A different approach to the improvement of the fundability of sustainable renovations for private homeowners

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This paper is written as a P2 document before starting the practical research next semester. The paper revolves around improving the fundability of sustainable renovations for homeowners. I have chosen this topic because of several reasons. Firstly I have been involved in the team of Prêt-à-Loger last summer in Versailles, where our end-product was a sustainably renovated row house. In this project I was already responsible for the financial feasibility.

Secondly, I have been always very interested in sustainability and economics. With the topic ‘improvement of the current housing stock’, I am able to combine these two passions and I can hopefully contribute to a better living environment for people, where they make use of clean energy, they save money and live more comfortably.

Future list of people to thank: Graduation mentors, consult (Koppels, van der Werf, etc), graduation company (whichever it is), Faro architecten, People from energiesprong (in particular Ronald vd Klauw), parents for support, Vereniging Eigen Huis for cooperating with the enquiry, etc.
For Final Report (P4/P5)
# TABLE OF CONTENTS

Foreword ........................................................................................................................................... 1
Summary ............................................................................................................................................... 2
Table of Contents ................................................................................................................................ 3
Terminology .......................................................................................................................................... 4
Reader's guide / Table of contents final dissertation .................................................................... 5
Introductory Chapter .......................................................................................................................... 6
  Introduction ......................................................................................................................................... 6
  Rationale ........................................................................................................................................... 6
  Fuel for renovations .......................................................................................................................... 7
  Target group ..................................................................................................................................... 8
  The importance of 100% energy neutrality .................................................................................... 9
  Payback model ................................................................................................................................. 9
Main research question ....................................................................................................................... 11
Sub questions ....................................................................................................................................... 11
Constraints/Prerequisites in this research .......................................................................................... 12
Conceptual Model ............................................................................................................................... 12
Objective and intended end product ................................................................................................. 14
  Objectives ....................................................................................................................................... 14
  Intended end product + application possibilities ........................................................................... 14
The research design ............................................................................................................................ 15
Related research ................................................................................................................................. 17
Relevance ............................................................................................................................................. 18
  Scientific relevance ......................................................................................................................... 18
  Societal relevance ............................................................................................................................ 19
Utilisation potential ............................................................................................................................. 19
Chapter 2 | Further identification of the research field .................................................................. 20
  theoretical framework .................................................................................................................... 20
  Practical framework ....................................................................................................................... 25
Graduation Planning ............................................................................................................................ 27
Team of mentors & Help ...................................................................................................................... 28
Interesting Stakeholders ..................................................................................................................... 28
  Literature list .................................................................................................................................. 29
### TERMINOLOGY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable renovation</td>
<td>A renovation of an existing building, whereby the building becomes energy neutral</td>
</tr>
<tr>
<td>Willingness to Pay (WTP)</td>
<td>The willingness of the client to pay for a product. In this report, often used in conjunction with private homeowners</td>
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<tr>
<td>Row-house / Terraced house</td>
<td>A row of single-family houses, connected on both sides with the neighbor’s house, with exception of the houses on the corner</td>
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<tr>
<td>Discrete Choice Method (DCM)</td>
<td>A research method that enables the collection of relevant data based on unconscious user preferences. It is the research method that will be deployed in this research.</td>
</tr>
<tr>
<td>SAS</td>
<td>The software that will be used to analyze the data of the DCM</td>
</tr>
<tr>
<td>SPSS</td>
<td>The software that will be used to analyze the data of the survey and to order the data of the DCM</td>
</tr>
<tr>
<td>Prêt-à-Loger (PAL)</td>
<td>The student team that won the 3rd prize in the global competition</td>
</tr>
<tr>
<td>Willingness to Pay (WTP)</td>
<td>The willingness of consumers to pay for a certain article</td>
</tr>
</tbody>
</table>
Chapter 1 | Reader’s guide: explanation of what to find per chapter

Chapter 2 | Introductory chapter: problem statement, research objectives, research questions, conceptual model, research design, utilization potential, relevance and related research.

Chapter 3 | Theoretical research question 1: an answer to the first theoretical research question: “What are the current barriers for loan providers (banks) to provide private homeowners with capital for sustainable renovations”?

Chapter 4 | Theoretical research question 2: an answer to the second theoretical research question: “What are current financial barriers for private homeowners to invest in the upgrading of their terraced house and how can these barriers be addressed?”

Chapter 5 | Theoretical research question 3: an answer to the third theoretical research question: “What can be financial benefits of sustainably renovating the Dutch post-war (<1979) terraced houses for the private homeowners”?

Chapter 6 | Theoretical research question 4: an answer to the fourth theoretical research question: “What is the perception of current homeowners towards investing in sustainable renovations”?

Chapter 7 | Theoretical research question 5: an answer to the fifth theoretical research question: “When do private homeowners usually opt for a renovation or addition to their current house”?

Chapter 8 | Theoretical framework: research Stroomversnelling Koop on PAL house: an answer to the extra theoretical research question: “How much of an increase in market value can private homeowners expect when doing a sustainable renovation according to appraisers”?

Chapter 9 | Summary and most important conclusions from theoretical framework.

Chapter 10 | Explanation survey, SPSS and SAS.

Chapter 11 | Practical research question 1: an answer to the first practical research question: “Which attributes of sustainable renovations add most quality according to private homeowners”?

Chapter 12 | Practical research question 2: an answer to the second practical research question: “How do private homeowners appraise this extra quality and how much of an increase in market value can this induce?”

Chapter 13 | Processing results of practical question 1&2.

Chapter 14 | Summary, conclusion, recommendations and discussion.
INTRODUCTORY CHAPTER

INTRODUCTION

My name is Derek van den Berg and prior to starting my current graduation research, I participated in the team of Prêt-à-Loger, which represented the TU Delft in the Solar Decathlon 2014 in Paris. In this global university competition which revolves around the development of sustainable housing, our team was awarded with the 3rd position. Together with two other students, I was responsible for a research of the market viability and the affordability of our product. This final product was a toolbox that enables housing associations and private homeowners to sustainably renovate their existing dwellings. The type of housing that we targeted were typical Dutch post-war <1975 row-houses, also known as terraced houses, from which 1.4 million are scattered over the Netherlands. During this research plenty of question arose from which some remained unanswered and therefore I happily welcomed the opportunity to further research this field for my graduation thesis.

By choosing the graduation topic ‘Improvement of the current housing stock’, I am able to combine my two passions ‘Sustainability’ and ‘Real Estate Investments’. Since a young age I have been surprised about how slowly we transition into a more sustainable society while the technologies are already there. As a grown-up, I now understand that there are many forces having an influence in the decision arena, making things rather complicated. Above all, the economic forces play often a crucial role.

To transition into a more sustainable society, I believe that improving the current building stock is one of the most important pieces of the puzzle. As said in the last paragraph, economic forces often play a crucial role. Hence it is key to satisfy the economic forces involved in sustainable renovations. This is why I aspire to aid in making sustainable renovations for private homeowners economically more attractive. With current sustainable renovations, private homeowners are often left with a financial gap on their investment. Although this will not scare away all private homeowners (some people are willing to have a financial gap in return for extra quality), it complicates possibilities for others.

My focus is on the group of private homeowners that cannot, or are not willing, to acquire a financial gap on their investment due to their sustainable renovation. For these private homeowners, my aim is to take a different approach towards the fundability of these renovations, by focusing on adding value through quality. I am convinced that by adding quality to sustainable renovations, market appreciation will follow and as an effect these renovations can become more economically feasible.

RATIONALE

Humanity has only one planet, one home and therefore we cannot simply demolish and reconstruct our home. On a smaller scale, this same school of thought applies to societies. In order to counteract processes that induce environmental exhaustion, the focus on constructing new buildings shall be rather directed on improving the existing building stock. This approach both reduces the consumption of natural resources and preserves the current urban DNA as well as the emotions and memories inhabitants have developed out of them.

Unfortunately there is a tendency that discussions about the sustainability of the housing stock revolve around the focus on new houses. This is related to inadequate information, externalities and side effects of governmental policies that focus on the construction of new buildings (Awano, 2003). This can induce
decisions that generate demolition and reconstruction. Demolition and reconstruction not only exhaust natural resources, but also lead to high energy consumption.

Because of this focus on demolition and reconstruction, the construction sector is a major consumer of energy. Construction activities cause 20% of the overall greenhouse emissions worldwide, whilst in the Netherlands this even reaches 30% (Siderius, 2008). In addition, 45% of the Dutch energy consumption is related to construction and the exploitation of construction. Dwellings are responsible for 15% of these emissions, with heating, heating of water and electric domestic appliances as biggest energy consumers (van Eck, 2008, pp. 16).

The Netherlands has witnessed a growing number of demolitions over the last years, whilst it is already much higher than in neighboring countries (van der Flier & Thomsen, 2010, pp. 3). This high number of demolitions cause three main problems, (1) demolition waste with its ecological consequences, (2) social problems when groups of residents are moved between neighborhoods (waterbed effect) and (3) the increasing volume of capital loss due to demolition and reconstruction (van der Flier & Thomsen, 2010, pp.3). On top of that, the entire process of demolition and reconstruction requires a lot of other resources as well, such as people, time, materials and energy. In addition, an immense logistical problem is created because temporary housing for the ‘homeless’ families will have to be provided. And lastly, the emotional bond that families have with their home is broken and the historical and urban DNA is eradicated. All these arguments show that demolition and reconstruction is not a favourable option.

Due to the relatively high demolition rate, the Netherlands deals with an annual replacement of 0.25% of the total housing stock, i.e. it would take 400 years to replace the entire current housing stock. While these calculations have to be taken with a grain of salt, they show that it is highly probable that the average house will have a much longer lifespan than expected (van Nuenen, 2008). Hence there is not much of a choice rather than preserving and improving the current building stock. According to de Jonge (2005, 2006) and Itard and Klunder (2007), transformation or renovation of the current building stock does offer the best chances for a sustainable solution under most of the conditions.

**FUEL FOR RENOVATIONS**

In order to extend the lifespans of these dwellings, they will need renovations that make them future-proof and protected against price increases in conventional energy sources. With rising energy prices, a lot of common housing typologies that suffer from poor insulation become every year more expensive to inhabit. Over a period of 12 years between 1996 and 2008, household costs of electricity have risen by 140%, while gas prices have increased by 300% (Tensen, 2011). It cannot be ascertained if this trend continues, however if it does, a lot of Dutch houses will become unaffordable and this is an immense problem for the families that inhabit these houses as well as for the owners of the real estate.
TARGET GROUP

In the Netherlands 61.2% of the residents inhabit semi-detached row (terraced) houses and this seems the preferable housing option for most Dutch residents. The typology of the row houses is not only limited to the Netherlands, but it is a typology that can be found all over Northwestern Europe consisting in total of more than 36 million dwellings. TU Delft professor Kees Dol (2013) states that ‘the row house is part of the Dutch culture; there is a large market for apartments and flats in the country, but the majority of the people prefer to have a house with a garden’. Approximately half of these row houses have been built as a response to the post-war shortage that required fast, inexpensive housing solutions for the predominant middle class in the period between 1946 and 1975. This fast and cheap housing solution represents in the Netherlands alone already a total number of 1.4 million post-war dwellings which do not satisfy the present-day demands in terms of energy efficiency (Heijneman & Ham, 2004).

Although these dwellings have provided a pleasant living environment to its families for many decades, they entail more shortcomings next to energy inefficiency, namely; an uncomfortable indoor climate due to poor insulation and a lack of space. Interestingly enough, the high energy bill is not the most
important complaint by its residents. The comfort, quality of space, social security of the home, the appearance of the accommodation and the directly foreseeable costs are more important themes for the residents when it comes to a sustainable refurbishment (Nieboer et al., 2012). It is therefore these points that should be taken seriously, when aiming for a successful a sustainable renovation.

THE IMPORTANCE OF 100% ENERGY NEUTRALITY

Kortman and van Ewijk (2004) found in their research that new construction normally outcompetes existing construction when the latter surpasses the 70 year age mark. Therefore, in order for existing constructions to be able to compete with new constructions, a substantial improvement is needed. For such a required life cycle extension small upgrades are not sufficient and the focus should therefore be on the highest possible outcome, meaning the upgraded dwellings should be designed in a flexible way, 100% energy neutral and preferably with extra space. To get to a 100% energy neutral house, this does not necessarily imply one renovation. Such an improvement can also be done in steps. For instance, first an improvement of the South façade and a few years later an improvement of the North façade. This would have the advantages that the homeowner does not need deep pockets in a specific moment, but can save money over time to do upgrades. Furthermore, the first upgrade can partially finance the second upgrade. If a private homeowners would first renovate the side of the houses that yields the most financial benefits, this is advantageous for further renovations. This is something that can be taken into consideration.

PAYBACK MODEL

To support the economic feasibility of these sustainable renovations, the current energy bill of the residents can be used as a means to recover part of the investment. The average annual energy bill in the Netherlands is 1,900 Euro, which equals grosso modo 160 euro per month (Milieu Centraal, 2014). 60% of the post-war row houses are owner occupied and in comparison to housing associations they have to overcome more problems in order to achieve a sustainable renovation:

- Private homeowners often do not possess sufficient capital to finance such a renovation;
- Private homeowners often face difficulties to acquire a mortgage top-up or an extra loan from a bank for these kind of renovations;
- Private homeowners have shorter payback periods than institutions such as housing associations;
- Private homeowners might already have modifications to their house that will complicate a sustainable renovation;
- Private homeowners have very personal desires and hence it will be difficult to achieve ‘economies of scale’ advantages by up scaling standard products. This will be more easy for housing associations since they can renovate entire blocks in the same way.

Because of the abovementioned problems, the focus of this research is on the private homeowners. The business model for housing association entails its challenges, but it is expected that the market will come up with economically feasible solutions by itself. The challenges lie with the private homeowners that possess the majority of these row-house dwellings. Not all of these problems will be deeply investigated during this research. For instance, the fact that a lot of private homeowners already have modifications to their dwelling which complicate a sustainable renovation, is something that should be further investigated in another research. The focus in this research is on reducing the required financial investment of these sustainable renovations and on the problem of personal desires. These two
problems might influence each other, since the ability to integrate personal desires in a sustainable renovation, might increase the willingness to pay.

In a standard payback model the energy bill is used to amortize the investment, hence a sustainable renovation is more attractive for private homeowners that have a high monthly energy bill. Because of this only private homeowners with energy bills of more than €175/month are taken into consideration, satisfying the monthly energy cost prerequisite of the Stroomversnelling. Of all the post-war privately owned terraces houses, 135,000 dwellings comply with all these requirements, as can be seen in figure 3.

Figure 3| The distribution of the target group for this research (The Choice marktonderzoek, 2014)

As said, in a standard payback model, the former energy costs would be used to amortize the debt of the loan. Instead of paying averagely >175 euro per month to the energy provider, in the situation of an energy neutral dwelling this same amount of money is now used to amortize the loan.
The problem with the payback period of these loans with average energy costs of >€175 per month, is that with a current average renovation cost of 80,000 euro, this can take more than 40 years. The ‘Stroomversnelling’, which embodies a partnership between several Dutch construction companies and Dutch housing associations to sustainably renovate the existing housing stock, states that at this moment they can renovate an existing dwelling to an energy neutral dwelling for around €60,000. The target price for these kind of renovations is 45,000 euro (Stroomversnelling, 2014). With the average energy costs of >175 euro per month this would still take 20-30 years to amortize a loan and that period is too long for private homeowners, due to the fact that the average dweller changes of home every 11 years (Ministerie van Binnenlandse zaken & Koninkrijksrelates, 2014). However, there are also other financial benefits that might be taken into the equation, such as reduced maintenance costs, extended lifespan, increased market value and protection against rising energy prices. It is however unclear what the exact influence is on the market value of these financial benefits.

**MAIN RESEARCH QUESTION**

“How can the fundability of sustainable renovations of the Dutch post-war (<1979) row-housing stock be improved for private homeowners”?

**SUB QUESTIONS**

**Theory | Part of theoretical framework**

1: “What are the current barriers for loan providers (banks) to provide private homeowners with capital for sustainable renovations”? → Surveys Banks + interviews

*Will be included in the chapter literature study and will be the start of the research.*

2: “What are current financial barriers for private homeowners to invest in the upgrading of their terraced house and how can these barriers be addressed”? → Literature Study

*Will be included in the chapter literature study.*

3: “What can be financial benefits of sustainably renovating the Dutch post-war (<1979) terraced houses for the private homeowners”? → Literature study
Already named in the part ‘payback model’ in the introductory chapter. Will be elaborated upon further in the chapter ‘literature research’. Might be moved entirely to chapter ‘literature study’.

4: “What is the perception of current homeowners towards investing in sustainable renovations”? → Literature Study

Already shortly named in ‘related research’ in the introductory chapter. Will be elaborated upon further in the chapter ‘literature research’. Might be moved entirely to chapter ‘literature study’.

5: “When do private homeowners usually opt for a renovation or addition to their current house”? → Literature Study

Will be included in the chapter literature study.

Starting point of research to market value: “How much of an increase in market value can private homeowners expect when doing a sustainable renovation according to appraisers”? → Case Study PAL + Appraisers needed

Practice | Main research and part of practical framework

6: “Which attributes of sustainable renovations add most quality according to private homeowners”? → Discrete choice model in combination with SPSS and SAS, conducted with private homeowners affiliated to the VEH (Vereniging Eigen Huis)

7: “How do private homeowners appraise this extra quality and how much of an increase in market value can this induce”? → Discrete choice model in combination with SPSS and SAS, conducted with private homeowners affiliated to the VEH (Vereniging Eigen Huis)

CONSTRAINTS/PREREQUISITES IN THIS RESEARCH

- The to be researched renovation should be aimed to make the dwelling 100% energy neutral;
- The population for the research are private homeowners inhabiting post-war <1979 row-house dwellings in the Netherlands, who are member of the Vereniging Eigen Huis (Dutch homeowner association);
- The 3D model that will be used to design the images for the discrete choice model, will be based upon the design of Prêt-à-Loger.

CONCEPTUAL MODEL

Disclaimer: this conceptual model is based on assumptions that lead to a hypothesis which is researched during this dissertation.

There are about 1.4 million post war (<1979) row-houses that are poorly insulated, outdated and have a lack of comfort and a lack of space. 60% of these dwellings are owned by private homeowners, but they often have limited investment capacity. This limited investment capacity leads to a poor fundability of sustainable renovations. The fundability depends on several factors, such as the height of the energy bill, the reduction in maintenance costs and the accrued quality. The ‘reduction of energy costs’ and
‘less maintenance costs’ are defined as fixed numbers in this research (there other that are not even listed because they do not influence the model), while the assumption is that accruing quality in a sustainable renovation can lead to an increase in market value. Hence this is the variable that we attempt to maximize. Therefore, in order to improve the fundability of sustainable renovations, an increase in quality is sought. Usually, by increasing the quality, one would need the required upfront investment as well. Both the required upfront investment and the quality (through a loop), influence the investment capacity. The quality in sustainable renovations that is sought, is quality that induce a higher increase in market value than the upfront investment required.

‘Quality’ has been put at the core of the conceptual model. It will be researched what quality exactly is for the target group. By clarifying what is perceived as optimal quality, an increase in quality in sustainable renovations can be achieved and thereby it is assumed that the willingness to pay for such a renovation by the target group will increase. This will in its turn positively affect the number of sustainable renovations.

**Hypothesis**

The hypothesis is that this increase in market value can increase the investment capacity of the target group and thereby the fundability of sustainable renovations can be improved. This could allow the target group to apply more easily for a mortgage top-up or a loan and it would allow banks to make a better risk assessment of their client.
OBJECTIVE AND INTENDED END PRODUCT

OBJECTIVES

1) **Main objective:** Improving the fundability of sustainable renovations of the Dutch post-war housing stock for private homeowners, by clarifying the different attributes in such a renovation that influence the market value of these dwellings and making a recommendation about the attributes that should be included in a sustainable renovation in order to boost a market value increase.

2) **Subgoal:** To determine the current barriers for private homeowners and banks in the process of realization of a sustainable renovation.

3) **Subgoal:** To discover the perception of private homeowners towards sustainable transformation.

4) **Subgoal:** To get insight in the financial benefits of sustainable renovations.

5) **Subgoal:** To discover how the value of certain attributes which can be included in such a sustainable renovation (e.g. a glasshouse, solar tubes light or a green roof) would be appraised.

6) **Subgoal:** Trying to determine an ideal set of attributes which can be added to a sustainable renovation in order to support the financial feasibility of the renovation as whole;

7) **Subgoal:** Determining the market value increase of such an optimized sustainable renovation compared to the old situation. And can this variable be used to make these renovations financially more attractive for its involved stakeholders? → shorter payback time homeowners, less risk money provider, etc;

8) **Personal goals:** to contribute to the body of knowledge of making sustainable renovations to post-war Dutch housing possible. To become a specialist in this field and be able to deploy this knowledge during my further career.

INTENDED END PRODUCT + APPLICATION POSSIBILITIES

The end product will be an advisory report, containing the entire research and a final chapter containing a summary, conclusions, testing of the hypotheses and recommendations. There will be recommendations for further research, but there will also be recommendations for important stakeholders in the field of sustainable renovations for private homeowners, such as the homeowners, the money providers and the designers of the renovations/attributes. This product can be very important for these stakeholders, as it will clarify the benefits of integrating certain attributes in sustainable renovations with regards to the economic feasibility. This can create a situation where homeowners are better able to assess these economic benefits of sustainable renovations and its attributes, which in addition is also beneficial for money providers as they are better able to determine the risk profile for the client. For designers/architects it is important, so they know which attributes are important in a renovation. More about this in the subchapter ‘Relevance’.
THE RESEARCH DESIGN

Below one can find the research design model. In this model you can get a quick overview of the different steps needed to be taken until the final product. This is both done visually through a scheme, as textually through tasks that have to be performed before the different evaluation moments (P1 to P5). On the extreme right, it is possible to see in which phase the different evaluation moments fall, ranging from the research framework to the end product.

The research design consists of five periods which can be subdivided into three periods (P1 to P5), to (P1+P2) + (P3+P4) and P5. These five periods fall in a certain framework: the research framework, the theoretical framework, the practical framework and/or the end product.

**The research framework** | Part of the research framework is the problem statement, the objective(s), the research questions, the research design, the conceptual model, the scientific relevance, the utilization potential and the research design.
The theoretical framework

1: "What are the current barriers for loan providers (banks) to provide with capital for sustainable renovations?"

- Survey Banks + Interviews"? → Already did an interview with Thomas Dekker. Maybe more interviews necessary

2: "Current financial barriers for homeowners to invest in a sustainable renovation of their house and how to address these barriers"

- Literature study: Is partly researched during the P2 already however needs more elaboration and finalising during P3

3: "What can be financial benefits of sustainably renovating the Dutch post-war (<1979) terraced houses for the private homeowners?"

- Literature study: Already started it needs finalizing

4: "What is the perception of current homeowners towards investing in sustainable renovations?"

- Literature study: Already shortly treated in 'related research' in the introductory chapter. Will be elaborated upon during P3

5: "When do private homeowners usually opt for a renovation or addition to their current house?"

- Literature study: Is a small research question that will be answered during the P3

EXTRA: "How much of an increase in market value can private homeowners expect when doing a sustainable renovation according to appraisers?"

- Case Study Appraiser with Prêt-à-Loger. This case study has been done. The information is being processed. First results are quite interesting

In the theoretical framework, an answer to the theoretical research questions is sought. In order to answer these questions, not only literature sources are used, but also interviews with experts in the field and participation in meetings. The start of this theoretical framework has been during the P2, somewhere during the P3 these research questions will need to be completely answered and finalized in order to move on to the conduction of the practical research questions.

The practical framework

6: "Which attributes of sustainable renovations add most quality according to private homeowners?"

- Discrete choice model in combination with SPSS and SAS, conducted with private homeowners affiliated to the VEH (Vereniging Eigen Huis)

7: "How do private homeowners appraise this extra quality and how much of an increase in market value can this induce?"

- Discrete choice model in combination with SPSS and SAS, conducted with private homeowners affiliated to the VEH (Vereniging Eigen Huis)

The practical framework will start during P3 and will be finished at the P4. In the practical framework, the two practical research questions will be conducted to determine the value private homeowners assign to certain attributes that can be part of a sustainable renovation. The first step is designing a questionnaire to later be able to distinguish the results according to gender, age, demographic background and so on. Then, a selection of the attributes that could be added to a sustainable
renovation is made. The discrete choice method (DCM) is used to find out which attributes are adding most quality to the existing house, according to private homeowners.

The following step is designing the pilot with the images. The private homeowners will have to make choices between the images. When they see the images with the attributes (for example one image of a house with the glasshouse and one image of a house without the glasshouse, they can then choose their favourite image. The next questions could be showing different versions of that image and making them choose the favourite out of these options. They could also give a mark to both the pictures, so the picture without the attribute (in casu the glasshouse) and the picture with the glasshouse. This will have to be further researched though.

For the second question, the private homeowners have to state how much extra they would be willing to pay for such an attribute no the house they see. Here it is important to research if it is necessary to give them information about the neighbourhood, the location and the orientation. Also it is important to research if it is necessary to give the value of the reference dwelling (without attributes).

Afterwards, the following steps will have to be taken:

- The results of the questionnaire are processed in SPSS
- The results of the DCM are processed and coded in SPSS;
- Then the coded results are inserted in SAS;
- A summary of the work can be written;
- Conclusions out of the research question can be extracted;
- Hypotheses can be verified/discarded;
- Recommendations for further research can be done.

End product | The finalising of the end product takes place during the P5. This is the last month to finalise everything and to give shape of the final report which will be presented in the form of an advisory report, containing the entire research and a final chapter containing a summary, conclusions, testing of the hypotheses and recommendations for further research.

RELATED RESEARCH

Within this research to a possible increase in market value due to implementation of certain attributes, in a sustainable renovation, quality plays a key role.

According to research of Annelinda van Eck (2008), former graduate at the master of Real Estate & Housing at the TU Delft, homeowners do value quality and financial benefits much higher than possible energy efficiency which is beneficial for the environment. This does not imply that environmental issues don’t play a role at all, but it shows the marginal importance for homeowners. Francisca Riccardo (2013), another former graduate of the Real Estate & Housing Master in Delft, presents in her research the finding that post-war buildings in Europe of the period 1954-1970 rarely meet the demands of today and they usually require large maintenance costs. On top of this dilapidation, the housing stock in the Netherlands from this same period suffers from a lack of identity and poor aesthetics (Andeweg&Koopman, 2007). Individuals tend to prefer exteriors that resemble elements of the past and that have facades that contain decoration and details (Herzog&Shier, 2000; van den Berkhof, 2008). In
addition, in the situation of proper maintenance there is a general preference for older buildings (Herzog & Shier. 2000).

All of the above concurs with the findings of Faro architecten, who emphasize the importance to add details in sustainable renovations to boost the physical appearance of a dwelling. Faro Architects from Haarlem already researched how the public appraises certain housing elements, such as details, ornaments, colours and the amount of green, by employing the discrete choice model (more about this method in chapter 3) and they came to the conclusion that there is a certain ideal set of attributes that can be incorporated in renovations of the existing housing stock in order to boost its market value (Hulsman, 2011). Sometimes it is in the little details and these attributes not necessarily have to cost a lot of money, whilst they add a lot of quality. Ideally these extra attributes would be added to the existing dwelling on a moment that the dwelling is already awaiting large maintenance. A decent investment will then have to be made anyway, hence the inclusion of extra attributes that add quality could be done at relatively low costs. Jurgen van der Ploeg (2014), owner at Faro architecten is of the opinion that the glass house in the design of Prêt-à-Loger is a typical example of an attribute that not only improves the energy performance of the dwelling, but also adds a lot of quality in terms of comfort, extra space and aesthetically. He states that this idea of looking for attributes that combine an improvement in energy performance and other benefits, should be taken into consideration because plenty of sustainable renovations to the existing housing stock will have to be done anyway.

Thomas Dekker (2014), a last year’s graduate of the department of Real Estate and Housing at the TU Delft states in his research to the influence of the energetic performance of a dwelling to its market value, that for a correct market value, appraisers will have to take energy-saving measures into account. Although the research of van Eck (2008) shows that residents are willing to pay more for attributes that aid in making their home more energy efficient, a lot of appraisers still feel reluctant to take these measures into account since exact information on energy-saving measures is missing, both for market actors and for consumers (Dekker, 2014).

In order to take energy saving measure into account, information about the valuation of the different attributes in a sustainable renovation is needed. Also the appraisal of other elements, that sometimes are included in sustainable renovations but do not necessarily have a positive impact on the energetic performance, such as extra space, is needed to make a correct valuation and to find optimal renovation solutions in terms of increase in market value. With the discrete choice method, in collaboration with methods such as SPSS and SAS and a real life valuation by appraisers, this should become clear.

**RELEVANCE**

In this paragraph the societal relevance and the scientific relevance is explained. The scientific relevance is about the importance of this research while the societal relevance treats the necessity of this research for society as whole.

**SCIENTIFIC RELEVANCE**

This research can be an important follow-up on the researches of Thomas Dekker and Annelinda van Eck, both graduated within the Master of Real Estate & Housing. Annelinda van Eck (2008) found out that homeowners value quality and financial benefits much higher than possible energy efficiency which
is beneficial for the environment. Thomas Dekker already mentioned in his research (2014), for a correct appraisal of the value of dwellings, appraisers will have to take energy-saving measures into account.

Also in earlier researches, such as in a research of Anke van Hal (2006), the importance of a tool that makes sustainable construction an auditable tool has been emphasized. Wobben & Hooglander (2006) state that consumers are willing to pay extra for a house that consumes less energy. And a research done by Banfi et al. (2006) in Switzerland corroborates these results, implying that homeowners opt for a house with sustainable attributes over a normal house, at least in a hypothetical situation. These are very interesting findings and an important first step. Since it is still unknown how much these homeowners are willing to pay extra for these kind of sustainable attributes and therefore, how much homeowners are willing to pay extra for a sustainably renovated dwelling compared to a similar dwelling without these attributes, a follow-up on these old researches is needed. Hence in this research, the role of the possible increase in market value entailed by a sustainable renovation of the property, comprising certain sustainable attributes will be investigated.

As a next generation research, I hope to contribute to the body of knowledge concerning valuation of sustainable dwellings by homeowners and more specific, to contribute to the knowledge concerning the valuation of the different attributes in such a sustainable renovation to an existing dwelling by its homeowner. I will do that by employing stated preference methods, such as the discrete choice method. This method will allow me to calculate the willingness to pay of private homeowners for these sustainable attributes in sustainable renovations. By mapping the determined value of sustainable attributes in a sustainable renovation, I expect to get more insight in a possible market value increase as a result of a sustainable renovation.

**SOCIETAL RELEVANCE**

If I am able to come up with new insights in how to alternatively finance sustainable renovations for private homeowners, this can have a big impact on the lives of hundreds of thousands of Dutch families and sequentially on society as whole. If the value of certain attributes included in sustainable renovations is clarified, this is not only useful for the Netherlands, but for all the families inhabiting the 36 million row-house dwellings scattered over Europe. All these people will much better be able to assess the financial impact of such a renovation on their household. Hopefully that will lead to more people getting convinced of the benefits of a sustainable renovation for their dwelling.

In addition it can boost for the development of new branches within the construction industry and it can result in the creation of plenty of new jobs. Hence the fact that this topic has such an enormous societal importance motivates me even more, because I realize that with my research I can add quality and bring up solutions for something particularly important.

**UTILISATION POTENTIAL**

Who, or what instance –directly- can make use of the outcome of this research, and to what extend does it contribute to their work, live or processes, are the outcomes directly applicable or are additional steps needed and what’s the economical valorisation.

My research will hopefully benefit:

- Private homeowners;
Private homeowners | This research can benefit private homeowners, because they get a much better insight in the costs and benefits of sustainable renovations. They will be able to make a rational choice about the kind of attributes they want to have in a sustainable renovation, not only based on functionality, comfort and aesthetics, but also on the financial benefits. This reduces the risk and will hopefully give private homeowners more confidence about the potential of a sustainable renovation.

Money providers (banks) | The outcome of this research can also be beneficial for money providers such as banks. As banks are interested in the risks of their client’s investments, a better insight in the increase in market value can give more precise estimates about the risk level of their clients. Hence they will be better able to assess the maximum height of the loan and the interest level. Since homeowners might feel more comfortable about applying a sustainable renovation to their house, this could also lead to an increase of clients for the banks, or an increase of the total outstanding loans.

The entire Architecture, Engineering and Construction industry (AEC) | If this research leads to more confidence among homeowners and banks to apply sustainable renovations to existing row-houses, this will benefit the entire AEC industry. There will be more demand for architects, engineers and construction companies and with the current situation in this industry as of 2015, this could be more than welcome.

CHAPTER 2 | FURTHER IDENTIFICATION OF THE RESEARCH FIELD

THEORETICAL FRAMEWORK

Before the practical research starts, it is important to get some background information about the motives and perceptions of the different stakeholders such as private homeowners and banks. That is why firstly the 5 research questions, part of the theoretical framework are worked out.

1: “What are the current barriers for loan providers (banks) to provide private homeowners with capital for sustainable renovations”? → Surveys Banks + interviews

The most important reason why banks can be reluctant with providing loans to private homeowners has to do with their risk assessment. A bank wants to keep the risk that the homeowner becomes insolvent as low as possible. In the current situation, where it is relatively unclear how much extra increase of market value a private homeowner can expect after a sustainable renovation and banks have no guarantee about the energy efficiency of the considered sustainable measures, it becomes difficult to provide attractive loans for individuals. According to Rabobank employee Thomas Dekker (2014) and Roland van der Klauw (2014), chief operating officer of NRG031, both factors will have to clarified before mass adoption of sustainable renovations that turn unsustainable <1975 row houses into energy neutral row houses takes place.

They state, that first of all a performance guarantee should be provided by the producers of certain sustainable attributes such as the solar panels, the heat-recovery system or a performance guarantee
about the quality of the window frames or the airtightness. With current guarantees, that often don’t stretch further than 2-3 years, the risk that the performance after 10-15 years is significantly lower is too high, which could lead to insolvent homeowners.

That is why producers should at least give off guarantees of 15 years. Another thing that should be taken into account is that family compositions change due to the birth of children, the death of people or children moving out to study. Families can also move out entirely and be substituted by a family that uses much more or less energy. What happens with that loan or mortgage top-up? will that be automatically transferred to the next house you buy? Or is the loan necessary to make the house energy neutral attached to the house and will it be adopted by the next family? These are all factors to consider account for banks.

Concerning the increase in market value, some aspects have been clarified in the meantime. Stroomversnelling Koop set up a small research with 10 appraisers, to appraise 3 different energy neutral houses in comparison with their neighbours (which are not energy neutral), among them the house of Prêt-à-Loger. These results will be discussed in the extra research question “How much of an increase in market value can private homeowners expect when doing a sustainable renovation according to appraisers”?

2 “What are current financial barriers for private homeowners to invest in the upgrading of their terraced house and how can these barriers be addressed?” → Literature Study

#Under Construction

At this moment it is getting more difficult for (potential) homeowners to get a mortgage, or a loan in general. This is a result from the economic crisis, from which as a result the Dutch housing markets has suffered a severe collapse, with housing prices declining almost 30% in certain Dutch regions. This collapse in the housing market was in one way a result from the global economic crisis, but it was also the results of a housing bubble which built up in the years before 2008. To control the housing market better and to avoid a next housing bubble, the Dutch government has taken certain measures such as the gradual dismantling of mortgage tax reduction and a reduction of the maximum loan-to-value percentage.

- Something about undervalue of mortgages (value less then when they bought the property)
- Something about global trends: more flexible contract resulting in more people with difficulties in acquiring a mortgage/mortgage top up
- Another global trend: the emergence of the lease society, where people value flexibility which they find in lease/rental contracts and not in home ownership → could induce decline of demand → decline of housing prices → difficulties for sustainable renovations because of mortgage under water.
- Er moeten bronnen ingevoegd worden, preferably Thomas Dekker en Roland van der Klauw

Bron: Congres 9 december Stroomversnelling Koop

3: “What can be financial benefits of sustainably renovating the Dutch post-war (<1979) terraced houses for the private homeowners”? → Literature study

When talking about financial benefits, one should take into account that a focus on short term benefits will hamper development in sustainable construction (Robinson, 2005). Most financial benefits need
time to become clear. However, the quicker these benefits become clear, the higher the perceived advantage of the technology and the faster the adoption rate of the technology (van Hal, 2006).

It is true that in the problem statement it has been stated that homeowners on average change their house every 11 years and hence the payback period should be as short as possible, but indicators show that a focus on the entire life cycle of a building can make sustainable construction more cost-effective (van Hal, 2006). Some people will move out a few years after their renovation, meaning that they did the large upfront investment, while the next families reap the benefits. A solution for this problem could be to make the extra investment needed for the sustainable renovation a separate loan attached to the dwelling, which is adopted by the next homeowner as part of the purchase contract. Another solution to incentivize sustainable renovations, is to give incentives to homeowners. These incentives could come in the form of discount on property tax, green mortgages or an overall quality test for housing to make quality a controllable element of the price among others (van Hal, 2006).

Another important factor to take into account are the hidden environmental costs. Anke van Hal (2006) has written about these costs in ‘A labeling system as stepping stone for incentives’. These costs are the costs that buildings incur to avoid having a negative impact on the environment during the years to come. In the case of the <1975 Dutch row-houses, most of these houses already have a current lifespan of 40-60 years, whilst these buildings were initially constructed with cheap materials and without long term vision. Housing associations owning these building often face the difficult decision to either demolish and reconstruct the dwellings, or to renovate these dwellings, thereby extending the lifespan with at least another 20-30 years. For homeowners it is a different story. Not many homeowners will deconstruct their own home to make place for a new one. In order to avoid these hidden environmental costs, homeowners possessing a <1975 row house therefore have quite some incentive to do a major renovation whereby they also improve the dwelling’s energy performance. When you take into account these hidden costs for the next decades, the financial picture of the investment changes completely.

As already mentioned in the problem statement, the savings made on the energy costs are not the only financial benefits homeowners can expect when applying a sustainable renovation to their house. It is now clear that the hidden environmental costs (translated into future maintenance costs) are of quite some importance. A sustainable renovation to your house also offers an extended lifespan and a protection against possible rising energy prices.

An interesting factor that is often forgotten, it that a sustainable renovation to your dwellings often also dramatically improves the indoor climate, consisting of a stable temperature, proper ventilation, stable and low humidity levels, a lack of draught and proper ventilation. According to van Hal (2006), the comfort and health incentive that this improved indoor climate boasts are often more important than the profit based on calculations on a piece of paper (van Hal, 2006).

It can be concluded that there are many direct, indirect and possible (depending on legislation) financial benefits for homeowners. However, one of the possibly biggest financial benefits, an increase in the market value of the dwelling, remains something to be relatively unclear and that is why this research revolves around that topic.

4: What is the perception of current homeowners towards investing in sustainable renovations? → Literature Study

#Under Construction
As we have seen under subquestion 3, comfort & health are often higher appreciated than cost reductions. Nieboer et al. corroborate these findings, stating that the high energy bill is not the most important complaint by its residents. The comfort, quality of space, social security of the home, the appearance of the accommodation and the directly foreseeable costs are more important themes for the residents when it comes to a sustainable refurbishment. These are important elements to consider when aiming for a successful sustainable renovation.

A research conducted by Maguire & Robinson (2000) showed that in the rental market tenants are willing to pay 5-10% higher rents in return for improved comfort and indoor environmental control.

- Researching if there are similar findings in the homeowner market

5: “When do private homeowners usually opt for a renovation or addition to their current house”? → Literature Study

#Under Construction

Different researches (e.g. van Hal 2008, Itard & Klunder, 2006) have shown that the energy efficiency improving measures tend to be done in conjunction with major maintenance works such as repairs or renovations. The advantages are of course the cost benefits, the increased efficiency, but most important, the benefits of combining energy efficiency with boosting the quality of the dwelling. This combined effect becomes more attractive when there is a situation of overdue maintenance. Here counts, the worse the state of the property, the more attractive to combine measures and include sustainability as a relevant factor in a renovation (Bronkees van der Flier: upgrade or replace).

- More information about particular moments in life when these decision moments occur: family expansion, children moving out of house, etc.

Starting point of research to market value: “How much of an increase in market value can private homeowners expect when doing a sustainable renovation according to appraisers”? → Case Study PAL by appraisers

At the 9th of December 2014, ‘the Stroomversnelling Koop’ (Roland van der Klauw, 2014), a conglomerate of participants in the construction sector such as banks, appraisers and construction companies presented the result of a study to differentiate the market value between similar dwellings whereby one of the dwellings had been subject to a renovation to become energy neutral, whilst the other dwelling remained in the old conditions. These dwellings are exactly the same dwellings as the dwellings researched in my research, namely post war <1979 Dutch owner-occupied row houses. Three different dwellings were researched. One whereby the
owner conducted the sustainable renovation himself, one where the sustainable renovation was outsourced to a construction company and the case of Prêt-à-Loger, the student team in which I have participated. The first case could be identified as a ‘hobbyist project’, without considering too much the general taste of possible home buyers. It is not a surprise that this dwelling was only valued €5,000-10,000 higher than similar dwellings in the street.

The second house became also energy neutral thanks to a sustainable renovation, but this was done by a construction company. This house was valued about €10,000 higher than its neighbours. The sustainable measures were deployed not very thoughtful, resulting in a roof that is randomly covered with solar panels and a garden containing an urban wind turbine. This is very much related to the taste of these particular consumers and it makes therefore sense that it does not result in a much higher price appreciation.

The third house that was appraised, is the project of Prêt-à-Loger. The difference of this house, compared to the other two projects, is that there is a much bigger focus on quality expressed in extra space, a higher comfort level, proper aesthetics and the use of natural daylight. This dwelling was appraised as €37,000 more valuable than an exact copy, in the standard original condition. It has to be said however, that this type of renovation also requires the biggest upfront investment, but it shows that serious value increases can be made by combining a transformation to energy neutrality with extra quality. The question remains, how much the separate attributes of this renovation such as the glasshouse, the green roof or the solar tubes have all contributed.

**Conclusions from this conference**

Despite an increase in market value because of a sustainable renovation, a dwelling is still worth depending on what people are willing to pay for it. One important conclusion is that there is a maximum of value increase you can expect. If a dwelling is already situated in a neighbourhood that is less in demand and the surrounding dwellings sell for relatively low prices, it is expected that the dwelling in casu will not yield an exorbitant high market value increase. In other words, dwellings already situated
in more popular neighbourhoods, have more higher market value increase ceiling than dwellings in less favoured neighbourhoods (van der Klauw, 2014). Especially row-houses boasting a value already above the national average for these kind of dwellings will benefit from these measures.

- Saying something about the ‘risk’ → both for banks and for consumers not extremely high

**PRACTICAL FRAMEWORK**

**Research Method**

In this research it is attempted to clarify consumer preferences. There are different methods to find consumer preferences. This consumer preference is also called utility for a certain product. There are different research methods that help to map consumer preferences, such the stated preference method, the non-preference method and the revealed preference method (Adamowicz, Louviere et al., 1994). The state preference method uses statements of individual respondents about their preferences in a set of option to estimate utility functions, by employing interviews and choice experiments. This will be used in this research as well through the discrete choice method, which falls under the stated preference techniques.

With the discrete choice method, it is possible to get insight in the preference of homeowners for attributes of sustainable renovations. The respondent has to consider consistently the different attribute features that are listed on the image (vignette in Dutch). This way, the respondent has to opt between a qualitative better but more expensive situation and a qualitative worse but cheaper situation. This forces the respondent into a choice moment.

The advantages of a model such as the Discrete Choice Model, is that it enables the collection of relevant data based on unconscious user preferences. People do not always make rational choices whenever they make purchase decisions for things such as a house or a car. It is difficult to grasp this preference, however with the DCM this is possible. Preference however, does not induce necessarily a choice. Preference revolves around attractiveness, which can lead to a choice (Jansen et al, 2011). By labeling values to the visualizations, it is sought to generate information about the user’s willingness to pay. The disadvantage of this method is that it does not provide solid, hard data and it requires a lot labor. Some consults with Clarine van Oel are definitely needed to get a firm understanding of the method and its capabilities.

Conducting a research with the discrete choice model will take a lot of time. Most of the time will go into the selection of the different sustainable attributes that will go into the model and the building of the model itself (producing visualizations, researching the costs). Besides the model, I foresee a platform will be needed where the model will be integrated and where people can use the model. Such a platform can be an app, or a website. The latter is easier and therefore I think this will be the preferable option. This has to be discussed with my graduation mentors however.

**Which attributes will be selected from PAL for the DCM and the appraisal of appraisers?**

The PAL-house (Prêt-à-Loger house) consisted of several elements that contributed in making the house completely energy neutral. Among them are measures such as a heat-recovery system, triple glazing or improved insulation. These measures are very important in making the house energy neutral, however most of the time they are not visual, or quasi visual for the resident. For the discrete choice method to function, images (vignette) that elicit user preferences should be deployed. Tripple glazing or improved
insulation might be problematic to display in these images, complicating the incitement of an unconscious preference. This is why (for the moment) a selection of four attributes has been made, that have not only in a certain way improved the energy performance of the PAL-house, but also have a visual impact. These elements are:

1: The glass house;
2: The solar panels;
3: The green roof;
4: The solar tubes;

These elements not only have a visual impact, but surely also represent a certain quality. It will be interesting to see how this quality is assessed by the private homeowners and how much they are willing to pay extra for these attributes.

This is how two of these images could be juxtaposed:

![Image of two juxtaposed images]

One of the questions is, how much information should be added to the images (vignette) and how much questions should be added to questions separately to the images. This is something that will be discussed with the graduation mentors.

**How is the methodology going to work!?**

With the DCM method, the respondent has to communicate his preference based on two or more images. With these choices the willingness to pay of the consumers can be deduced. For every image showing an attribute, the consumer will derive a utility, which is called a sub utility. All the choices for images of the consumer combined, form the total utility of the preferred alternative for the user (van Eck, 2008). In this case, the hypothetical ideal sustainable renovation for the user.

Besides choosing a favorite image (vignette), it can be also interesting to map the appreciation a consumer assigns to the image by allowing them to mark the image from 1-10. This way, a more specific appreciation of the images can be derived.
**Which software is going to be used to process the research results?**

Before applying the DCM to the population, it might be useful to get more insight about this population. An idea could be to first get information about the target group, such as gender, age, total area house, family size, average age children, annual household income, the value (€) of their house, family relocation plans for the coming years and so on. This way, the specifics of the population can be mapped and future research results from the DCM, might be related to certain population specifics. The program NetQ can be used to construct the survey. Another option is to create the survey in Google Forms, which is a free, open source application of Google to design surveys.

To process and arrange the survey results of the population’s specifics, SPSS can be used. For the analyses of the DCM results, another program has to be used however. This program, called SAS, allows to analyze the total utility of the images, to analyze the probability of choice (the chance an image in the DCM method is chosen) and to report (van Eck, 2008).

**Which actors are needed to fulfill the research?**

In order to fulfil the research successfully, the following actors are of utmost importance:

- My graduation mentor Clarine van Oel, who is a specialist on the DCM and knows how to use SPSS and SAS.
- The Vereniging Eigen Huis (VEH) = Dutch homeowner association with grosso modo 100,000 members. This association has cooperated before with Real Estate & Housing graduation students, such as with the dissertation of Annelinda van Eck (2008). In that research she managed to get almost 1,000 respondents. A similar number will be my goal.

**How am I going to establish contact WITH VEH?**

I hope to establish contact with the VEH through my graduation mentors and hopefully with a graduation company behind my name. I expect that they are willing to collaborate, because of their past involvements in graduation researches.

**GRADUATION PLANNING**

This planning made in excel will be updated regularly, since it is impossible to say at the moment which stakeholders will be needed exactly during all the process and which tasks will be done at what time. The planning has been sent as an additional file, since the table is too big to display in this paper.
Anke van Hal en Clarine van Oel are the first two mentors. Anke van Hal will bring in knowledge about the existing housing stock and sustainability. Clarine van Oel is my second mentor and is highly necessary for conducting the research with the Discrete Choice Model, as she is a specialist on this method. Philip Koppels will give me consult in case I need help with the financial calculations.

The scientific domain this research falls within is ‘housing’ and more specifically ‘the existing housing stock’. It also has strong relation to sustainability and building economy however.

For this research I am looking for an interesting company to partner up. I have two appointments the coming weeks, with Built4U in Amsterdam and with BAM in Bunnik.


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Internet sources


Interviews

