below. (The figures have been translated into Euros using the exchange rate 10SEK/€, which is an average of the last 10 years). The total investment below includes what the company classifies as maintenance measures (€27,000 per apartment). The distinction between investment and maintenance is important, as the Swedish rent regulation system allows rent increases when the standard of the apartment is improved, but not for maintenance measures.

**Table 1.** Economic consequences of the three renovation alternatives.

Alternative	Total Cost per Apartment	Negotiated Rent Increase per Month
Mini	€49,000 (€800/SQM)	€82
Midi	€51,000 (€840/SQM)	€179
Maxi	€68,500 (€1120/SQM)	€190

In the following sections, the renovation will be described in more detail according to the different sustainability dimensions.

#### 4.3. Environmental Sustainability

Renovation instead of demolition and rebuilding can be seen in itself as a way to save natural resources. The specific measures carried out during renovation were mainly related to energy efficiency, but indoor climate was also important. The company studied here belongs to the category that is called “The Little Extra Company” in [20], but the “little extra” that it does is mainly related to customer satisfaction and not to environmental goals. The company has not aimed for any environmental



classifications of the buildings after renovation and there are, for instance, no investments in solar panels or wind power.

Rents in Sweden usually include heating, and all reductions in heating costs or in the use of electricity in common areas directly reduce the operating costs of the company. The electrical appliances within the apartment are, however, paid for by the tenants.

A number of measures carried out by the company to reduce energy use were analysed. Here are some examples:

- A balanced ventilation system with heat recovery. This was also motivated by increased comfort for the tenants, as draught would be reduced. From a strict economic perspective it was not judged to be profitable. The houses are linked to a district heating system as is common in Swedish multi-family housing. The hydronic heating system was changed from a one-pipe system to a more reliable two-pipe system.
- Improvements in the shell of the building. Insulation in the loft was increased to 25 cm as a thinner insulation leads to a situation where the attic floor becomes a strong thermal bridge, which means both high energy consumption and problems with comfort for the tenants.
- Water-saving aerators were put in the shower fittings and thereby reduce hot water consumption.
- Low-energy lighting was installed in stairwells.
- Exhaust air heat pumps for heat recovery were installed in some buildings.
- A system forecast control, automatically adjusting so heating according to weather forecasts, was introduced. This alone would save the company more than €100,000 per year.
- Replacement of the heat exchangers in the district heating system. This both increases reliability and reduces costs related to thermal losses.

The heat recovery from ventilation, forecast control, and replacement of heat exchangers are estimated to lead to an 8% reduction in energy use.

There have also been a number of more strategically motivated measures. Price increases for district heating in recent years have created incentives for property owners to look for other sources of heating. The company is actively investigating such alternatives, such as recovery of heat from wastewater. The company is also investigating the possibility of using ground source heat pumps linked to solar panels, and using excess heat from a nearby supermarket.

The company has introduced individual metering of hot water in 1,200 apartments, but there have been some technical problems with this.

#### 4.4. Social Sustainability

Social sustainability goals affected the design of the alternatives and the process for carrying out the renovations. The Mini, Midi and Maxi alternatives reflected the failures of the renovation in the first area, and the new alternatives—with corresponding rent increases—were negotiated with and approved by the Tenants' Unions.

Staff from the company contacted each household in order to find out about the current housing situation, such as specific problems with draught, and the household's preference concerning the renovation. It should be underlined that the company did not want low-income households to move to cheaper apartments in the unrenovated stock. Before the major renovation, one apartment in each block was renovated to each of the different standard levels and was exhibited to the tenants to give them a clearer idea about the alternatives.

There were also meetings in each block about, for example, entrances and the green areas surrounding the houses.

In order to make the renovation process as smooth as possible, temporary housing was put up near the houses that were to be renovated, as households had to be evacuated while the work was being carried out. The households could, however, leave furniture and unneeded items in the apartment

during the eight weeks that they were evacuated. This has worked very well and the Tenants' Union has not heard any complaints.

The Mini alternative was chosen by 85% of the tenants, 10% chose the Midi alternative and 5% the Maxi alternative. On average, 10% of the tenants did not move back when the renovation was carried out, but this is equivalent to normal turnover in the properties.

Interviews with social authorities indicated that they had not observed any increase in applications for welfare due to these renovations. As discussed in [28], housing allowances can reduce the negative effects of rent increases. These allowances have been reduced in Sweden and primarily go to the elderly and single parents [29]. As the rent ceiling for housing allowances is rather low, our calculations indicate that most households in the area would not be compensated with higher housing allowances. The net rent increases correspond to a necessary income increase from 3 to 12% of the household's disposable income. This necessary increase can be even higher for some households. Still, the households were able to cope somehow with these rent increases, probably rearranging and cutting other costs. Home is an important place.

From a long-term perspective, it is important to see how the rent increases affect who will be able to rent an apartment. The company demands that new tenants have an income before tax of at least three times the rent. With the current rent (€640/month) the required income is €23,000 before tax per year. After the renovation, the rent will be €722–834/month and the income demanded would then be €26,000–30,000 per year. This means that when an apartment becomes vacant, the current tenant will be replaced with tenants that on average have higher income than the tenants moving out. The number of apartments available for households with lower incomes is thereby reduced by the renovation, especially as the company can raise a Mini renovated apartment to a Midi renovation when the apartment is vacant.

## 5. Economic Sustainability

### 5.1. From a Project Perspective

When evaluating a renovation project, it is important to clarify what would be the best alternative, then base comparisons on this. Given that demolition was not on the agenda, the most realistic alternative would be to delay the renovation for some years. The calculations below therefore compare the policy actually followed by the company and an alternative that consists of waiting for 10 years before carrying out the renovations.

### 5.2. Basic Assumptions

- The calculations are made in *real terms*—unless otherwise stated it is assumed that everything follows inflation (interest rates, rents, costs), so relative prices are not affected by inflation. To simplify calculations, it is assumed that both rents and all operating costs are paid at the end of the year.
- The calculations focus on the *difference* between the two alternatives: renovating now or waiting 10 years. The basic calculations are made for one apartment with the Mini alternative, and then the Midi and Maxi alternatives are evaluated separately through a new difference analysis.
- The calculation covers a *10-year period*. It is assumed that the renovated and the unrenovated building fall in value by the same absolute amount every year. The difference in value in year 10 is then equal to the investment made in year 1 in the renovated apartment.
- The real discount rate is assumed to be 3%. Real interest rates have fallen in recent years and a long-term value could be between 1 and 2%, and then adding risk compensation could motivate a 3% real discount rate. This rate is actually higher than the real rate paid by the company for loans during recent years.
- Operating costs for the unrenovated case are assumed to *include costs for water damages and similar repairs on the same level as in recent years*. According to figures from the company, these costs were approximately €2 million in 2012 and if it is assumed that all of these are in the 3000 Million



Homes Programme apartments, the cost per year per apartment would be around €650. Further assuming that energy use falls with 20 kWh per m<sup>2</sup> and year, then for an average apartment of 70 m<sup>2</sup>, the reduction in energy cost would be around €150 (energy price €0.1/kWh). Other operational expenses are estimated to be reduced by €150 per apartment per year. The total reduction in operating costs would then be €950 per year.

The results from the calculations for the Mini alternative are presented in Table 2 below.

**Table 2.** Profitability of the Mini alternative for a typical apartment (€).

Renovation Cost per Apartment	49,000
Rent increase per apartment per year	1000
Present value of rent increases	8500
Reduction in operating cost by renovation, per apartment	950
Present value of reduction in operating costs	8100
Difference in value at the end of year 10	49,000
Present value of difference in exit value	36,500
Total present value of project	+4100 (53,100–49,000)

As can be seen, the Mini alternative is profitable for the company. A small sensitivity analysis is presented in Table 3 below. The Mini alternative is still profitable even if the reduction of operating cost is somewhat smaller. At an interest rate of 4%, the project shows a very small loss, but given the uncertainty in the assumptions, one could say that at a 4% real interest rate, the project approximately breaks even.

**Table 3.** Sensitivity analysis for the “Mini-case” for a typical apartment, €.

	Present Value of Project
Interest rate 4%	–100
Reduction in operating costs of €700	+1700

The profitability of the Midi and Maxi alternatives are presented in Table 4b below. The calculations for the Midi alternative start from the Mini alternative and look at changes in costs and revenues of going from the Mini to the Midi level. The Maxi alternative is compared with the Midi alternative in the same way.

**Table 4a.** Profitability of going from “Mini” to “Midi” for a typical apartment (€).

Extra Renovation Cost	2000
Extra rent increase per apartment per year	1160
Present value of rent increases	9850
Difference in value at the end of year 10	2000
Present value of difference in exit value	1490
Increase in present value of project	+9300

**Table 4b.** Profitability of going from “Mini” to “Midi” for a typical apartment (€).

Extra Renovation Cost	17,500
Extra rent increase per apartment per year	130
Present value of rent increases	1110
Difference in value at the end of year 10	17,500
Present value of difference in exit value	13,000
Total present value of project	–3400

Increasing the standard beyond the Mini alternative is profitable for the company, especially the Midi alternative. If the Maxi alternative is compared with the Mini alternative, the Maxi alternative is more profitable, and this means that:

- The company gives priority to social sustainability, as it does not choose the most profitable alternative.
- A private profit-maximising company would renovate to a higher standard (Midi).
- It is therefore questionable whether the municipal housing company acted in line with the new legislation about acting in a “business-like way.”

### 5.3. From a Company Perspective

The company has been benchmarking against other companies as a member of the IPD Swedish Residential Property Index since 2010. The company annual report of 2013 shows a total return including projects of 5.2%, of which 1.9% is income return and 3.3% is capital growth. The company states: “The income return is affected by the large proportion of projects which in the short term are pulling down the yields. There is a delay of project profitability. It is important to note that for the average three-year annualised total returns the company ranks second in comparison with the 25 companies that IPD measured during the period.”

### 5.4. From a Municipality Perspective

According to the interviews with the company and the social authorities, there was no observed increase in welfare dependency related to the renovation project, but it is likely that some households began receiving higher welfare payments since their rents increased. It was, however, not possible to get any data about this. As no household was forced to move out, there were also no costs for the social authorities related to helping them find another apartment. Earlier it was argued that there was only a marginal increase in housing allowances.

### 5.5. Technical Sustainability

In the first stage of the renovation programme, there was an attempt to try a more innovative “industrial” approach when renovating the bathrooms by replacing an old bathroom with a ready-made new one. This, however, turned out to create serious mould problems. The ambition to reduce costs came into conflict with technical sustainability.

The choice of technical alternatives was thereafter determined by the policy that the buildings should be able to function for another fifty years, and that long-term and reliable solutions should be chosen. Pipes were, for example, replaced instead of being renovated by relining techniques. This strategy also reflected the customer focus of the company, as reliable techniques lead to fewer problems for the tenants also.

The company also introduced a new property information system combined with regular inspections of the technical systems in order to identify early on problems such as leakages.

An example of the proactive strategy is that there are currently plans to renovate the culverts for heating and water within the area. This is important from a service perspective, as the consequences might be very serious if these culverts break down in the middle of the winter. Renovation of the culvert system would reduce energy losses to 1/10 of the current level even if this alone is not enough to make the measure profitable.

One further reason for carrying out planned maintenance is that it will be possible to undertake procurement in a much more planned way and this should lead to lower prices and/or higher quality.

## 6. Concluding Analysis

### *The Result Points to a Number of Crucial Issues*

- *The concept of sustainability.* There seems to be a need for a fourth interpretation of sustainability in the context of housing renovation and that is “technical sustainability.” This means that more reliable, less risky and longer-term solutions are chosen, even if these cannot be justified from an environmental or economic perspective. Pipes are, e.g., replaced instead of relined.

- *Priority between different sustainability dimensions.* Within social sustainability there is a conflict between a focus on the current tenants and their situation, and trying to create more mixed communities. The company gives priority to the current tenants. Economic sustainability was seen as a long-term precondition for the other dimensions and the company therefore did not go as far as some other companies have in trying to reduce energy use.
- *The possibility of sustainable renovation.* The case presented here shows that it is possible to reach fairly high levels of sustainability in all dimensions or, in other words, to satisfy (the prioritised) needs of the community at least as well as before renovations and simultaneously reduce or sustain negative impact on the environment. Even if social and economic sustainability were the focus, a number of environmentally motivated measures were carried out and the company also tried to act more proactively with technical sustainability in focus.

There were, however, also a number of more problematic aspects.

- *The role of the new legislation.* It seems that the company did not choose the most profitable alternative from a business perspective. The company interpreted “acting in a business-like way” as “not needing any direct subsidies from the owner” and “acting professionally with a customer focus,” but this is perhaps not the correct interpretation.
- *Optimal timing.* The profitability of the renovation depends in this case on fairly high operating and maintenance costs before the renovation, primarily because of water damage. If the company had acted more proactively and started the renovation earlier, it would not have been profitable.
- *Financial aspects.* Even if the renovation was profitable it was judged to be necessary to sell part of the unrenovated stock in order to finance the renovation. An important aspect is then what happens to the stock that is sold. The economic analysis above indicates that the buyer will wait a few more years and then renovate to a higher standard, meaning that some of the households will not be able to afford to move back. If this predication is correct, then some areas would have to be “sacrificed” from a social sustainability perspective in order to create financial resources that “save” others.
- *Relation between renovation and new construction of affordable housing.* Looking at the housing market as a whole, the supply of affordable housing is crucial. If older areas are renovated to a high standard, this might not be problematic from a social perspective if there is either a filtering down in other not-so-old areas, or new construction of affordable housing.

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