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**COHERENO**  
Collaboration for housing nearly zero-energy renovation

# Customer segments and value propositions in the nZEB single-family housing renovation market

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## Contents

<b>Abstract</b> .....	4
1 Introduction .....	5
2 Research approach .....	6
2.1 Research goal.....	6
2.2 Research methods .....	6
3 Customer segmentation and value propositions .....	8
3.1 Demand-side questionnaire.....	8
3.2 Overall results .....	9
3.3 Insights from partner countries .....	18
3.3.1 Austria.....	18
3.3.2 Belgium .....	26
3.3.3 Germany .....	34
3.3.4 The Netherlands.....	39
3.3.5 Norway.....	45
4 Market potential for nZEB renovation .....	49
4.1 Introduction .....	49
4.2 Partner countries.....	50
4.2.1 Austria.....	50
4.2.2 Belgium .....	51
4.2.3 Germany .....	53
4.2.4 The Netherlands.....	54
4.2.5 Norway.....	55
5 Conclusion and discussion .....	57
References.....	59
International .....	59
Austria.....	59
Belgium .....	60
Germany .....	60
Netherlands.....	61
Norway.....	61
Appendix I: Questionnaire for homeowners .....	63
Appendix II: Interviews with homeowners .....	76

## Abstract

Research was done in Austria, Belgium, Germany, the Netherlands and Norway as part of the Intelligent Energy Europe project, entitled “COHERENO - Collaboration for housing nearly zero-energy renovation” ([www.cohereno.eu](http://www.cohereno.eu)) to better understand the customer segments and the value propositions for nZEB renovation of owner-occupied single-family houses (SFH). The partners analysed the results of a demand-side questionnaire sent to experience home-owners, interviewed experiences home-owners and used national available literature to do so. Next national literature and statistics was used to determine the market potential of nZEB renovation.

It is observed that the customer segments of nZEB renovations are diverse and differ per country. Most important segments are households between 40 and 60 years old, with an income above average, living in a detached house. The majority of the households that had their house renovated had clear energy saving targets in mind and took decisions by themselves, knowing what they wanted. Most of the households had multiple reasons to decide to renovate. Reducing the consumption of energy and improving indoor comfort or health conditions was for the majority of the households important to decide to renovate.

In most countries the market for energy renovations of single-family houses is clearly growing. Clearly, there is a lack of data about construction years of single-family dwellings and their current condition status. A greater part of research results in the field of energy-efficiency measures are focusing on individual renovation measures and do not provide clear guidance about the possible uptake of integrated nZEB renovations. In all partner countries governmental initiatives address the private SFH market to go beyond single energy efficiency measures.

## 1 Introduction

The report is established as part of an Intelligent Energy Europe project, entitled “COHERENO - Collaboration for housing nearly zero-energy renovation” ([www.cohereno.eu](http://www.cohereno.eu)). The main objective of this project is to strengthen the collaboration of enterprises in innovative business schemes for realizing nearly Zero Energy Building (nZEB) renovation in owner occupied single-family homes.

Based on findings in previous European projects (One Stop Shop, 2012; SuccessFamilies, 2012) it is the opinion of various researchers (Haavik et al., 2012, Mlecnik et al., 2012) that collaborations should aim for integrated renovation and streamlined project management where responsibilities of actors are clearly defined, and actors collaborate to reduce fragmentation. To increase volume uptake of nZEB renovation, it is generally assumed that this should be led by lower costs, lower burden for the client, limiting renovation time, and so on (One Stop Shop, 2012; SuccessFamilies, 2012).

However it is poorly understood what the characteristics are of segments of households who want to engage in nZEB single-family home (SFH) renovations. In most cases those initiating the retrofitting and those living in the house before, during and after the retrofitting are the same people. Often the owner-occupants do not have specific technical knowledge or an interest in retrofitting. In other words: What are their motives to choose for a nZEB-renovation of their house? Also, it is not well understood who they are, how they can be reached and what type of relationship with actors that have the specific technical knowledge, they value.

*Customer segmentation is defined here as dividing a market segment into identifiable groups of customers that are specific in specific ways relevant to business modelling, especially what are the needs of each defined segment and what value propositions could fulfil these needs. What are their customer values and motives to choose for nZEB? Also, it is not well understood through what channels they can be reached and what type of customer relationships they value. Therefore further research was established to investigate these issues in the five COHERENO partner countries.*

This report analyses relevant experiences from homeowners who recently renovated their house to a nearly zero-energy buildings (nZEB) renovation and proposes national customer segmentation for business modelling purposes. The research was performed in five partner countries (Austria, Belgium, Germany, The Netherlands, Norway) in order to identify regional business modelling issues - particularly customer segmentation and value propositions for suppliers - that can lead to improved collaboration of actors and to identify the need for quality assurance in these countries in order to increase customer confidence of such home renovations.

## 2 Research approach

### 2.1 Research goal

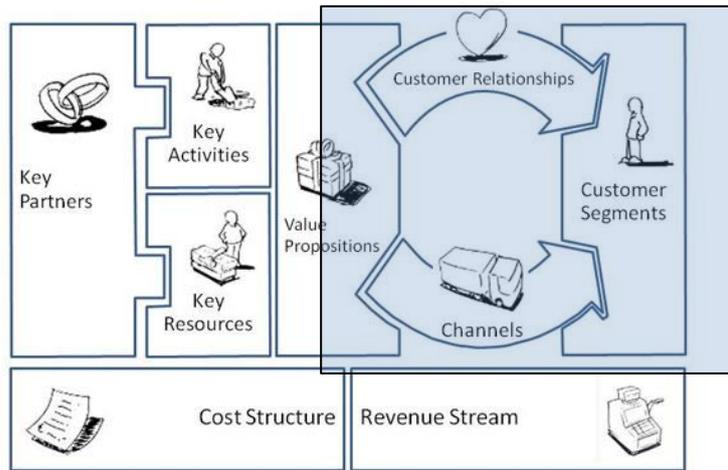
The general goal of the COHERENO project is to map structures for successful collaboration between contractors and other supply actors that are involved in nearly zero-energy building (nZEB) single family home (SFH) renovations. To support this general goal, it is the goal of this work to detect most potential customer segments (of owner-occupants) for nZEB SFH renovations and to identify characteristics of customers (in this case innovators and early adopters) that are similar in ways relevant to business modelling (like for example for the definition of customer values).

### 2.2 Research methods

On the one hand, this research wishes to identify the customer segments per partner country willing to take up nZEB renovations as well as propositions of customer values (value propositions) that can meet the needs of these customer segments. On the other hand this research also aims to estimate the market potential for nZEB SFH renovations, i.e. the volume of the customer segment willing to take up nZEB renovations per partner country. These issues will then be used for suppliers' business modelling purposes.

To address the first part, the building blocks of the business model generation canvas developed by Osterwalder and Pigneur (2010) were used as a basis for setting up a demand-side questionnaire. See Figure 1. The model defines customer segments as different groups of people or organizations an enterprise aims to reach and serve. Value propositions are the bundle of products and services that create value for a specific customer segment. Channels are the means how a company communicates with and reaches its customer segments to deliver a value proposition and customer relationships are types of relationships a company establishes with specific customer segments.

This questionnaire focusses on providing additional insights for business modelling, especially regarding the definition of the customer segment willing to take up nZEB renovations, their value propositions, communication channels they used and customer relationships they appreciated. In the development of this questionnaire particular attention went to finding arguments to increase customer confidence by quality assurance. In previous work the nZEB radar was used to define a pool of interviewees (frontrunner homeowners) in each partner country. These homeowners in five partner countries are addressed with the demand-side questionnaire. Furthermore three homeowner interviews per country (covering different customer segments) and national studies on customer segmentation provide additional insights that will lead to defining national customer segmentation approaches for nZEB SFH renovation.



Source: <http://www.businessmodelgeneration.com/>

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**Figure 1: Scope of the demand-side questionnaire in the framework of business model generation.**

Used additional research differs per country: available literature, available statistical data, extra interviews because of embedding in a broader education research project (Belgium), state-of-the-art in the nZEB renovation market (demand and supply), and so on. Various countries have already performed studies on customer segmentation and value propositions to address the uptake of (high) energy efficiency. The results of these studies are taken into account with a literature study per partner country.

The market potential for single-family homes nZEB renovation could be based upon national statistics and other available national data, for example about the total number and types of single-family dwellings, construction years, single-family dwellings in need of deep renovation, energy performance certificates of these dwellings, investments in energy saving measures.

Furthermore, the study approximates the volume of SFH needing nZEB renovation based on preliminary data from the IEE projects ‘ENTRANZE’ (<http://www.entranze.eu/>) and ‘EPISCOPE’ (and TABULA) (<http://www.episcope.eu/>).

Additional insights are obtained through national advisory board meetings and in an international workshop entitled “nZEB Home Renovation: Who asks and who delivers?”, held in Brussels, 16 October 2013. In this workshop some results of previous studies on customer segmentations and business cases were presented to members of the national advisory boards of the COHERENO project. In this way, feedback could be organized from both the demand and the supply-side.

## 3 Customer segmentation and value propositions

### 3.1 Demand-side questionnaire

The demand-side questionnaire has been developed taking the business model generation canvas as a reference (Osterwalder and Pigneur, 2010). The questionnaire focusses on providing additional insights for business modelling, especially regarding the definition of the customer segment willing to take up nZEB renovations, their value propositions, communication channels they used and customer relationships they appreciated.

The development of the online-questionnaire was done August 2013-January 2014 to ensure all relevant issues would be addressed and especially to guarantee the relationship with parallel on-going work about 'creating customer confidence'<sup>1</sup>. After revising an extensive questionnaire, 54 questions remained to assure a higher response rate.

The English questionnaire was translated into German, Dutch, French and Norwegian with the help of the partner countries. The partner countries were responsible to send the electronic questionnaires (by e-mail) to the frontrunner households of the projects listed in their country<sup>2</sup>. The questionnaires were sent in January 2014. The reference data of the response is 24<sup>th</sup> February 2014.

The questionnaire addresses the following questions:

- Household characteristics (size, age, income);
- General data about the renovation (house type, construction year, investment in energy savings, resources to invest, completion date);
- Motivation for energy renovation (energy saving targets, communication channels);
- Motivation for a major renovation (building conditions, indoor comfort and health conditions, financial and environmental reasons);
- Activities during the renovation (thermal insulation activities, building service systems, involvement of professional parties);
- Experiences with contractors, especially the general contractor and the contractor building services (quality assurance, offer, what made the contractors excellent?);
- Product used on site;
- Aspects and elements that give trust in achieving overall end results;
- Successfulness and satisfaction of the renovation project;
- Recommendations helping other people that plan to renovate to find good contractors.

The final questionnaire can be found as an appendix of this report.

Answers from the different partner countries were recorded in an English database enabling to present overall results of the questionnaire. Besides, the partner countries have analysed

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<sup>1</sup> See the COHERENO Work and reports on Creating Customer Confidence (WP4)

<sup>2</sup> See the COHERENO Work reports on Mapping Frontrunners (WP2)

the answers on the questionnaire in their own country illustrated with quotes from the interviews with home-owners.

**Results of the questionnaire, especially dealing with Quality Assurance, are also reported in “Creating customer confidence through quality assurance“ (D4.2).**

### 3.2 Overall results

The questionnaires were sent to owner-occupants of SFH nZEB renovations, listed as frontrunner households (WP2) and occasionally to other household not already listed as such, in five different languages. Overall 66 frontrunner households responded to the questionnaires. See table 1.

**Table 1 Response questionnaire per country**

	Responses
Austria	7
Belgium	19
Germany	11
Netherlands	19
Norway	10
Total	66

As we are dealing with “innovators” the number of responses is low. Therefore an in-depth quantitative analysis per country is neither possible nor meaningful. A quantitative analysis would be meaningful if the nZEB renovation market has grown into maturity. However meaningful indications are made clear for the frontrunner home-owners per partner country.

#### Customer segments

An overall picture reveals that:

- The households exist for one third of 1-2 person households and exist for two thirds of more than two persons. The majority is between 40 and 60 years old (64%). Of the household 23% is younger than 40 and 13% is 60 years or older.
- Almost half of the households think their household has a total annual income above average. A few households (4; 6,5%) think their household has a low income.
- 60% of the households renovated a detached house, 23% a terraced house and 10% a semi-detached house. 47,5% of the renovated houses was originally built before 1945, of which 10% was built before 1900. 77% of all renovated houses wer built before 1970.
- 12% of the households invested according to their own estimation less than 40,000 Euro, of which 5% invested less than 10,000 Euro. It is doubtful if the invested sum accord with a nZEB renovation. Almost 64% invested more than 100,000 Euro in their

home renovation and almost 50% invested even more than 200,000 Euro in their major renovation.

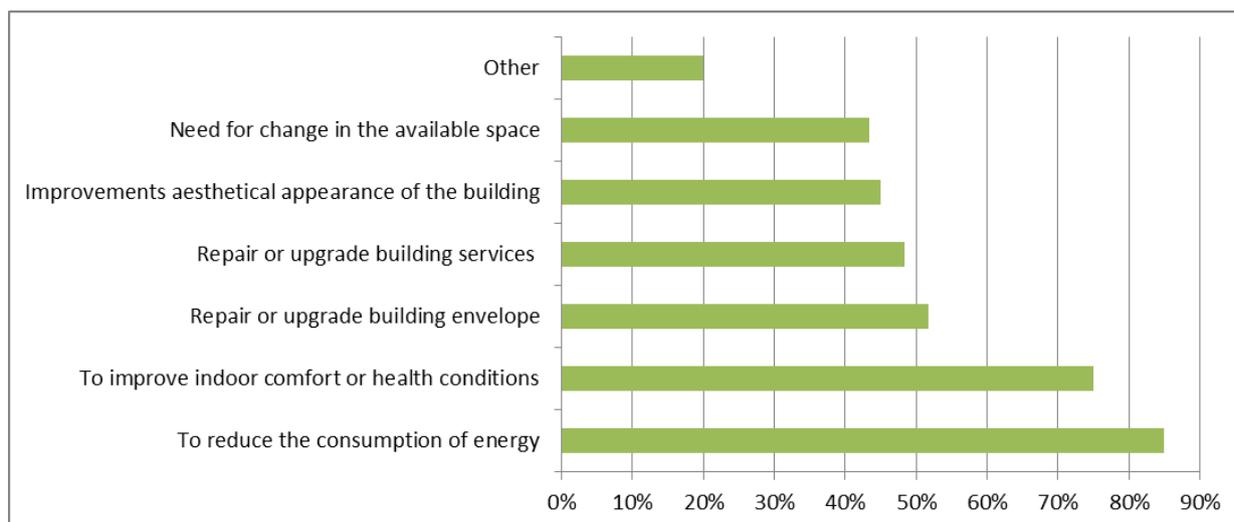
- Most of the households financed the renovation largely with own savings. 16 respondents (25%) applied for a new mortgage, others for a loan especially for home renovation (13) or a loan especially for energy-efficient renovation (18).
- Half of the renovations were completed less than 3 years ago, of which 20% was completed less than 1 year ago. 28% of the renovations are not yet completed.
- Surprisingly 30% of the households did not live in the house that was renovated. 25% lived in the house for less than 5 years before the renovation started.
- Almost one third of the households that already lived in the renovated house, did not live in the house during the renovation. Meaning the renovation works probably didn't make that possible.

### Value propositions that convinced homeowners to renovate towards nZEB

70% of the households had clear energy saving targets in mind before renovating their house. 18% had no specific energy target in mind before the renovation. The target came later on, for example after discussion with professionals. The other households did not aim for a specific energy performance target. Almost 80% say that the renovation has led to the targets or aspired end results they had in mind.

Generally the households were not influenced by other people to choose for high energy efficiency renovation of their house. People that influenced households partly were especially architects and energy auditors.

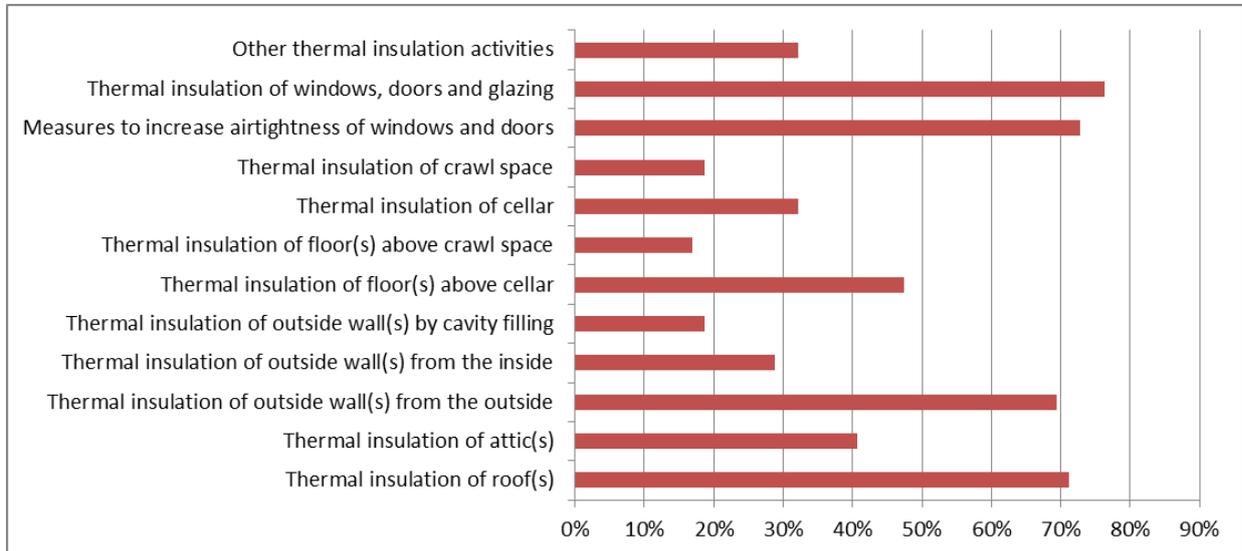
Clearly, reducing the consumption of energy and improving indoor comfort or health conditions was for the majority of the households important to decide to renovate. Most of the households had multiple reasons to decide to renovate. See Figure 2. In the report D4.2 and in the insights from partner countries home-owner views on the drivers for renovation are further elaborated.



**Figure 2 Motivation for a major renovation (multiple answers possible; n=60)**

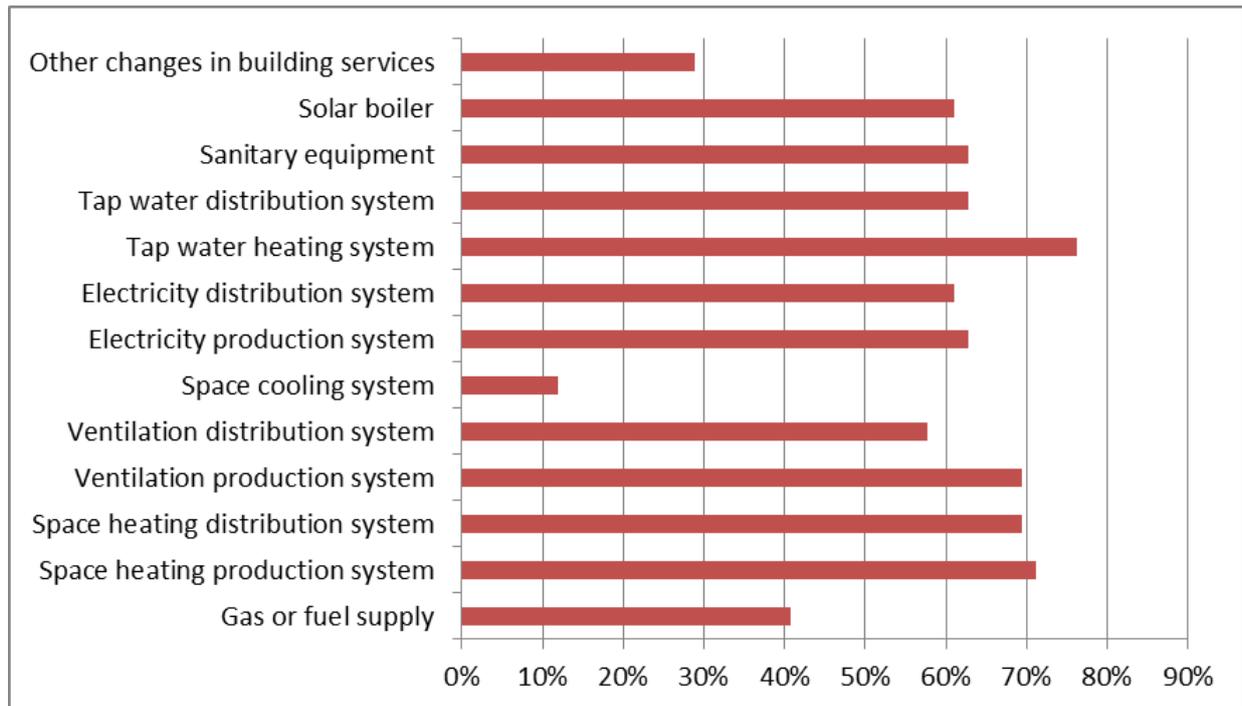
### Renovation activities

The households performed all kinds of thermal insulation activities of roofs, wall, floors, windows, door and glazing. Also measures to increase airtightness of windows and doors were performed by 73% of the households. See Figure 3. Many household gave examples of other insulation activities they had performed.



**Figure 3 Thermal insulation activities performed during the renovation (multiple answers possible)**

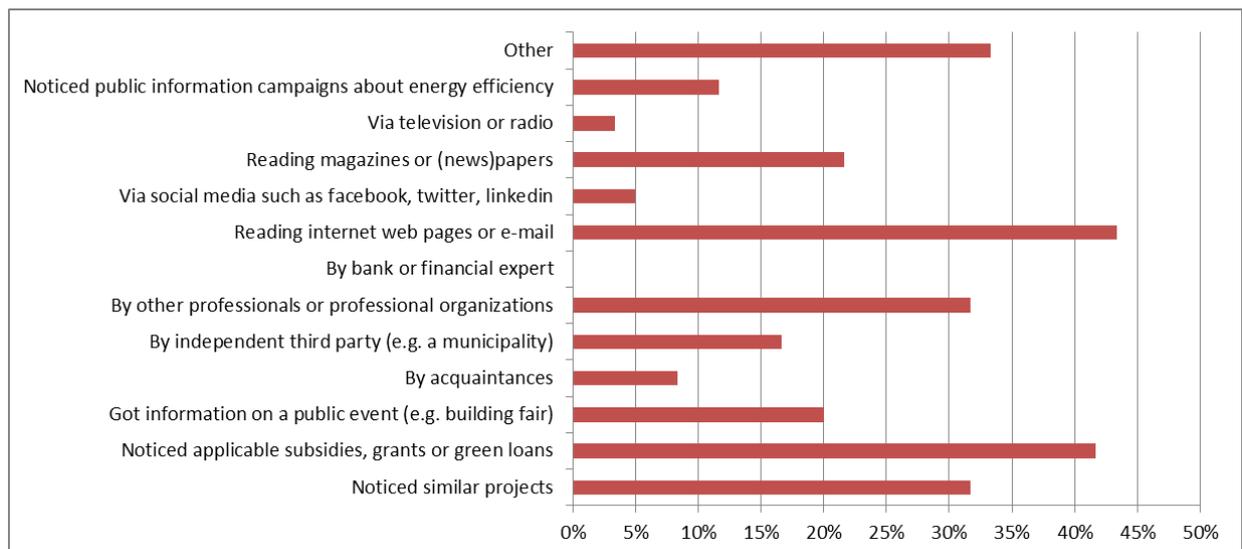
Most of the households changed several building service systems during the renovation. Except space cooling systems and gas or fuel supply all systems listed in the questionnaire were changed by more than 60% of the households. 41 households changed the ventilation production system. See Figure 4. Many household gave examples of building service systems they had changed during the renovation.



**Figure 4 Building service systems changed during the renovation (multiple answers possible)**

### Communication channels that effectively reached home-owners

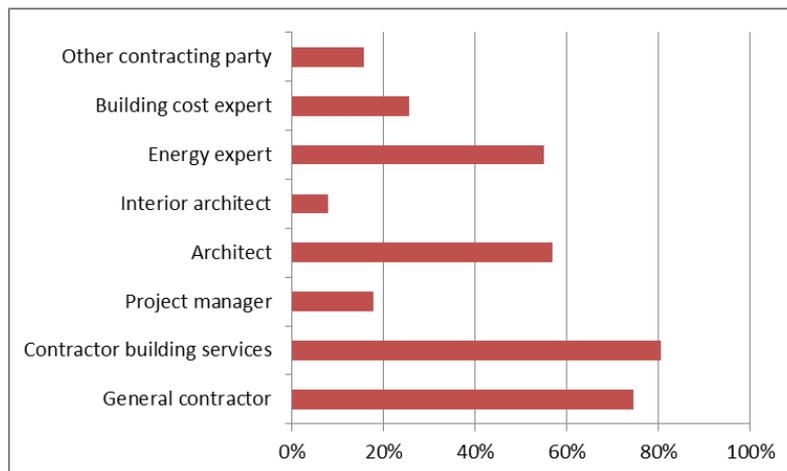
The used communication channels that influenced the households to decide for very high energy efficiency are quite diverse. Noticing similar projects, information about energy efficiency on the internet and e-mail, and especially noticing applicable subsidies, grants and green loans were important. Also, professional organisations seem to have a noticeable influence. See Figure 5.



**Figure 5 Communication channels that influenced the households to decide for very high energy efficiency (multiple answers possible)**

### Customer relations

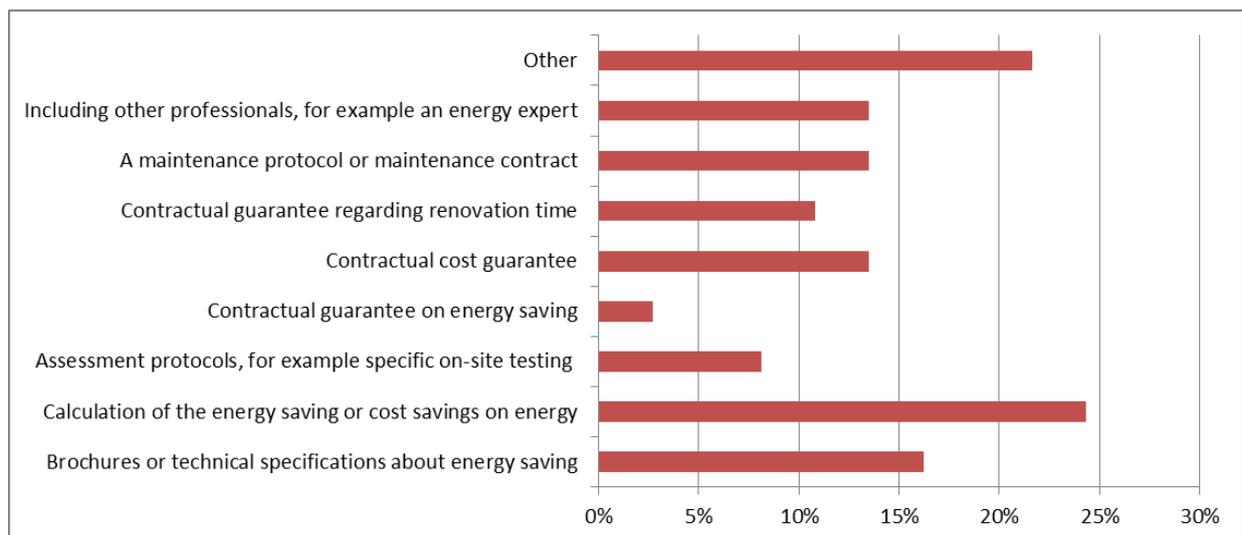
86% of the households (51) contracted professional parties to do the renovation projects. The other households had very diverse reasons not to contract others. Especially contractors for building services (41) and general contractors (38) were involved as professional parties for the renovation works. Also architects and energy experts were in more than half of the renovations involved. See Figure 6.



**Figure 6 Contractors involved in the renovation (multiple answers possible)** (\* in the German questionnaire the answer category building cost expert was not available)

### General contractor

The households were asked what the general contractor offered them. See Figure 7. Various things were offered. A calculation of the energy saving or cost savings on energy was just offered 9 times (out of 38). However, other involved professional parties could have offered these calculations instead.



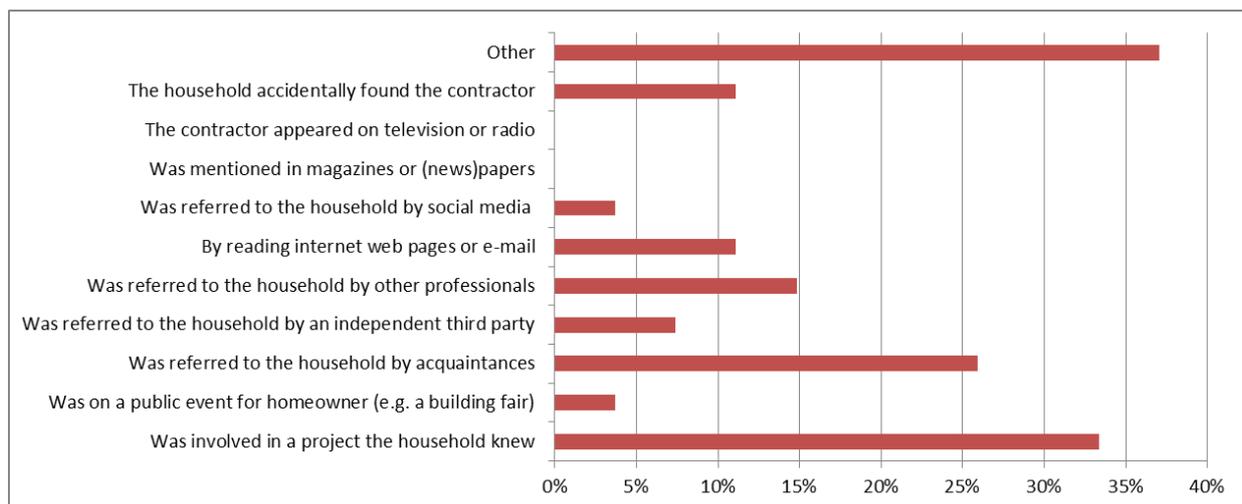
**Figure 7 What did the general contractor offer the household (multiple answers possible)** (\* in the German questionnaire the answer category contractual guarantee on energy saving was not available)

73% (27) of the households have the opinion that the general contractor delivered an excellent job. Figure 8 shows what those households particularly appreciated about the general contractor. Most important are the creativeness of finding solutions, the times spent with the household to discuss the project (both issues mean time investment for the contractor!), and keeping to agreed costs and delivery time.



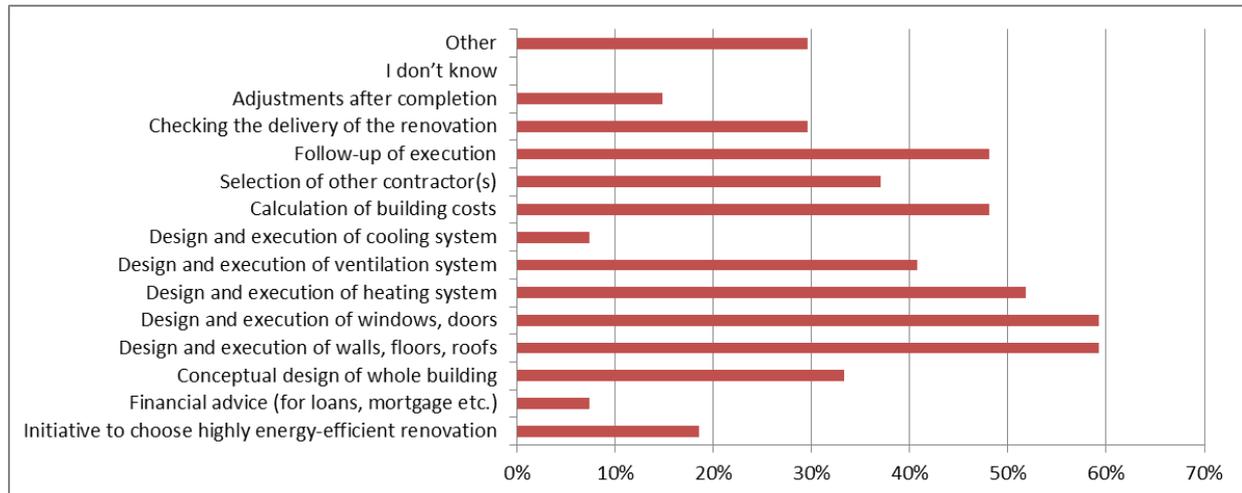
**Figure 8 Issues households particularly appreciated about the general contractor (multiple answers possible)**

Figure 9 shows how the households knew the general contractors, that they indicated to be 'excellent'. The answers correspond with the answers on the question how the the households checked whether the engaged contractors had the proper skills and experience for the job. Important is to know a contractor from other projects and references of acquaintances.



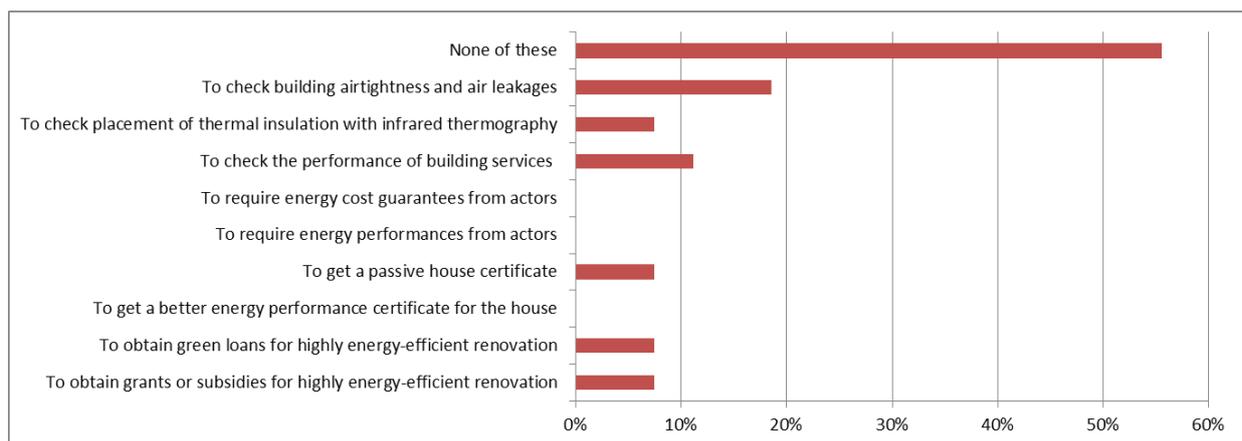
**Figure 9 How the households knew the excellent general contractors (multiple answers possible)**

The households were asked for the construction phases in which the general contractor was involved. See Figure 10. Not surprisingly design and execution of walls, floors, roofs, windows and doors are mentioned the most. However, also the design and execution of heating and ventilation system is named by almost one third of the households. Of course the contractor can be multi-skilled and also be the contractor for these building services. A lot of excellent general contractors were also involved in the calculation of building costs and follow-up of execution.



**Figure 10 Construction phases in which the excellent general contractor was involved? (multiple options possible)**

The households were asked for issues – possibilities - they were informed about for the first time by the excellent general contractor. See Figure 11. Obviously, the excellent contractor is not the actor that informs the household the first time about e.g. subsidies and green loans, energy performance guarantees, and methods for quality assurance.

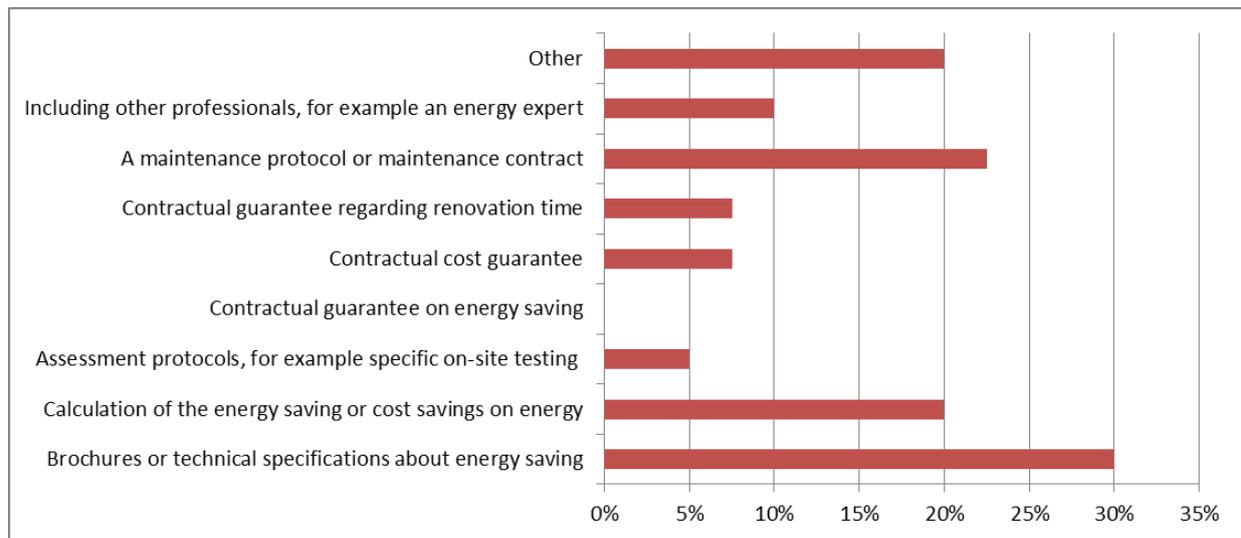


**Figure 11 Issues the households were informed about the first time by the excellent general contractor (multiple answers possible)**

### Contractor building services

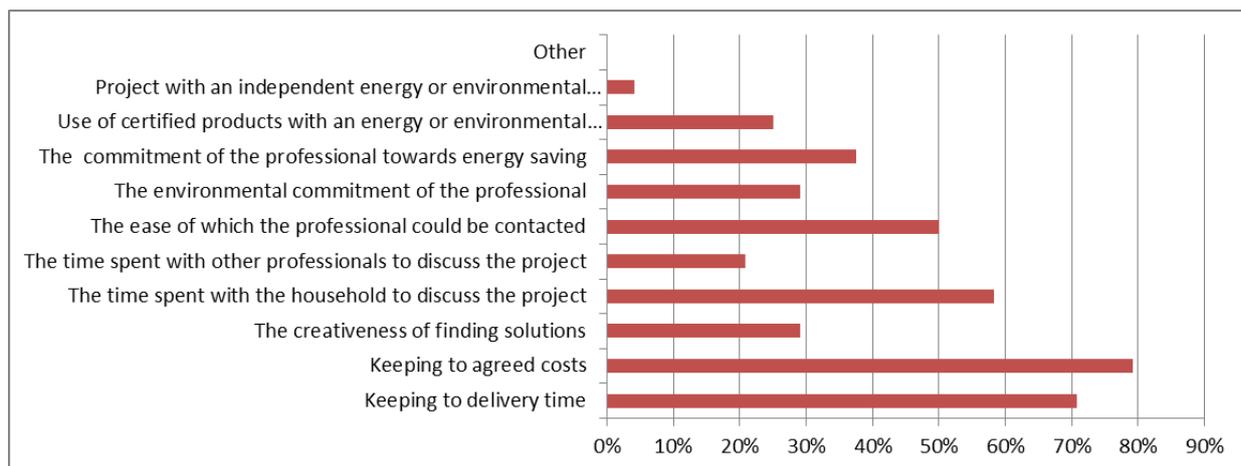
The households were asked what the contractor building services offered them. Brochures or technical specifications about energy savings were offered to 12 of 40 households. You

might expect that contractors of building services always offer this material about their services. Also a maintenance protocol was just offered to 9 households. Contractual guarantees on energy savings were just offered once. See Figure 12.



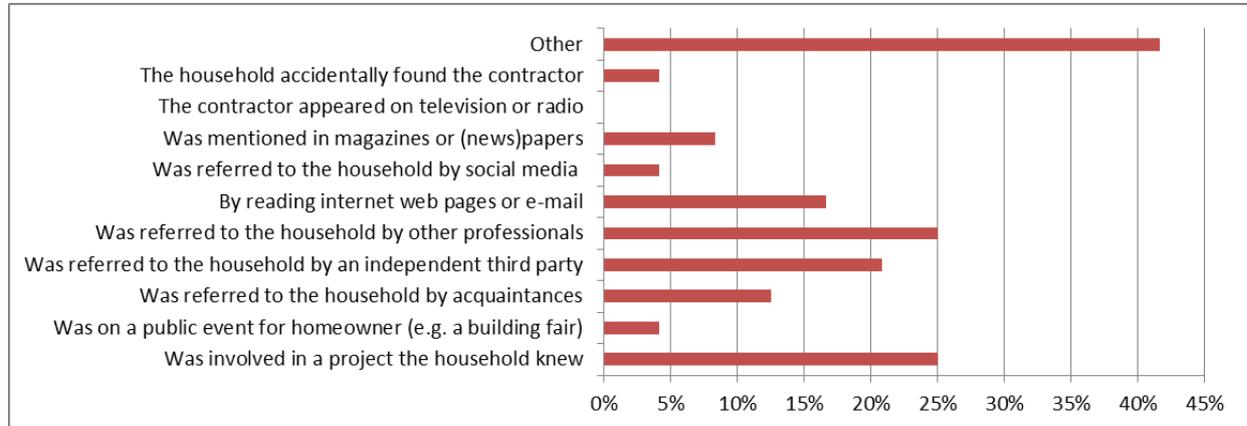
**Figure 12 What did the contractor building services offer the household (multiple answers possible)** (\* in the German questionnaire the answer category contractual guarantee on energy saving was not available)

63% (25) of the households have the opinion that the contractor building services delivered an excellent job. 20% (8) had not that opinion and 17,% (7) didn't know. Figure 13 shows what those households particularly appreciated about the contractor building services. Keeping to delivery time and to agreed costs are appreciated by the majority of the households. Also, the time spent with the household to discuss the project and the ease of which the professional could be contacted were important parameters.



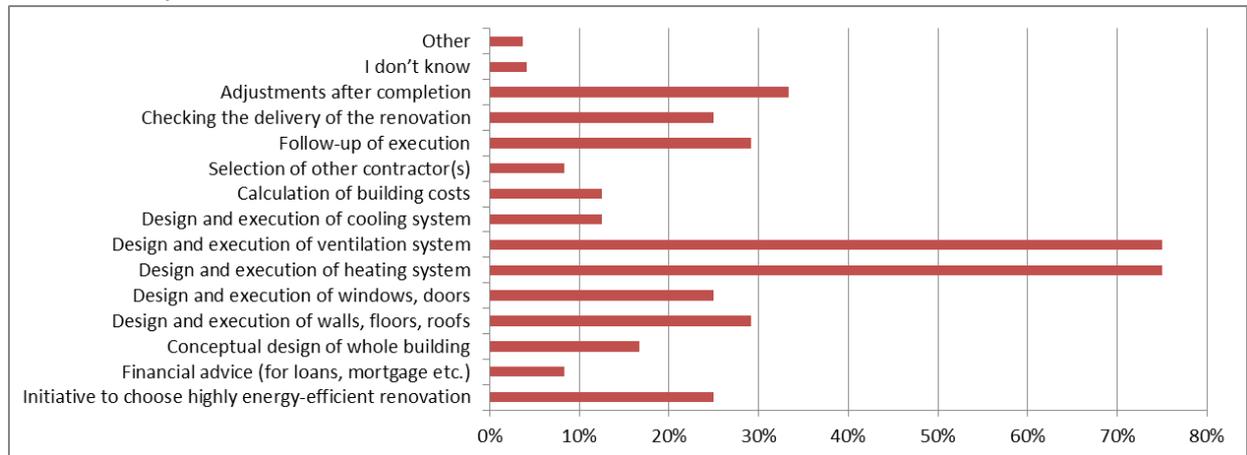
**Figure 13 Issues households particularly appreciated about the contractor building services (multiple answers possible)**

Figure 14 shows how the households knew the excellent contractors building services. The answers correspond with the answers on the question how the the households checked whether the engaged contractors had the proper skills and experience for the job. Important is to know a contractor from another project. Also important is a reference by other professionals or professional organizations.



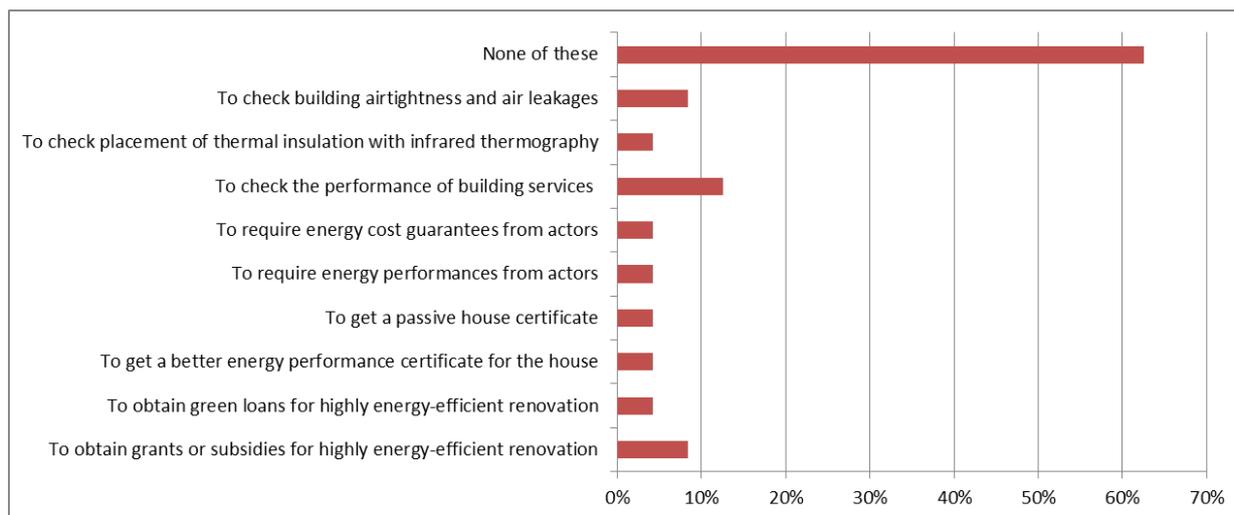
**Figure 14 How the households knew the excellent contractors building services (multiple answers possible)**

The households were asked for the construction phases with involvement of the contractor building services. See Figure 15. Not surprisingly the design and execution of heating and ventilation systems are mentioned the most.



**Figure 15 Construction phases in which the excellent contractor building services was involved (multiple options possible)**

Finally, the households were asked for issues the household was informed about for the first time by the excellent contractor building services. See Figure 15. The various answers indicate that the contractor building services is not the actor that informs the household the first time about e.g. subsidies, energy performance guarantees, and quality assurance.



**Figure 16 Issues the households were informed about the first time by the excellent contractor building services (multiple answers possible)**

### Successfulness and satisfaction of the renovation project

The home-owners were asked how successful they think the renovation project is and their satisfaction with the result of the renovation:

- 27% of the households consider their renovation project extremely successful giving a 10 on a scale from 1 very unsuccessful to 10 very successful. Another 33% give a 9 and 32% a 7 or 8. 8% consider their renovation not successful giving a 4, 5 or 6.
- 33% of the households are extremely satisfied with the result of the renovation project giving a 10 on a scale from (extremely dissatisfied) to 10 (extremely satisfied). Another 29% give a 9 and 30% a 7 or 8. 8% is not satisfied giving a 3, 4 or 5.
- 92% of the households will in a next project choose again for a highly energy-efficient renovation. The others don't know.

## 3.3 Insights from partner countries

The insights from partners countries are based upon the questionnaire, interviews and a literature search of related research.

### 3.3.1 Austria

#### 3.3.1.1 Customer segments, value propositions, channels and relations

##### Customer segmentation

In total, 7 responses were obtained from the web-questionnaire. In order to gain additional insights, three qualitative interviews were conducted. The households are situated in two different parts of Austria (two of them in Tyrol and one in Upper Austria). One household is inhabited by a young couple (mid 30's) with no children, whereas the other two households are inhabited by a family of five persons, respectively. According to the Austrian survey, the average age of respondents is 43 years ranging from people aged 35 to 50, with higher income and higher level of education. Correspondingly, previous studies in Germany and Austria have uncovered similar customer segments according to renovation motives,

personal characteristics, building characteristics and access to information services and consulting services. Due to the fact that the number of respondents in COHERENO was quite limited, the results do not claim to be statistically representative. However, the results correspond to the findings of the literature study. Table 2 summarizes the different homeowner typologies.

**Table 2 Customer segmentation in Austria (based on literature study)**

Type	Distribution	Motives for Retrofit	Characteristics - Person	Characteristics Building	Information / Advice
<b>Type 1</b>	<b>25% -26%</b>	energy rehabilitation measures, reduction of energy costs, interest for technologically solutions, value preservation and increase	younger to middle age, middle and higher level of education and income	own house, short holding period,	wide range of advice, energy consulting more often than average
<b>Type 2</b>	<b>24-29%</b>	Maintenance, energy savings must expect to secure and increase value, price advantage	middle age group, middle social class	long period of ownership, rental housing	construction and maintenance advice instead of energy advice
<b>Type 3</b>	<b>12-21%</b>	solve acute problems, single measures, the environment is not an issue	older people, light to medium education, low income	long holding period, older building	not actively seeking information
<b>Type 4</b>	<b>12-14%</b>	"Do it yourself"-maintenance work, embellish, cut costs	younger, male, lower income	short period of ownership, urban	Craftsmen, DIY-Store
<b>Type 5</b>	<b>16-18%</b>	embellishment, renewals, maintenance work	younger, male, middle to higher class	younger building, property,	hardly any energy consulting, receptive to new technologies,

Source: Energy Styles (2011), ENEF Haus (2010), ÖGUT (own table)

The assessment of the segmentation of the five types in both studies is approximately the same. Around a quarter of the people are open-minded to extensive refurbishment because of their attitudes and values. They often ask for energy information and counselling services.

The customers who were interviewed by ÖGUT in the national project "WoZuBau" demonstrate Type 1 characteristics (ÖGUT et al. 2014). Within this group, different subtypes have been developed. One is Type A, most likely to have a preference for nZEB-renovation. See Table 3. It is interesting to note that the typologies identified in the COHERENO project have strong similarities to those in the "WoZuBau" project.

**Table 3 Customers 'Type A' in Austria most likely to have a preference for nZEB-renovation**

Personal characteristics	Younger or middle age group (under 50 years), better educated, middle and higher income households with children or two-person households 21% of the renovators are between 31-40 years old; 10% are younger than 30 years (50% of women in this age group); 23% secondary school, 31% have university / college education; 25% more than € 3000, 8% more than € 4,500; Younger people are more willing to invest more
Building features:	SFH-renovation, suburbs as well as centre; shorter holding period (less than 5 years); acquired either by transfer of ownership (e.g. inherit), or by buying buildings openness to extensive (energy) renovation shortly before or shortly after the transfer of ownership.
Motives for renovation:	A comfortable indoor climate and home comforts; energy-efficient renovation; Use of renewable energy sources: = for younger people (73%) and those with high education (73%) important; Increase the value of the building = more important motive for the middle age group.
Willingness to implement / themes in counselling:	This type shows more openness to technical and environmental measures (e.g. also to comfort ventilation ...); "Using renewable energy sources" is of above average importance; greater willingness for greater energy efficiency in more promotion, men show more willingness for energy monitoring; more willingness for a loan = highest consent in middle-aged (41%) and middle education.
Sources of information:	Financial services, purchasing consultants, planners and builders may be the first point of contact; energy consultancy is actively sought; major information campaign by the energy consulting, comprehensive counselling services; show best practice examples
Recommendation:	Recommended models: renovation when purchasing home, deep renovation concept. Mandatory Energy consulting (on site consulting), attractive funding model with specific requirements for energy efficiency; Energy Performance Certificate; profitability, LCC.

Source: ÖGUT (own table)

### Value propositions

In Austria, the survey carried out within COHERENO indicates that respondents have different priorities and objectives for renovation. There is no single objective that can be attributed to a majority of respondents. The main reasons for a 'deep renovation' are to improve the aesthetic appearance of the building, thereby preserving the historical structure, and to reduce the consumption of energy (71% of respondents, respectively). However, it is also interesting that several respondents aimed to retain the unique historical structure and combine it with state-of-the-art living comfort. Other objectives convince homeowners to a lesser extent - namely enlarging the available living space, renovation of the building envelope and technical equipment or improving indoor comfort - and are evenly distributed

among the respondents in Austria (4 out of 7). This implies that most people have manifold objectives.

Most respondents named saving on living expenditures and reducing their energy bills, linked to receiving grants or subsidies for low-energy measures, as the main financial reasons to renovate their single family home. The answers indicate that energy-saving renovations are considered a significant and uncertain investment, which means that the actual energy saved could remain below expectations. Hence, policy instruments such as subsidy programs could be an effective way of promoting such investments.

In general, respondents have reported altruistic motivations such as environmental protection or unconventional reasons such as doing it as a hobby and making a personal contribution to their energy-efficient renovation. Financial reasons are also given to a lesser extent, only a small fraction of building owners have considered incentive programs such as financial subsidies as a motivation for their renovation. Hence personal preference and intrinsic motivation are important drivers that determine whether and which type of renovation is conducted. The interviewed persons and those who filled out the questionnaire are primarily concerned with energy-efficient building through their profession.

## **Channels**

As in other countries, the main source of information concerning energy efficient renovations was the profession itself. The majority (> 50%) of respondents either work or are experienced in the field of energy efficient building such as energy consultancy, passive house planning or architecture. Generally, the interviewed persons were directed to energy efficiency by other professionals or professional organisations.

To a lesser extent but still very effective, homeowners were convinced due to applicable subsidies, grants or green loans. However, this leads to the conclusion that the funding authority has a steering role regarding the quality of the renovation. In Austria, the funding conditions are partly very different in each of the nine Federal States, pursuing own targets and objectives. Taking this fact into consideration, an Austrian-wide harmonised funding regime could push nZEB renovations by the promotion of standardised criteria. The only common criteria between the Austrian provinces are the minimum requirements for housing subsidies according to the thermal heating demand, which are defined in an agreement between the state and the provinces (WBF-15a-B-VG, 2008). The next agreement is scheduled for autumn 2016.

As a starting point, internet and social media serve homeowners as source of information but there is no alternative replacing professional craftsmen like energy advisers, architects and contractors. For the scope of COHERENO energy advice was not stated as a very important source of information, because most of the respondents were personally involved in the renovation value chain and had an educational or professional background in the field of energy efficient building.

To sum up, personal motivation to renovate the single family homes has been crucial for the people who took part in the survey. In addition to energy advice, construction and maintenance advice were also appreciated.

## Customer relations

Among the biggest challenges mentioned by respondents concerning the renovation was the difficulty to obtain adequate planning as there are no standard solutions for highly energy-efficient renovations available on the market. The challenge is to combine the preservation of the historical building structure with the application of passive house components. The major responsibility lies within good planning including a holistic approach.

It is indeed appreciated by customers if the contractor or service provider complies with the agreed costs. In general, trust and confidence in contractors is very important when it comes to a renovation. As a matter of fact, homeowners will trust local contractors they know and if they can demonstrate best practice examples in the vicinity. Renovation examples significantly increase confidence.

As stated in the interviews, another important issue is to find appropriate local contractors who are reliable and engage qualified, skilled labour. The time spent with the household and other professionals to discuss the project has been appreciated by most of the respondents. However, confidence in the quality of the contractors was reported as insufficient and partly poor.

The interviews revealed that the contractors' knowledge of energy-efficient renovation is largely insufficient and not up to date with modern building standards. It has been pointed out that networking is missing and as a result the ability to "think outside the box" with regard to tasks and responsibilities is not common. The coordination of contractors was difficult and mostly done by the homeowners themselves.

The following recommendations can be summarised:

- involve local contractors with qualified and certified staff in the renovation
- integral planning as a key success factor
- list contractors in a quality network
- establish a renovation coordinator, also who guarantees that different components match together (quality assurance!)
- schedule enough time with the household and other professionals to discuss the project

## Willingness to invest

According to the survey, the main motive of Austrian single family homeowners for the implementation of thermal-energy-related measures is the expected cost and energy savings. Comfort improvements and necessary conservation measures (44%) are important motives as well. Especially with very old buildings, maintenance is of particular interest. Subsidies are considered important. If subsidies are claimed, they often lead to higher energy refurbishment quality than originally planned.

The main obstacle for major renovations is the question of cost. In contrast to new construction, the tendency for a renovation is to finance measures from own resources and not to take out a loan. Therefore frequently only individual components will be renovated. A big problem in the implementation of a comprehensive redevelopment is the technical

uncertainty of the owner. They do not always know how to tackle the project properly and how to find good professionals.

According to related research on the customers of construction-related energy consulting (survey, n=348) which was conducted in 3 Austrian provinces in 2013, ÖGUT could identify a detailed motivation structure for those homeowners who are basically interested in energy efficiency (ÖGUT et al, 2014):

- Socio-demographic characteristics of the customer: half of energy consultation customers are older than 50 years. The younger the consulting customers, the more women there are. The number of pensioners within the renovation clients is above average, but correlates well with the age of the customers. Based on the budget form, two-person households with children or without children are approximately equally represented (around one third). The number of consulting customers with medium and high levels of education is higher compared to the rest of Austria. Around a quarter of potential renovation homeowners are retired.
- Holding period and age of building with main influence on the level of investment: 60% of the customers have owned their buildings for more than 15 years, with half of those planning to invest more than € 40.000,-. The older the building, the more likely the homeowners are to invest more money. People who have owned the building for less than 5 years are much more willing to invest more money.
- Internet and social networks are important sources of information: a quarter of the interviewed homeowners mention the internet, friends and social networks as the most important sources of information. Fairs and the communities are other main sources. Overall, the clients are satisfied with the energy advice given by the provinces.
- High degree of implementation of the measures recommended within the energy advice: Especially measures in relation to the surface and the building service system, which are prioritized in the consultation, are implemented even to a greater extent than recommended.
- Economic motives such as "less energy consumption" and "reduced energy costs" are the main motives of the customers: the reduction of energy consumption and energy costs are the main motives for the renovation. The use of renewable energy sources is less important than the question of comfort and maintenance. Energy consulting contributes to strengthening and supporting the existing motives of customers.
- Housing subsidies: state grants and federal funding: about one third of all people who perform a renovation claim state housing subsidies and federal funding as well, 60% opt for either the federal funding or check the state housing subsidies.
- High acceptance of guidelines for the subsidies: around 60% of homeowners would be willing to implement a higher efficiency level than originally planned to get more subsidies. This includes the willingness to implement special building services and for exclusive use of renewable energy sources.

### 3.3.1.2 Conclusions customer segmentation and supply-side activities

According to the previous studies which correspond to the results of the survey in “WoZuBau”, the most specific customer segment for nZEB renovation can be described as younger to middle aged persons with a high level of education and income. See Table 4.

**Table 4 Customer segmentation in Austria**



Type	Distribution	Motives for Retrofit	Characteristics - Person	Characteristics Building	Information / Advice
Type 1	25%-26%	energy rehabilitation measures, reduction of energy costs, interest for technologically solutions, value preservation and increase	younger to middle age, middle and higher level of education and income	own house, short holding period,	wide range of advice, energy consulting more often than average
Type 2	24-29%	Maintenance, energy savings must expect to secure and increase value, price advantage	middle age group, middle social class	long period of ownership, rental housing	construction and maintenance advice instead of energy advice
Type 3	12-21%	solve acute problems, single measures, the environment is not an issue	older people, light to medium education, low income	long holding period, older building	not actively seeking information
Type 4	12-14%	"Do it yourself"-maintenance work, embellish, cut costs	younger, male, lower income	short period of ownership, urban	Craftsmen, DIY-Store
Type 5	16-18%	embellishment, renewals, maintenance work	younger, male, middle to higher class	younger building, property,	hardly any energy consulting, receptive to new technologies,

Comparing the results of the different data, there are positive correlations regarding the building features, motives for the renovation, the willingness to invest and the sources of information, highlighted in red boxes in Table 5. The participating homeowners are open to extensive (energy) renovations shortly after acquisition or transfer of ownership. Primarily, customers are motivated by energy rehabilitation measures and creating comfortable indoor climate conditions. This type also shows more openness to technical and environmental measures (e.g. comfort ventilation). Finally, the information channels are the same.

Referring to demand-side experiences which are taken into account at the supply-side, many respondents pointed out that there is insufficient knowledge and more common a lack of quality of work. On the other hand, actors from the supply-side make an effort to establish quality networks. Moreover, the majority of actors from the supply-side carry out additional training and education on a regular basis.

The lack of communication and information is made up for by a constantly updated website and social media appearance by most companies. Awards and promotions for best practice examples as well as databases listing the examples also support their image and public appearance.

Finally, a tendency for cooperation and hence for the establishment of regional and local networks can be noticed as customers increasingly demand local contractors which give them confidence.

According to customers, there should be more attention paid to:

- more effective marketing strategies
- holistic renovation concept
- interdisciplinary collaboration
- coordination of renovation

**Table 5 Customers ‘Type A’ in Austria most likely to have a preference for nZEB-renovation**

<p><b>Typ A:</b></p> <p>personal characteristics :</p>	<p>Younger or middle age group (under 50 years), better educated, middle and higher income households with children or two-person households</p> <p><i>21% of the renovators are between 31-40 years old; 10% are younger than 30 years (50% of women in this age group); 23% secondary school, 31% have university / college education; 25% more than € 3000, 8% more than € 4,500; Younger people are more willing to invest more</i></p>
<p>Building features:</p>	<p>SFH-renovation, suburbs as well as center; shorter holding period (less than 5 years); <b>acquired either by transfer of ownership (e.g. inherit), or by buying buildings openness to extensive (energy) renovation shortly before or shortly after the transfer of ownership.</b></p>
<p>Motives for renovation:</p>	<p><b>A comfortable indoor climate and home comforts; energy-efficient renovation;</b></p> <p>Use of renewable energy sources: = for younger people (73%) and those with high education (73%) important; Increase the value of the building = more important motive for the middle age group.</p>
<p>Willingness to implement / themes in counseling:</p>	<p><b>This type shows more openness to technical and environmental measures (e.g. also to comfort ventilation ...);</b></p> <p>"Using renewable energy sources" is of above average importance; greater willingness for greater energy efficiency in more promotion, men show more willingness for energy monitoring; more willingness for a loan = highest consent in middle-aged (41%) and middle education.</p>
<p>sources of information:</p>	<p><b>Financial services, purchasing consultants, planners and builders may be the first point of contact; energy consultancy is actively sought; major information campaign by the energy consulting, comprehensive counselling services; show best practice examples</b></p>
<p>recommendation:</p>	<p>Recommended models: renovation when purchasing home, deep renovation concept. Mandatory Energy consulting (on site consulting), attractive funding model with specific requirements for energy efficiency; Energy Performance Certificate; profitability, LCC.</p>

### 3.3.2 Belgium

#### 3.3.2.1 *Customer segments, value propositions, channels and relations*

##### **Customer segments**

19 responses were obtained in total: 12 for Flanders Region and seven for Brussels Capital Region. Additionally, insights obtained from three interviews conducted with three households, complementing those when relevant with findings obtained from seven additional interviews (a total of 10 interviews have been conducted). Household 1 and Household 2 are composed of a couple in their 30's, plus one baby each, and Household 3 is a couple in their late 50s with no children living in the house any more. Drawing from the answers obtained from the web-questionnaire, it seems the selected households aged 30-39 followed by those aged 50-59 represent a majority.

The web questionnaire showed that the typical Flemish household who decides to renovate their single-family house to nZEB standards consists of two members. Those two-member households are mainly composed of couples above 54 – presumably with children already outside the house; alternatively, of young couples with no children yet. For Brussels the questionnaire reveals that nZEB renovations are most popular among 4-member families aged 30-40, very presumably a couple and two children based on ages and information obtained in the interviews.

The three households interviewed happened to be highly-educated as well as have a technical background and building expertise in-house or accessible through their jobs. Further interviews confirmed this is a tendency as all interviewed households were highly educated and just one household had no member with a background in architecture, engineering or environmental development. Household 1 and Household 2 rated their income as 'above average' while Household 3 did so as 'high'. In this respect, from the 16 responses to the COHERENO web-questionnaire obtained for Belgium, just one of the respondents who had conducted a nZEB renovation considered their income 'below average' (7 households described their income as 'average', 5 did as 'higher than average' and 3 did as 'high'). In general, the younger the household the lower the income was, all 'high' income households consisting exclusively of age groups 50+.

The web questionnaire showed that all Belgian single family houses renovated to nZEB standards dated from before the 80s. In fact almost 75% dated from before 1945 and 60% from before 1930. In Brussels more than the 85% of the houses renovated dated from 1930 or before which is not surprising considering from the two regions analyzed Brussels has a notably older housing stock. All the three houses renovated dated from before 1945. The web questionnaire in this respect shows that in both regions households with lower incomes tend to buy oldest houses whereas for households with higher incomes there is no obvious pattern: some opt for newer houses, some still buy older or the oldest houses.

The web-questionnaire illuminated that actually no household invested less than 60,000 euros and that 53% of the households invested 200,000 euros or more. The renovation of Households 1 and Household 3 amount more than 200,000. Household 2 invested between 120,000 and 140,000 euros. This significant difference is not due to the level of ambition of the households but to the fact that Household 2 contracted just the necessary professionals – for windows, roof and the timber-frame construction - and did the rest themselves.

## Value propositions

The analysis of the web questionnaire shows that in Flanders region environmental reasons seem to weigh most. There are no differences in the importance of this factor for different age groups. After environmental reasons, finance appears to be what end users care for most, closely followed by comfort reasons. There are no obvious patterns for the different age groups. In Brussels region comfort motivations closely followed by environmental reasons predominate, while financial motivations seem to be low.

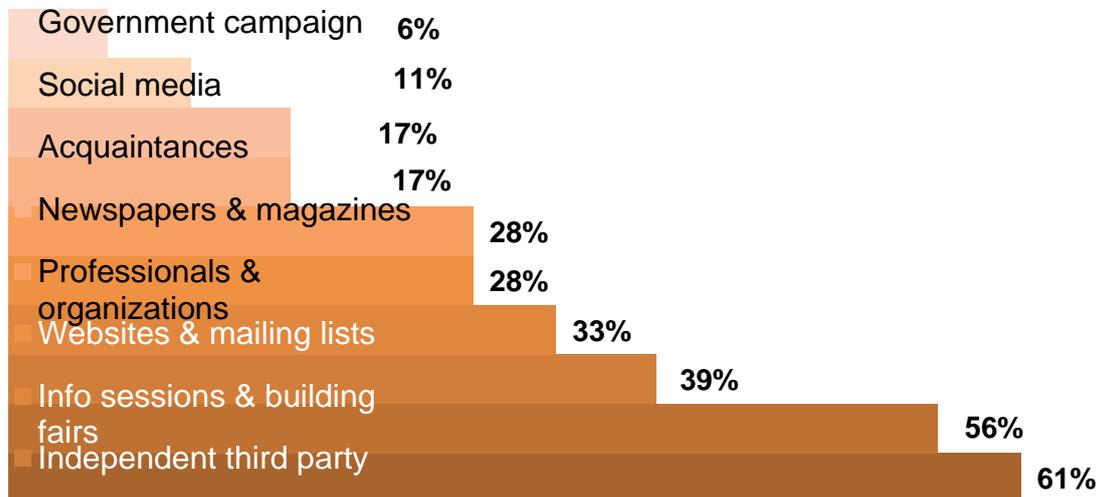
The questionnaire results somehow contradict the information obtained via the face-to-face interviews as probably the most remarkable finding is that in all renovations in the region of Brussels with no exception, the so-called “Bâtiments Exemplaires” government grant was key to take the projects that far; in fact, the majority of the households in Brussels agreed to be in the first instance interested in renovating their homes to a low-energy level yet having pushed further incentivized by this substantial grant whose ambitious energetic demands required more stringent measures to be taken. For the rest, results from interviews also point at a combination of environment and comfort as the most important drivers for nZEB renovation.

Household 1 and Household 2 both bought the house with the intention to renovate it. Household 1 lived there for almost 3 years before conducting the renovation but moved somewhere else when the renovation began. Both the web questionnaire and the interviews show that in Brussels region households did not live in the house during the renovation Household 2 on the other hand began the renovation works straight away as the house was not really habitable when they purchased it. Household 3 had been living in the house for thirty years when they decided to renovate - although they had conducted some other renovation works in the 80s as well and stayed in the house during the renovation. All households mentioned environmental sensitivity and comfort as reasons to renovate. Additionally, Household 1 and Household 3 highlighted the crucial role financial incentives played in their decision. Household 1 was part of the “very generous” – in the words of the interviewee - Brussels grant programme and Household 3 counted with subsidies for glazing and insulation, a green loan and fiscal benefits that in total amounted up to 15.000 euros.

## Channels

For Belgium as a whole the web questionnaire points subsidies and green loans as the most effective way to influence households to adopt a nZEB renovation, closely followed by example projects. See Figure 17. Independent third parties and public building fairs and info-sessions proved also effective means to a certain extent. On the other hand the least effective means to exert influence on households are the government, social media platforms and acquaintances. Differences between Flanders and Brussels region are quite significant in this respect when looking at the web questionnaire responses. While Flemish households were primarily lured by example projects and info sessions and building fairs, in Brussels region grants and green loans were the most effective (once again, in contrast to what households stated as their motivations to renovate). From the results of the face-to-face interviews building fairs and example projects would take the credit for motivating households in both provinces equally, as personal interest in environmental issues and sustainable housing is indeed often materialized into visits to such events. These events take credit for providing households with an initial understanding of nZEB renovations. There are

no clear differences on the effectiveness of different channels to influence different age groups although it appears that perhaps websites and emails, and green loans exert some more influence on the older groups.

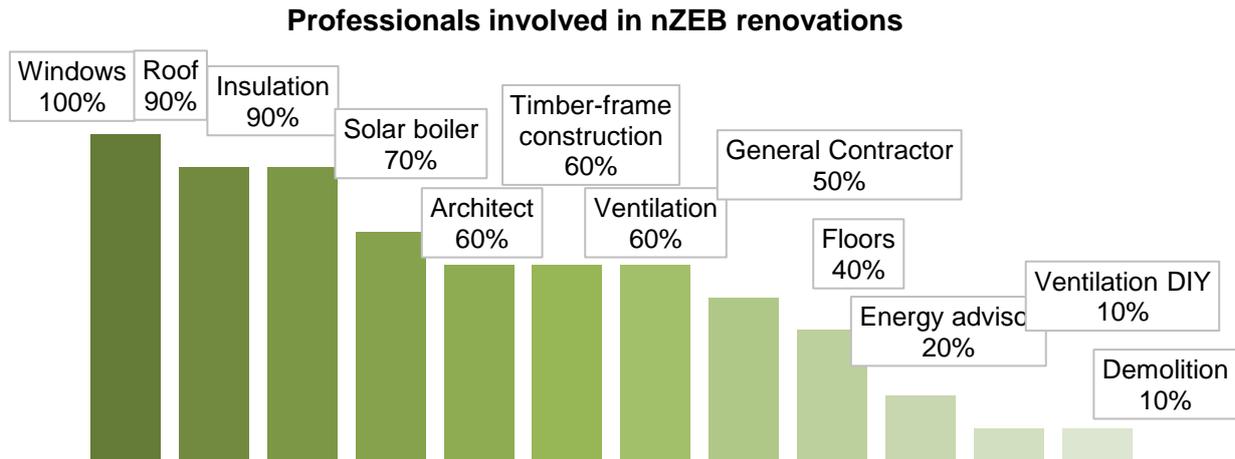


**Figure 17. Influence of different communication channels to promote nZEB renovations in Belgium**

Additional input from interviews allowed to obtain a better idea of the specific channels within those generic channels. For instance example projects were visited at the Open Doors days. Info sessions and building fairs named are the Passive House Symposium, meetings organized by Bruxelles Environnement with house owners who have already gone through a renovation, and Belgium’s largest building fair Batibouw. The websites Brussel Energie ([www.bru-energie.be](http://www.bru-energie.be)), Vibe ([www.vibe.be](http://www.vibe.be)), Bruxelles Environnement ([www.bruxellesenvironnement.be](http://www.bruxellesenvironnement.be)), as well as emails from Ecobouwers ([www.ecobouwers.be](http://www.ecobouwers.be)) were mentioned by the households.

### Customer relations

Figure 18 illustrates - based on the interviews conducted - the type of professionals typically involved in nZEB renovations in Belgium, as well as the relative frequency with which they tend to be contracted by households.



**Figure 18. Professionals involved in nZEB renovations according to the frequency they are contracted; Source: Face-to-face interviews (results from 10 interviewees)**

The involvement in the renovation of professionals varied considerably between the interviewed households. Household 2 did almost everything themselves (except placing windows and the timber-frame construction), from demolishing all that they reckoned not needed and preparing the foundations for the timber-frame construction, to placing and insulating the floor themselves, actively working on the roof with the contractor they hired for it, and so on. Household 1 contracted professionals for everything except the demolition work, which they did themselves with help of friends. Household 3 contracted professionals for everything, with the exception of some bits of floor insulation in one of the rooms they did themselves. The reason why these households –and every single other household interviewed- did some, many or all of the works themselves –instead of hiring professionals for it- was in all cases monetary. Yet for complicated works the time spent on it may not have compensated the amount of money saved as Household 2 stated regarding roof works.

The web-questionnaire revealed that a quarter of the households did not check for the quality of the contractors at all, and that the majority who did check, did not do so very exhaustively. They mostly relied on contractors recommended by acquaintances and some on-site experience examples of the contractors, or the impression of the contractors’ knowledge or talks with households who had worked with those contractors in the past. Handbooks and guidelines, courses and trainings, and certificates were seldom checked.

This is confirmed by the interviews. Household 1 looked for the contractors by “asking around” in their network and eventually through the trusted architect they found. Households 2 relied on friends and Household 3 conducted a thorough research on the internet as well as attended Belgian largest building fair Batibouw. What is striking is that none of the households was sure of the quality of the contractors contracted prior to the renovation starting, despite all said to contact contractors they had been referred to by someone they trusted or/and to have asked for references. Expressions such as “you can’t know” or “it is a gamble” reveal professionals in the sector should work on building a more trustworthy and strong image in order to gain some more confidence from the demand side. Household 1 relied on the positive opinion about the contractors acquaintances had and a prior successful collaboration between the architect and the contractors for the windows. Household 2 did not

conduct any check for “they were friends”. Household 3’s main criterion was to find local contractors and materials made in Belgium. At further interviews the following quotes were harvested: *“The best recommendation is someone who says “I’ve worked with [X] and he is a nice guy and he does the work carefully and you can trust him”, and “he [the air-tightness contractor] did not just do his job but was really interested, committed.”* From the interviews it can be deduced that households aged 40+ perform a more thorough selection and check upon contractors’ previous works by for instance asking previous customers. The web questionnaire in this regard showed that the two only households who thoroughly checked upon the work of the contractors prior to hiring them happen to be 50+, although assuming older households perform a more stringent quality check would be preliminary.

From the web questionnaire responses it is known just 25% of the households tend to live in the house while the renovation whereas more than the 60% does not; the other households tend to live there for a while. From the three interviewees, the only family who stayed in the house during the renovations was Household 3. The renovation in this case purportedly began at the upper floor so that once that ready the couple could move there while the renovation in the rest of the house would take place. The renovation took 2 years, yet they said to have enough comfort thanks to a kitchen, bathroom, bedroom, computer room and an extra bedroom they had access to on that floor, as well as the fact that dust did not go up two floors. Initially, Household 1 also intended to stay in the house while the renovation would take place despite having been thoroughly discouraged by professionals, although in the end they found out conditions were going to be worse than expected e.g. too much dust, no water or electricity, etc. and moved to the apartment of a friend of theirs who happened to be travelling for some months. Household 2 who started renovating immediately moved for the time the renovation will go on to the grandparents’ house of one of the two, available at that time. The renovations took 1 year for Household 1, is still in process for Household 2 after more than 1 year, and lasted 2 years for household 3. In all cases, the works have been delayed for at least 6 months. Household 1 was guaranteed a renovation delivered in 6 months by the general builder who had to pay a penalty for the delay. The delay in the case of Household 2 was due to the fact that they were doing everything themselves, next to their jobs, which has proven very challenging. Household 3 blames “the lack of follow up” among contractors for the delay, although in this case no penalties were included. From further interviews it is found delay are quite common. One household said their renovation should have been finalized two months prior to the interview whereas at that moment the only thing done was a concrete floor. They specified: *“we every day hope they are there working”*. Moreover, penalties were also agreed upon on contract by another household but when the delay happened, they encountered huge difficulties to make the general contractor pay for it, which caused the household much unrest and frustration with no payment from the general contractor at all as the only solution left was to take him to court and that would have been even more time-consuming and nerve-wrecking.

From answers of Household 3 and Household 1 which read *“I can’t understand how it took them so long to figure out...”* and *“I don’t know what his constraints were, his stories...”* respectively, it feels that some suppliers were not able to satisfactorily inform and manage expectations of end users along the renovation process. In similar vein, further interviews echoed this. For instance, one interviewee mentioned she wished contractors were “more realistic or honest with timing”; More than that, she added she could see how “the contractors

were good in their actual work”, and so she believed it is a pity that because of this kind of issues they may acquire a bad reputation.

When enquired about the quality of the (work delivered by) contractors interviewed households were quite satisfied despite some general comments by Household 2 and 3 on the actual contractor doing the works, who according to them would often lack knowledge on specificities to be taken care of in energy-renovations. Criticism of contractors was expressed with words such as “forgetful”, “mismanagement and lack of organization”, “lack of follow up”, “lack of knowledge”. Similar answers were obtained from additional interviewees. In contrast, Household 1 also had excellent experiences with contractors and praised aspects such as contractors being “really committed” and “interested”; “doing beyond their job”; being “collaborative” and “listening” to what the owner or other contractors say; and last but not least, belonging to a “well-organized company”. Having genuine interest in the renovation was actually brought up by Household 2 as a tip for distinguishing good contractors from those who are not.

All three households coincided in the *need of an architect* in the coordinator role, foreseeing potential problems that could arise and ensuring the works take place when they should and as they should. Further interviews reaffirmed this. An interesting comment in this respect from another interview further thoroughly recommends opting for an architect living nearby, due to the frequency –and sometimes short notice- with which this ought to visit the site through the renovation.

### 3.2.2.2. Related research on customer segmentation and customer values

The following paragraphs mainly summarize the results from a relevant market research for Belgium conducted by VITO et al. (2012) to determine what customer segments may be identified from literature. Results from other sources will be cited explicitly.

A third of the households in Belgium live in a detached single-family house or open house. In the Flemish and Walloon region this percentage is higher (40%) while in Brussels, it is less than one third. There seems to be a tendency shifting from detached and semi-detached family houses to apartment and studios, especially in the Brussels region.

The *age of the houses* is another aspect this research looked at concluding that 14% of the Belgian houses date from before 1921, 12% were built between 1921 and 1945, 27% after the Second World War and before the oil crises in the early 1970’s, 35% was built between 1971 and 2001, and 14% in 2001 or after that. In general, the housing stock is older in Brussels and the Walloon regions than in Flanders.

If we look at the size of the dwellings, the average total surface of a dwelling in Belgium tends to be 207 m<sup>2</sup>, of which 101 m<sup>2</sup> is heated. The Flemish region enjoys the highest average surface while Brussels the lowest, possibly as a result of the different dominant housing typologies in the later.

When it comes to *ownership*, it appears that two thirds of the households in Belgium (at least partly) own the property they live in. These numbers are even higher in the Flemish and Walloon regions, 73% and 68% respectively, Brussels region being again the exception, where only the 39% owns the property they live in. These numbers are very similar to those obtained a decade earlier in a similar research.

## **Willingness to invest**

In contrast to the results obtained for Belgium in the national questionnaire and interviews conducted, past research by VITO et al. (2012) found out that the main reason Belgian households invest in measures such as roof insulation and energy-efficient glazing is a growing awareness of the potential to save energy and governmental incentives such as premiums and tax reductions. Resonating with this, research (TNS & VEA, 2007) for Flanders concluded the reason Flemish households invest in energy-efficient glazing, in insulation and in energy efficient boilers is mainly to save energy, with a financial motive behind. For the double glazing and roof and basement insulation, respectively 47% and 40% also claimed comfort reasons.

When looking at the *reasons not to invest* in insulation, glazing or boilers, results varied. Investments in double glazing were refrained due to the costs of it, whereas investments in insulation and energy efficient boilers did not happen for they were perceived as “non-necessary”. An exception were those individuals with no roof and basement insulation, whose motive was mainly financial (instead of the perception of not needed). In both the roof insulation and the windows case, a small percentage as well considered themselves too old to invest (6% and 7% respectively) and in the case of the roof and basement floor insulation other few (8%) believed the intervention was too complex.

6 out of 10 Flemish said to be aware of *subsidies and fiscal incentives* of adopting certain energy-saving measures, the most aware being those belonging to the highest social class. In turn, the most popular subsidies are those that are paid immediately after the works are conducted over those which may be fiscally more generous but for whose reimbursement the household would need to wait for instance two years. Younger groups of high social class seem to be more willing to wait for this reimbursement though.

Owner-occupants of Belgian nZEB renovation projects indicated they have been motivated to adopt highly energy-efficient renovation concepts by the promise of structural improvement, increased surface area, and improved comfort (Mlecnik, 2010). Especially a concern for comfort improvement can lead to choosing energy-saving concepts. But also, owner-occupants can be driven by a more general concern for the environment and for improved health conditions.

## **Household characteristics and segmentation**

Investment expectations differ for different typologies of customers (TNS & VEA, 2007). While individuals belonging to higher social groups, and those living in their houses longer than 20 years pursue rather an energy saving effect with their investments, individuals pertaining to a lower class, and those who have bought their house (not erect it themselves) invest to achieve a bigger comfort.

An interesting fact found in literature (TNS & VEA, 2013) is that 14% of the Flemish families investing in energy-saving measures appear to have at least some member who has followed an education/training on energy or technical installations. In the highest social group this number reaches 19%.

An important notice is that all previous research results in this field are focusing on individual renovation measures and do not provide clear guidance about the possible uptake of integrated nZEB renovations.

### **3.3.2.2 Conclusions customer segmentation and supply-side activities**

Although from the limited number of responses to the questionnaire and interviews conducted conclusive customer segments cannot be identified in detail, the empirical research did help shed further light on some of the characteristics of households keen on investing in nZEB renovations. Based on that, three reference customer segments for nZEB renovation may be defined for the single-family housing market in Belgium.

The first segment consists of a first home buyer. This segment often captures young couples (plus a baby sometimes) with an average to above-average income who buy their first house with the intention to renovate it and turn it into their dream family house. The main motivation is not an ecological house in the first place, but the fact that a thorough renovation is needed anyway and certain environmental awareness tends to convince them to approach nZEB renovation. For financial reasons, these households type tend to contract less professionals – and do more themselves. They find professionals mainly by asking around in their network. They tend to live somewhere else while the renovation is on-going. Being very active in the renovation, they often appreciate professionals that provide them with guidance, advice, and from whom they can learn. These households soon realize the renovation consumes tremendous amounts of time and becomes difficult to handle next to a full-time job and personal life. Lastly, due to their day-to-day involvement in the renovation, they might be more sensitive to delays and changes of plans.

The second segment consists also of house buyers with the sheer intention of renovating a house to their expectations. In this case the households are often more mature 40-49 (with children in the house) with presumably higher than average salaries. They tend to work for environmental causes and their main motivation is living in an ecological house. This segment works with many professionals whom they find through active searches, and they tend to conduct a more thorough check than the prior on contractors by taking the time to meet them and by asking prior clients for feedback. They also tend to live somewhere else while the renovations are ongoing.

The last segment renovates their existing house from the main motivation to increase comfort and adapt the house to changing household conditions. To choose for nZEB renovation, they also care about the environment. This segment might mainly encompass households aged 50-59 (children left the house) with high income. They tend to live in the house during the renovation. They contract several professionals as well. They find professionals mainly online and they perform a thorough check on them. They might have negative or positive experiences with prior renovations.

An excellent contractor is seen by households as someone who respects dates, sticks to estimated costs, discusses the project with the household and the rest of the contractors involved in the renovation, and is committed to pursuing environmental and energetic goals. Next to that, the interest professionals show has proven to be important for end users, who especially value professionals who are genuinely interested in the project and enthusiastic about the renovation. In fact, good relations and prior successful collaborations with

architects and general contractors provides companies with an important competitive advantage, for these two – especially architects - are important sources of influence when making a choice for professionals to work with. An architect in the coordinating role is on top of that considered necessary in the formula for an appropriate unfolding of the renovation works. Surveying the work other contractors do, anticipating problems and in charge of caring for the details that matter in a renovation seems imperative.

Households spend a considerable amount of time in the search for contractors and assessment thereof through conversations, visits to example projects and asking previous clients. Thus, first of all having a good portfolio of example projects and being present at building fairs is imperative for suppliers to gain visibility, for it is those events where customers of nZEB renovations turn to for finding professionals. Being listed at specialized construction websites is also essential especially for approaching Segment 2 and Segment 3. Secondly, providing potential clients with additional example projects and references that prove experience, quality and customer relations seems convenient to develop to facilitate household's research and decision.

We can remark that governmental initiatives can have impact on demand for energy saving measures. Overall government stimulus with premiums and subsidies can be considered an important incentive for households to renovate or to take the renovation further towards higher energy efficiency. Subsidies and the like play a part in the payback of the investment and could be therefore considered a financial motive for homeowners. It is interesting for suppliers thus to be aware of these options and clearly present them to the clients. For houses applying to such subsidies, offering detailed breakouts of budgets can be seen as an added value. In similar vein, research showed insulation and glazing are adjusted mostly for financial motives and to a less extent comfort reasons, which leads one to think suppliers should use arguments of amounts of energy saving potential and effects on comfort of these measures.

Motivations and communication channels can differ for different typologies of customers. The supply side should therefore have this in mind when approaching such segments. Currently, suppliers should focus on environmentally sensitive households. The research showed that at the current stage low-income households are not an interesting segment for volume market development.

In any case the timing aspect holds the biggest potential for improvement as all three interviewed couples suffered from their renovation being delayed, in two of the cases clearly due to lack of organization or follow-up of problems among the contracted professionals. In order to avoid frustrated end users, an advice to the sector could be to set more carefully determined, realistic deadlines and to perform within those rather than set up high expectations and disappoint customers when not meeting those.

### **3.3.3 Germany**

#### **3.3.3.1 Customer segments, value propositions, channels and relations**

##### **Customer segments**

The customer segment of nZEB renovation in Germany related to the web questionnaire is mostly young and living with children in refurbished houses. Half of the participants finished their renovation in the age of 30 to 40, another quarter of participants were in the beginning of the 40s. So families with young children are one target group of nZEB refurbishment. The people of this group live with four and up to seven persons in their houses. One participant was nearly 60 years old when he finished his renovation. He is an example for the target group of those persons adapting their house to a life when children moved out of their homes. The families mostly live in detached houses (9 participants), one person refurbished a terraced house, another one a semi-detached house.

It is obvious that the participants of the web questionnaire are very interested in the field of energy-efficient renovation. Half of them have got a profession in the field of energy efficiency (architect, energy advisor, constructional engineering etc.). So their own experiences with contractors or with products were important to decide which company could be engaged and which material chosen. Many other home-owners asked relied on the knowledge and the experiences of people they know. In personal interviews the interviewees pointed out their interests in technical and sustainable topics.

Almost all of the German interviewees had clear energy targets in mind, before the construction process started. The aspired end results and energy targets which were set up or specified during the process of the renovation were achieved. The home-owners stated that they were satisfied or very satisfied (8-10 points out of 10) with the results of the energy-efficient renovation.

The interviewees modernised the whole house. In personal interviews they underlined that they preserved the former appearance of the building, but changed main parts inside the house. Results of the web-questionnaire show that changes had been done always at the façade and at measures to increase airtight packing and isolation of windows and doors. The renewal of the roof (8/10) and the basement ceiling (8/10) was done very often, too.

The renovation always included big changes in the building services system. Heating and ventilation systems and electrical installations were installed just as another hot water heating and distribution systems and sanitary equipment.

To conclude good situations to convince home-owners to renovate on nZEB-level are moments they became owner of a house or if children moved out and they adapt the house to the new living situation.

### **Value propositions**

Home-owners were motivated to have a highly energy-efficient renovation by different reasons. An important fact is they all wanted to modernise the house to increase living comfort because the house was old and not up to date with today's standards of living. Also aesthetical reasons were important ones. Energy-efficiency was an additional component of the refurbishment and named by all participants, but – that was pointed out in the personal interviews – not the main reason of the whole building project.

Sustainability and environmental points were picked out by many interviewees. They liked to reduce negative environmental effects (7/10) and to live in a healthy indoor climate (7/10). So

they used renewable or natural materials and products (6/10). To complete this image their goal always was to achieve the reduction of energy consumption. Financial reasons have got different aspects: Most often were named the reduction of actual energy costs (7/10) and to get special credits (7/10). Also the possibility of subsidies (6/10) is an advantage of an energy-efficient renovation, but the documentation afterwards was complex and time-consuming, was pointed out in personal interviews.

Thus it could be recommended for marketing strategies to focus on energy cost reduction, because this reason was pointed out by all participants.

### **Channels**

Home-owners were reached by different channels. The most important one is the existence and the possibility to get subsidies if they decide to renovate on nZEB level (7/10). Knowledge about this funding, was an important decision factor.

Hence, the main source of information about the highly energy-efficient renovation lies in the profession of the home-owners (5/10). Also, other interviewees paid attention to this theme: The personally interviewed home-owners said that they were interested in technical and/or sustainable themes even if they work in another field of the society.

Otherwise contractors were an important source of information about nZEB renovation. Half of home-owners emphasized that they had been influenced by contractors and crafts men who informed about the possibilities of energy efficiency. Also 5 of 10 persons named special journals and magazines as an important source to get a lot of information. It would be good to communicate continuously about energy efficient renovation to reach home-owners by publications.

### **Customer relations**

Customer relations were formed by different factors. Participants of the questionnaires were asked about features architects and contractors need. More than half of them answered that keeping agreed costs is really important. Also creativeness of finding solutions and time spent with the household to discuss the projects are related to positive appreciation of the relationship. In personal interviews customers underlined the relevance of communication with the home-owner. Contractors are not allowed to exercise something the way they like if problems appear, they said. Also further education of contractors is needed to know about the work of other partners in the construction process. Another person emphasized the importance of internal communication of one company: Staff has to know what to do and not only the chef. To find good contractors and to avoid negative experiences interviewees recommended online evaluations and lists of architects, energy advisors and crafts men. Existing lists have to be strengthened. An independent quality label which signifies that contractors comply with some requirements can prove their skills. Home-owners proposed the presence of best-practice-examples of renovations in the internet so potential building owners can contact other home-owners to ask them about their experiences. A permanent monitoring of planning work and results could also improve quality. So customer service is especially created by well-coordinated work. A project manager could be a possibility. Also home-owners want to be informed all the time. That's

why a fluent communication with households is recommended as well as communication with all companies involved in the construction process.

### 3.3.3.2 Related research on customer segmentation and customer values

The research association “ENEf-Haus” asked more than 1,000 home-owners in the year 2009 who lived in their houses themselves. The interviewees did several renovation measures at the building envelope or the heating system. The researchers detected five customer segments: convinced energy savers, open-minded sceptics, non-reflective maintainer, indifferent reluctant and enthusiastic optimizers of living value. See Figure 19.

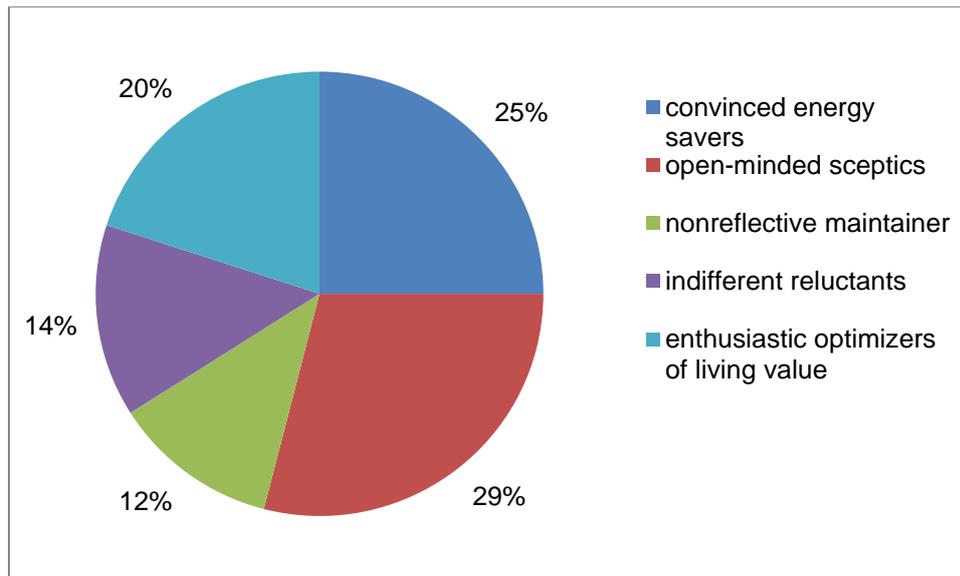


Figure 19 Distribution of customer segments in Germany. Source Stieß, I./van der Land, V./Birzle-Harder, B./ Deffner, J.. (2010)

Two of these customer segments are willing to renovate with aspects of energy efficiency. They are presented in detail in Table 6. It shows customer values being appreciated by these customer segments. For convinced energy savers advantages of an energy efficient renovation are the reduction of energy costs and the climate protection. Also they can explore new technologies and live their technical interest. Open-minded sceptics gain a house up-to-date in technical things because of the energy efficient renovation. By this way they increase the living comfort.

**Table 6 Customer characteristics and values of customer segments willing to renovate**

	<b>Convinced energy savers</b>	<b>Open-minded sceptics</b>
<b>Age</b>	2/3 < 50 years	> 50 years
<b>Education</b>	high educated (1/3 A-level or university degree), middle and high income	basic school education
<b>House</b>	detached, building year: older than 1978, short ownership (< 10 years)	building year: 1069-1988, ownership more than 11 years
<b>Motives</b>	reduce energy costs, climate protection, technical interests, obtain	obtain and increase value of house, keep technics of house up-to-date,

	and increase value of house	better living comfort, old-age provision
<b>Lifestyle</b>	sustainable, identify with house, a lot of personal contribution	inconsistent sustainable lifestyle (ecological food, but using car for short distances)
<b>Point of view: energy-efficient renovation</b>	inform continuously and detailed about energy efficient renovation	Positive attitude concerning energy efficient renovation
<b>Problems</b>	no more credits possible, scope of energy efficiency underestimated	dislike credits, doubt of necessity of energy efficient renovation, overextension with planning and implementation, doubt if technics are sophisticated
<b>Communication channels</b>	social networks, internet, experts (crafts men, chimney sweeper), ca 50% use energy advise	social networks, internet, TV, experts (architect, heating contractor), often energy advise
<b>Measures</b>	mostly high energy efficient standard, above average often combination of measures	mainly energy efficient standard - often high quality, above average often combination of measures
<b>Other</b>	50% own a energy certificate	

Source: Stieß, I. van der Land, V. Birzle-Harder, B. Deffner, J. (2010); own table *dena*.

### 3.3.3.3 Conclusions customer segmentation and supply-side activities

The analysis explained before shows contractors have to use the direct contact to home-owners. In situations touching the possibility to implement energy-efficient measures they have to inform about this theme. For these situations the following recommendations of interviewees are important:

They pointed out that contractors have to be up-to-date in topics of energy efficiency. They need widespread knowledge to answer all questions. Home-owners underlined differences between crafts.

Interviewees also proposed contractors to present reference objects. On the one side they can prove their experiences in energy efficient renovation. On the other side home-owners can contact other home-owners to ask them about their opinion about the contractor.

All persons underlined the necessity of a holistic approach to an energy efficient renovation, even if only individual measures can be implemented at the moment. So energy advisors should call home owners attention to the comprehensive view of energy-efficient measures and their best chronology and long-term planning.

To enhance the supply-side activities during the construction process customers emphasized the relevance of communication. Contractors have to communicate with other contractors, but also with home-owners. Thus wrong decisions in which the home-owner normally wants to be involved can be avoided and do not cause dissatisfaction. Moreover coordination between all partners is important. A project manager could be a good solution.

### 3.3.4 The Netherlands

#### 3.3.4.1 *Customer segments, value propositions, channels and relations*

##### **Customer segments**

Of the 17 respondents of the on-line questionnaire 8 respondents renovated a detached house and 4 a terraced house. R. The households of the Dutch respondents are for 44% about one or two persons and 66% are three persons and more. None of the households is below 40 years old. 77% is between 40 and 60 years old, meaning that also older households are interested in energy renovations. Their annual income level is above average. Part of the respondents were actively engaged with energy efficiency, working as an architect, adviser or constructor, or working for a governmental organization promoting energy efficiency. The in depth interviews with typical customers show that the customers may be characterized as innovators. The outcomes of the survey should carefully be interpreted. It seems that not all addressed households in the questionnaires really undertook an integrated nZEB renovation or renovate their house in phases to a nZEB comparable level.

The period the respondents had lived in the houses varies much. In the Netherlands the investments in the renovation are less than the general picture. As general, most of the households financed the renovation with their own savings.

##### **Value propositions**

The reasons for initiating the renovation projects were especially to reduce the consumption of energy (indicated by all respondents) and to improve indoor comfort or health conditions (11). Various physical needs such as needed reparations to building parts and building services were just for a minority important to decide to renovate. To reduce draught from windows and doors, and a more comfortable indoor temperature in winter are the most important indoor comfort and health conditions. Looking to financial reasons saving on the energy bill is an important reason to renovate. Also of some importance were a reasonable payback time of the investment and an increase of the property value. Looking to environmental reasons it is clear that the respondents found important a low or minimum energy use, to produce own energy, reducing the impact on the environment and a healthy indoor environment.

One of the interviewees (Amersfoort) said: "Important motivations for the renovation were using energy as less as possible and to live comfortable. Moisture problems were prominent in the house, effecting the health and comfort. In any way, we had to do something about those problems". Another interviewee (Amsterdam): "I hope that the payback time of the insulation investments is less than 10 years. If not, than the market value and the comfort has been increased". The third interviewee (Den Haag): "Awareness of the own energy use and possibilities to reduce this were the reasons to renovate".

The Dutch respondents performed all kinds of thermal insulation activities and changed all kinds of building services during the renovation. A thermal insulation activity that is comparably less performed in the Netherlands are measures to increase airtightness of windows and doors. Other named measures that were not listed in the questionnaire are sun

blinds, heat prevention by using foil on high insulated glazing, heat pumps and rain water foresting.

Respondents noticed as their biggest challenges in the renovation project and reaching high energy efficiency:

- to evaluate alternative energy-efficiency solutions;
- to make sure that all (new) building systems work proper together;
- gearing of the insulation with airtightness of the house;
- and to get guarantee about the energy savings and the renewable energy generation.

## **Channels**

The communication channels that were listed by the Dutch respondents of the questionnaire are reading internet, web pages and e-mail (9 respondents), noticing similar projects (7), and noticing subsidies, grants or green loans (6). A typical communication channel of some households was the own profession.

Important consequences of the findings for defining channels:

- being visible on the web as many do actively research
- being visible on sites so neighbours and friends see who is working on the project
- the use of communities of practice, neighbourhood ambassadors and other forms of local initiatives and structures.

## **Customer relations**

In the Netherlands general contractors, contractors for buildings services, architects and energy experts are often involved in nZEB renovations. The Dutch respondents especially appreciated these customer relations:

- creativeness of professional involved actors in finding solutions
- the leading role of an architect or another independent actor that the home-owner can trust
- commitment of the professionals towards energy saving.

Interview results indicate that architects can play an advising role and can communicate with home-owners. During the renovation the knowledge of the expected results and the role of all disciplines should be guaranteed. The home-owner can take the coordinating role of all involved contractors during realization or the contractors have to sort that out amongst themselves. An interviewee said that a project manager may be needed if a contractor of adviser isn't involved during all realisation phases. If a contractor takes the role, he will charge the home-owner for this.

An interviewee (Amsterdam) said: "Home-owners are not able to choose the right measures, even proposed by professional firms, because they are driven by figures. That different contractors bundled themselves in coalitions gave the needed trust in their approach and their offers". Another interviewee (Amersfoort): "The process till the final offers gave trust in the contractors. They were highly motivated. An extensive energy advise gave trust in reaching the desired end result." The third interviewee: " Trust of home-owners is based upon keeping to the made appointments. A list of good contractors, endorsed by the

municipality doesn't give guarantees. Home-owners need an independent place to share their experiences with energy renovations”.

The respondents and interviewees point to the fact that there are numerous energy efficient solutions. Often just the standard solutions are in mind of the professional involved actors. Interviewees stress the point to experience (new) unknown solutions before a final choice, e.g. a pellet stove. Related to this a home-owner has to know what the desired end result of the renovation project is. An interviewee said that he thinks that a lot of people start to make their house energy efficient without having the desired end result in mind. That may cause disinvestments.

To help other people to find good contractors and to avoid negative experiences with contractors, the respondents of the questionnaire and the interviewees suggested the following items:

- an independent platform and website to make the experiences of home owners with contractors, solutions, products and systems public
- a standard list of questions to help the selection of contractors
- a model for the procurement of a renovation
- a database with all possible solutions (products, systems) with experiences of users
- and a list of good contractors

To keep the list of good contractors updated is very important. A selection criterion for part of the home-owners could be that contractors give the possibility to perform part of the activities by the home-owner itself.

#### **3.3.4.2 Related research on customer segmentation and customer values**

Despite a potentially large market, the actual demand for energy renovations must not be exaggerated. It is generally known that despite decades of efforts of various parties to attain a substantial reduction in national energy consumption, actual figures show either a small decline or even an increase. Moreover, not renovation, but piecemeal adoption of measures is the norm in the private housing sector (Murphy, 2012). As for energy saving measures in owner-occupied housing, not an intrinsic motivation to contribute to environmental quality, but financial arguments are dominant (e.g. Veltman and van Welzen, 2012; Provoost and Hallebeek, 2013). Improvement of comfort is also an important incentive. In a survey by Westeneng and van Elst (2013: 5) 97% of the households mentioned comfort as an important reason for adopting energy saving measures, followed by cost savings (92%). Environment or sustainability is also mentioned as an important reason, but less frequently (67%). Veltman and van Welzen (2012) found different (much lower) percentages (50%, 40% and 23% respectively), but in the same order of preference.

Lack of finance, the disorder caused by the works and uncertainty about the energy savings are frequently mentioned in literature as barriers for investing in energy saving measures. Westeneng *et al.* (2012) found from interviews with households that subjects related to freedom of choice and certainty were frequently mentioned. This 'certainty' had much to do with the confidence of customers in the contractor. Homeowners can be uncertain about making a choice between contractors, because they have too little knowledge about their

qualities and, related to this, do not know how to select those (Westeneng *et al.*, 2012). This is confirmed by Veltman & van Welzen (2012), who stated that 40% of the owners-occupiers were confronted with contradicting information and that 48% found difficulties in distinguishing reliable from unreliable information.

Murphy (2012) found a significant correlation between holding an energy performance certificate and adopting energy saving measures. Nevertheless, households purchasing a home with an energy performance certificate did not adopt more energy saving measures than those who purchased their home in the same period without such a certificate.

Together with the issue of a certificate, the receiver is advised about several (voluntary) measures that are seen as appropriate in his/her situation according to the assessor. However, 60-70% of the recommendations of the assessors are ignored (Murphy, 2012).

Murphy (2012) identified the following characteristics of households *contributing positively* to adopting energy saving measures:

- living in a detached dwelling;
- living in an older dwelling (mainly built before 1971);
- aged between 40 and 65;
- having already adopted some energy saving measures.

The last point is confirmed by Westeneng and van Elst (2013: 2), who found that 82% of the households that have adopted energy saving measures are prepared to take new energy saving measures.

According again to Murphy (2012), the following household characteristics resulted in a *reduced likelihood* to adopt energy saving measures:

- living in an apartment or in a terraced dwelling;
- consisting of one person;
- aged over 80 years;
- living in a dwelling for less than one year;
- planning to move within one year.

Not surprisingly, the immediate period after the purchase of a home is relatively often chosen for adopting energy saving measures (e.g. Westeneng *et al.*, 2012), but the previous finding indicates that shortly after this period, households are less willing to invest than on average.

Above figures and conclusions have to be taken by care because almost all related research on customer segmentation and customer values deals with energy saving measures and not integral nZEB renovations.

### **Customer segments**

The apparently small demand for energy renovations, let alone nZEB renovations, makes a segmentation of the market less relevant and also more difficult to substantiate. Moreover, Westeneng *et al.* (2012) state that individual homeowners are very diverse in their preferences. This obstructs the development of a clear and concise categorisation of consumers; any typology would be not of use because of the heterogeneity within each of the types. Nevertheless, Veltman and van Welzen (2012) have developed, from a survey

among homeowners, a classification of three groups, based on commitment to environmental issues. These groups are as follows in Table 7.

**Table 7 Customer segments in the Netherlands**

Segment name	Sample share	Description	Population characteristics
Indifferent	31 %	uninterested in environmental issues, but do not necessarily have a negative attitude towards sustainability	mostly younger homeowners, living in relatively affordable housing (mostly flats), low education, modal income
Positive	45 %	take a position between the “indifferent” and the “fans” as for attitude towards sustainability	mostly middle-aged, living in a terraced house
Fans	24 %	positive attitude towards sustainability	on average somewhat older homeowners, high education, high income, living in larger and more expensive homes

Source: Veltman and van Welzen (2012).

According to Veltman and van Welzen (2012), each of these groups needs a different communication strategy for the adoption of energy saving measures. Unfortunately, the publication does not mention how this should be done.

More information about this can be found in Burghouts *et al.* (2013). They presented the respondents several ‘propositions’, which did not only include measures, but also means to get these measures realised, for instance by offering a finance scheme or someone who would take care of all the arrangements. Education level, income and age were important factors for not only the willingness to invest in energy saving measures, but also for the choice of the propositions. The results can be summarised as follows in Table 8.

**Table 8 Customer values households in the Netherlands**

Type of household	General willingness to invest	Desired approach	Desired financial savings
high education, high income and/or living in expensive home	relatively high	relatively more interested in someone who takes care of all the arrangements	relatively more interested in return on investment
low education, low income and/or living in inexpensive home	relatively low	relatively more interested in finance scheme	relatively more interested in direct savings

Source: Burghouts e.a. (2013); own table DUT.

In addition, households in flats are relatively more inclined to engage in activities together with the other residents in their streets. Finally, households aged over 60 are less willing to invest in energy saving measures. Relatively speaking, they are more interested in someone who takes care of all the arrangements and less interested in DIY options.

Initiated by the Dutch Ministry of the Interior and Kingdom Relations the organization Platform31 carries out the policy programme “Energy Leap” (NL: EnergieSprong) for the built environment. One of the projects called “The Acceleration for the private sector” ((NL: Stroomversnelling) is targeting the refurbishment of owner-occupied single-family dwellings according to the ‘Energy bill = 0 principle’. Consortia of builders, architects, product suppliers and other professional actors are challenged to make renovation proposals for ‘Energy bill = 0 houses’, to be realised in ten working days and an investment of maximum 45.000 Euro (including VAT). By means of a questionnaire owner-occupants of single-family row houses built between 1950 and 1980 and a monthly energy bill of 175 Euro were asked for their interest in having their house refurbished to an ‘Energy bill = 0 house’, for the price of their current energy bill, based upon a mortgage of 30 years (Van Welzen and Van Delft, 2014). One third of the respondents are (very) sure that they will accept this offer, one fourth of the respondents will likely accept the offer and one third has doubts. 16% will decline the offer. The researchers conclude that the innovators and early adopters are especially high educated couples, between 35 and 40 years old and with a higher income. Often they live less than 10 years in the current house and they appreciate a new look of it. Asking for drivers and barriers, the most mentioned drivers are value increase of the house, energy savings, a limited renovation process, no energy bill and more comfort. Barriers are the high investment, an extra mortgage and overall for the respondents the lack of clarity and certainty of the offer.

#### **3.3.4.3 Conclusions customer segmentation and supply-side activities**

In the Netherlands customer segmentation for SFH nZEB renovations currently is not useful because of the limited actual size of the market. One could focus on somewhat older households, high educated and with an income which is on average or above. Characteristics of the dwelling, the energy use, the technical status and inherent comfort levels could be taken by suppliers as main ingredients for value propositions.

Trust in professional involved actors is a very important issue in customer relationships. Trust based upon objective advice, a solid piece of work, intrinsic motivation of professionals in energy savings and the willingness to combine knowledge and experience with other actors. In case of nZEB renovations architects can play an advising role and can communicate with home-owners, as a an actor trusted by the home-owners. Clear commitment of the professionals towards energy saving, e.g. expressed in energy saving guarantees, is important.

Recent research results of the Dutch Ministry of the Interior and Kingdom Relations that evaluated energy saving projects, indicate that private home-owners need a custom-made approach: each home-owner wants to decide what measures when to take (Rijksdienst voor Ondernemend Nederland, 2014). The demand for energy efficiency measures is stimulated the best by bottom-up initiatives at neighbourhood or street level, in well-known structures and personalised. Information should be fitted to the personal circumstances of the home-

owner and should often be repeated. This means that suppliers have to think about the needed investments in personal relationships with home-owners to convince them to nZEB renovations.

### 3.3.5 Norway

#### 3.3.5.1 *Customer segments, value propositions, channels and relations*

##### **Customer segments**

The Norwegian respondents of the questionnaire have an average age of fifty one years. Their annual income level is above average (the two lowest reported; "average"). In-depth interviews showed that they all were curious and had a strong interest for energy efficient houses, in other words they may be characterized as innovators.

A hypothesis has been that the majority of nZEB renovation projects are done by persons who have just bought the house or have been living there for a shorter period of time. The results from the questionnaires show however that the period the respondents had lived in the houses varies very much. This is also in line with an analysis by Bolig Enøk and Segel (2013) executed among 28 owners who bought an energy audit.

Reflecting on the implications for the market potential we have to focus on the persons owning a house and with an income which is on average or above. In order to estimate the sizes of the individual projects, we see that the average size reported by the Norwegian respondents was in the range of € 120,000 to € 139,999 per project. Four of the respondents answered that they spent more than € 200,000 on the renovation. Projects with such sizes should indeed be of great interest for local contractors.

##### **Value propositions**

The reasons for initiating the renovation projects were of various physical needs such as:

- the need of changing the space (4 respondents);
- the need to repair/replace parts of the envelope of the house (4 respondents);
- to improve the aesthetic of the house (4 respondents).

While first being in the mood to start the project, these value propositions moved the home owners towards nZEB level:

- improvement of comfort (7 of the respondents of the questionnaire): "After having lived in a cold house, we now wanted a warm and comfortable indoor climate";
- improvement of energy efficiency (4). 5 of the respondents had energy targets from the beginning, 2 said this came later on, and only one answered he did not have energy efficiency target;
- trust in experienced craftsmen.

One home owner said: "We wanted to have a home on one floor and had interest in low energy houses. We lived earlier in a house with a very high energy bill, and wanted therefore now a very energy efficient house and at same time very comfortable. We now call it "the comfort house", because it is warm, comfortable, without noise and easy to control/adjust indoor temperature."

From the three in depth interviews there are some important similarities regarding motivation:

- all did own research about energy efficient houses and two of them had also previous experienced (skilled) with house construction;
- they had all experienced cold houses and wanted now to have a warm, comfortable house with low energy consumption. The owners' represent three different age groups; one in the 30'ies, one in the forties and the third in the sixties;
- none of the three had lived in the house for a long time. Only one family lived in the house during renovation (been living there for 11 months). The others moved in after completion of the renovation.

Important consequences of the findings for defining market strategies are:

- There is a physical issue which triggers the investment. Improvement of the comfort and energy efficiency is dealt with as opportunities as the owner can exploit as he anyway is retrofitting the home.
- It is very important to create trust through good communication and by using serious channels.
- These innovators did much own research to identify challenges and opportunities. When the market later moves from the introduction phase to growth phase, the customers (who are not innovative) will have less knowledge at the start of their project. The supply side will therefore be prepared to cope with other type of communication challenges.

## **Channels**

Before starting the renovation the home-owners actively searched for good craftsmen:

- recommended by friends, etc.;
- became aware of them through other projects, on the web and social media.

When first chosen one actor, his recommendations for other crafts were followed. During planning and renovation advisors and craftsmen influenced the ambition level and solutions.

Based on the findings from the Norwegian research these channels are relevant for suppliers of nZEB renovation of SFHs:

- be visible on site so neighbours and friends see who is working on the project;
- be visible on the web as many do actively research;
- be listed by third party actors as ENOVA (The Norwegian State Energy Efficiency Body).

As a response to the findings of the value propositions, it is important that the form and content of the communication should be serious in order to build credibility.

## **Customer relations**

The Norwegian respondents appreciated these customer relations:

- the creativeness of finding solutions
- the ease of which the professional could be contacted – good communication
- keeping to delivery time and stuck to agreed costs
- commitment of the professional towards energy saving
- keeping to delivery time
- flexibility and cleverness in executing the work

Two of the interviewed owners were very satisfied with the architect while the third was disappointed about his interest for energy efficiency measures. This owner pointed out the enthusiasm and flexibility of the carpenter as excellent. This point illustrates, that house owners at this stage are dependent on finding actors that are interested in the topic and willing to have a learning approach together with the owners.

A house owner pointed out the biggest challenge during the renovation project: "Lack of neutral information regards good solutions for low energy renovation." As a consequence of this experience the home owner stated that he missed an independent certification of contractors.

In short we could say that professionalism with a holistic approach, good communication and flexibility are the crucial factors to address for contractors with ambitions to take a leading position in this evolving market. To achieve this, strategies for customer service should be dealing with the questions how to obtain:

- dedicated and communicative project managers;
- skilled craftsmen with capacity to be creative to find solutions;
- to make sure to have sufficient capacity
- good management and QA system.

### **3.3.5.2 Related research on customer segmentation and customer values**

In a study completed by Prognosesenteret commissioned by the Norwegian energy efficiency body Enova, the yearly energy saving potential for the residential sector in Norway is estimated to be 13,4 TWh which corresponds to 30% reduction from currently 45 TWh. The assumptions for this scenario include an upgrading of the existing building stock to the new building code (TEK10) by 2020 and that all new homes built in the period 2010-2020 fulfil the low energy standard (Prognosesenteret, 2011)

As a result of the research in IEA SHC Task 37 the idea for a new Nordic project "SuccessFamilies" (2012) was born. The focus of this research was to address a systematic approach towards the small house market where the owners are faced with challenge of choosing between fragmented offers and without having own skills to do a good decision.

Deliverable 2.1 "Report on stakeholder interests" (2010/2011, SuccessFamilies, points at the 60'ies and 70'ies houses as the main target segment. The main customers' needs defined by the Nordic experts were:

- Warmer house in winter
- Reduced draft
- Improved condition of windows
- Reduced energy costs
- Improved physical condition
- Reduced noise from outdoor environment

The Eracobuild project OneStopShop (2012) developed the results from SuccessFamilies to new business models for renovation for single family houses.

In order to understand the Norwegian housing market, it is useful to refer to the establishment of The Norwegian State Housing Bank short after the Second World War. The idea of the Government was that all Norwegian families should be able to own their own

home. The home was recognized as the savings which grew in line with the reduction of the mortgage as they paid their monthly instalments. Today young people get special tax deduction for saving for their first flat. When couples get children and sell their flat and buy a semidetached house, they have already some equity to be used for the bigger house. In 2012 the share of owner occupied dwellings was 82% (National Statistics Norway) . In deliverable 2.1 in SuccessFamilies (2010/2011) the “ideal situation” for finding a customer who is most likely to go for a holistic sustainable renovation was defined to be:

- The house needs some kind of renovation
- The house is newly bought, or about to be bought
- The persons who have bought the house are innovative

Further, it is a prerequisite that the owners either have own funds or a capacity to increase the mortgage, i.e. that the balance of the loan is less than the estimated value of the house.

### ***3.3.5.3 Conclusions customer segmentation and supply-side activities***

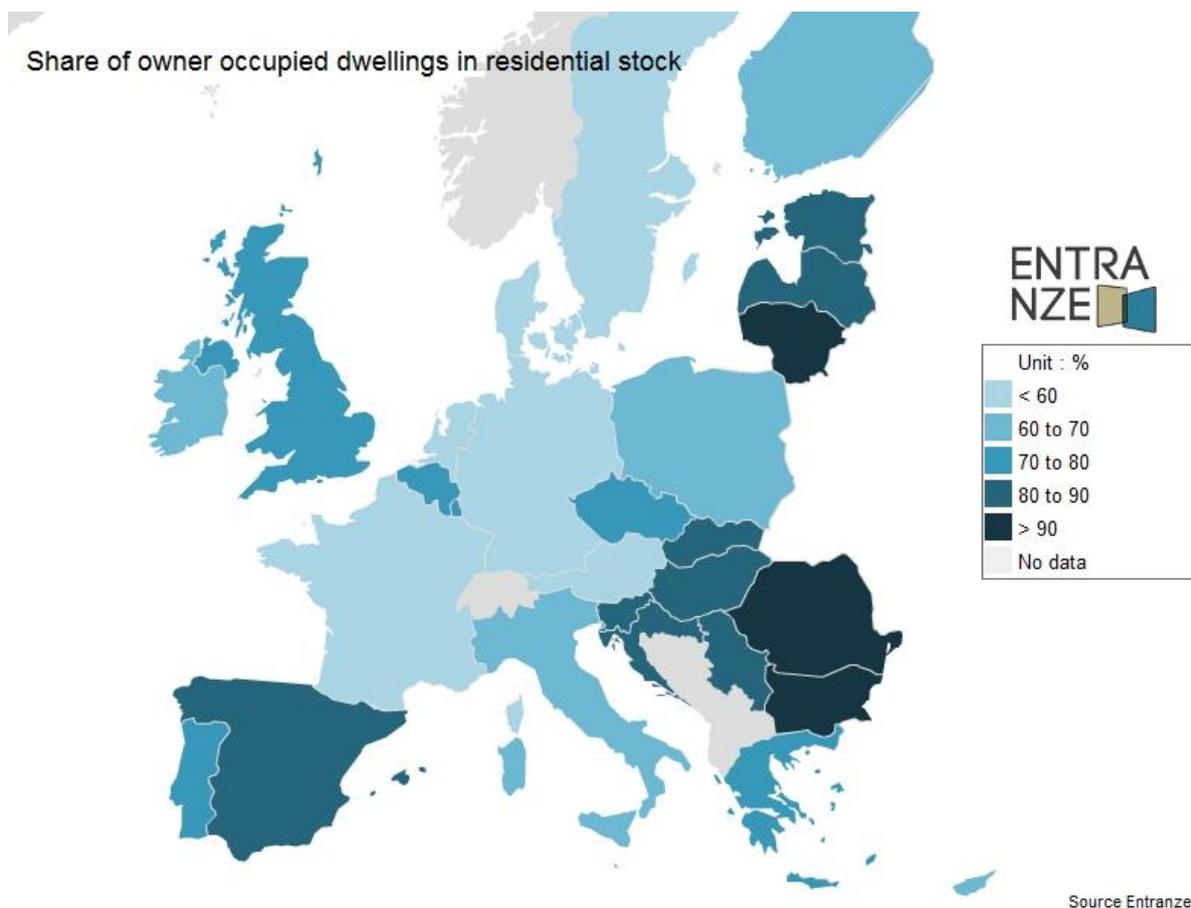
In Norway the main target segments are owners of single family houses built in the period from 1960 until end 1980'ies. As the owner occupancy rate is very high (84%) of single family houses in Norway, this represents the majority of the market. Suppliers which aim for long term position in this market need to be recognized as serious and professional craftsmen. Beside documented skills in nZEB renovation, very good communication skills and a good abilities to be creative and flexible in order to fulfil the customers' needs.

## 4 Market potential for nZEB renovation

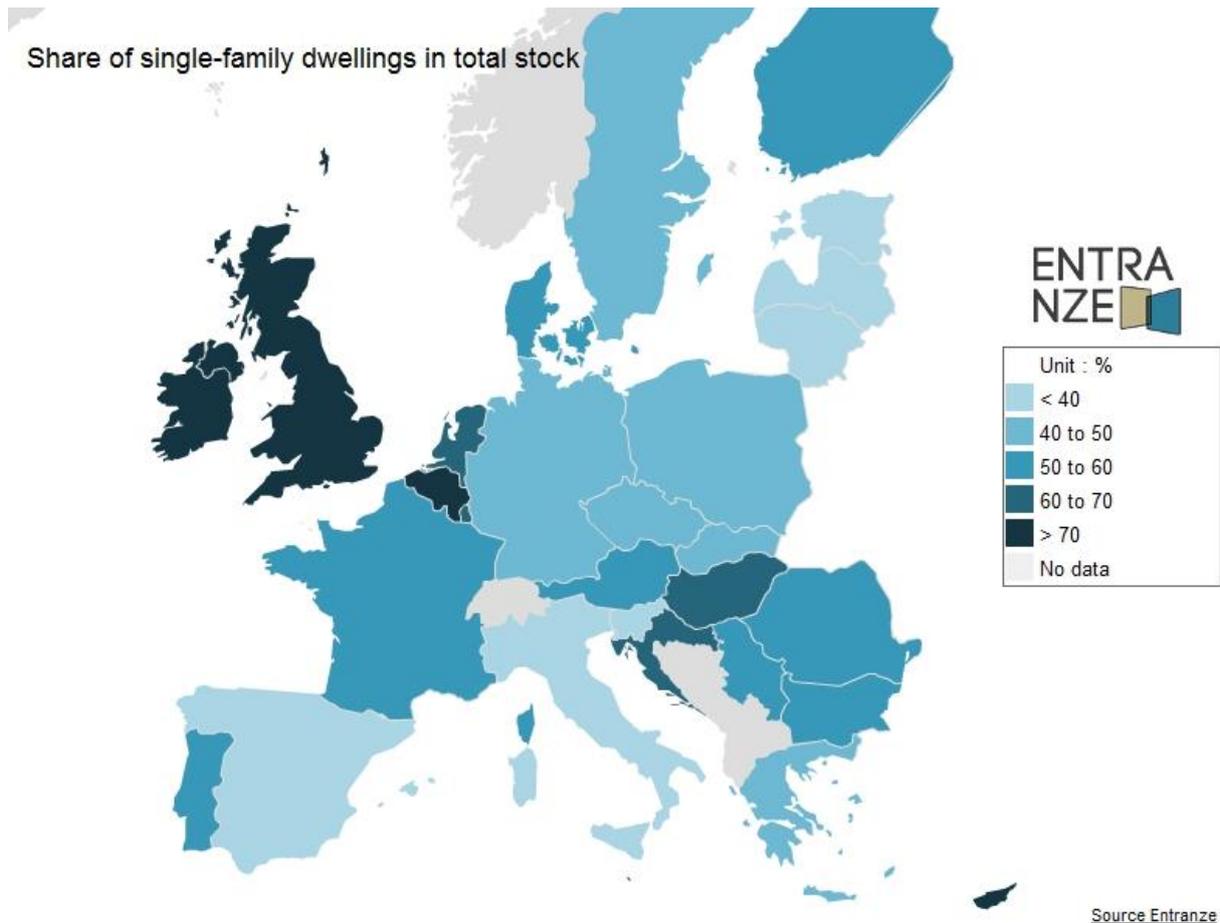
### 4.1 Introduction

The EU-funded project Entranze provides some data about the EU-27 housing stock (<http://www.entranze.enerdata.eu/>). Figure 20 displays the **share of owner-occupied houses** in the EU-27, Figure 21 shows the **share of single-family houses** in the EU-27. Unfortunately a break-down by ownership combined with single-family houses is not possible. COHERENO partner country Norway does not belong to the EU-27. The targeted housing stock (single-family, owner-occupied houses) in the five countries is in total approximately 17,000,000 dwellings.

The current **renovation rate** in Europe is about 1%. 85% of the renovations is rated as 'minor', 10% 'moderate', 5% 'deep' energy renovations and the share of nZEB renovations is yet negligible (BPIE, 2011). With an annual renovation rate of 1%, yearly 17,000 houses will be renovated at a moderate level, and another 8,500 will undergo a deep renovation. nZEB renovations will have some overlap with these numbers, but the impact of the renovations will be much higher.



**Figure 20 Share of owner occupied dwellings in EU-27**



**Figure 21 Share of single-family dwelling in EU-27**

The market potential for single-family homes nZEB renovation could be based upon national statistics and other available national data about the total number and types of single-family dwellings, construction years, single-family dwellings in need of deep renovation, energy performance certificates of these dwellings, investments in energy saving measures, etc. The per country available data (especially national statistics) was analysed. The available data differs a lot per country.

## 4.2 Partner countries

### 4.2.1 Austria

#### 4.2.1.1 National market for nZEB renovation of SFH

76% of the 3.68 million principal residences (2012) in Austria were built before 1991. With regard to the year of construction and the usual thermal standard of those years principle needs for refurbishment can be expected. For the 1990s, a rate of renovation of 1.0% has been documented (Statistics Austria, 2004), in fact the thermal standard didn't meet today's demands for thermal renovations. The amount for the 2000s renovation rate is 0.9%, the used measures largely complies with the requirements for major renovation. For the 2010-years, a rate of 1.2% is assumed (IIBW, 2013). With regard to the assumptions, the

renovation demand can be defined for 2.16 million principal residences (59% of the portfolio). Especially high is the potential for the 900,000 Single Family Houses. See Table 9.

**Table 9 Estimates for major renovation in Austria (principal residences, in 1.000 / %)**

	Total	SFH
<b>Existing buildings 2012</b>	3.680	1.450
<b>year of construction before 1991</b>	2.790	1.060
<b>renovation rate 1990s</b>	1,0 %	0,8 %
<b>renovation rate 2000s</b>	0,9 %	0,7 %
<b>renovation rate 2010s</b>	1,2 %	1,0 %
<b>renovation demand</b>	2.160	870
<b>% of total</b>	59 %	60 %

Sources: Statistik Austria; renovation rate 1990s: GWZ, 2001; renovation rate 2000s: Umweltbundesamt, 2013; renovation rate 2010ser: IIBW, 2013); own table ÖGUT

#### 4.2.1.1 Market potential for customer segments

There is a quarterly consumer survey by Eurostat<sup>3</sup> that asks home owners for the important measures that are planned for the building in the next 12 month. The results can be taken as an economic indicator of the market potential for renovation. The scale for Austria rose since the early 2000s and is at a very high level. After the global financial crisis of 2008 the Austrian values increased again, 2013 shows a slight downward trend. The good values for Austria possibly linked with the importance of rehabilitation in the public debate and to the availability of funding. The Austrian consumers are interested according to this indicator to a far greater extent than in other EU countries to renovations.

#### 4.2.2 Belgium

##### 4.2.2.1 National market for nZEB renovation of SFH

With a rather old housing stock (see Figure 22) whose average energy consumption is 70% higher than the EU average, and considering the slow demolition and growth rates thereof - at 0,075% and 1% respectively (Singh et al., 2013) -, ample opportunity exists in Belgium for the renovation market.

According to the National Statistics Belgium in 2013 there were 1,4 mln. residential units in open setting. The residential buildings stock in the three Belgian regions (Flemish region, Brussels capital region and Walloon region) varies considerably with predominance of apartments in Brussels Capital region and in cities (Hilderson et al, 2010) and on the contrary a majority of single family houses (detached houses and semi-detached houses) in Flanders and Wallonia. The percentage of owner-occupied homes in Belgium (74%) is considerably higher than in the other (neighbouring) European countries.

<sup>3</sup> [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ei\\_bscq\\_g&lang=de](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ei_bscq_g&lang=de)

The market for energy renovations of single-family houses is clearly growing. The number of renovations of dwellings with a building permit in 2013 has been 2,3% higher than in 2012 (FOD et al., 2013), which was in turn similarly higher than in 2011. The number of renovations of dwellings in general in 2013 reached the 27.296 (NIS, 2013b). Despite government cuts in support for renovations in 2012, 6% more households invested in renovations that year than in the previous year (Essencia, 2013). In 2013 Essencia Marketing (marketing advice bureau) enquired and gathered responses of 2,033 representative Belgians regarding their attitude towards renovation. These investments are notably more popular for owned properties than for rental properties and are generally aimed at making the dwelling more energy-efficient through placing insulation, highly energy-efficient glazing or an energy-saving boiler (Essencia, 2013). Although some homeowners already invested in energy saving measures, there is still huge potential for insulating homes.

According to the National Statistics the amount of renovated single family houses in Belgium renovated during the last 10 years hovers the 27,000. Some of those renovations may not have been energy-saving renovations per se and therefore those households may still be interested in such, consequently increasing the market potential above this number.

Previous statistical research in Belgium (Hilderson et al., 2010) defined various Belgian dwelling types for urgent energy renovation. The north of Belgium has more recently built houses than the south. In a very rough way, the most important share of the Belgian building stock can be divided in: New-North or Old-South on the one hand, and City or Suburbs on the other hand. The Old-South group and the City group have the highest retrofit potential. Those houses belonging to both of these groups have the highest potential. These are the Walloon houses of the workman's class in the industrial belt between Liège and Charleroi. In comparison, the suburbs house is mostly detached, recently built, large and has very good comfort. Therefore, the most important house segment to target are older terraced city houses, built before 1970 (or even 1919), which have a very large energy consumption and poor comfort.

#### **4.2.2.2 Market potential for customer segments**

With predominance of single family housing, single-family homeowners are particularly appealing as a target group for suppliers in Belgium. Figures from the past years reveal there seems to be a tendency of growing investments in energy renovations and that these renovations are particularly embraced by homeowners who are keener to invest and environmentally sensitive. In a country such as Belgium with high proportion of privately owned houses, ample opportunity exists to advance the market, particularly for the renovation of urban terraced houses with poor comfort. Moreover, if we look at the time buildings date from, the vast majority of the existing residential housing stock was erected before 1945. Particularly in cities, a large potential exists to renovate terraced houses in old industrial belts. According to previous research age and income would be the primary enablers and hindrances. For example, investments are least expected by the elderly and low-income groups. On the contrary the keenest segment appears to be home owners aged 25-44.

## 4.2.3 Germany

### 4.2.3.1 National market for nZEB renovation of SFH

The German building stock comprise about 20 million buildings: residential and non-residential ones. 15.1 million buildings are single- and two-family-houses. About 13.3 million dwellings are owner-occupied. The major part of single- and two-family-houses are detached houses (68,4 percent), 16,1 percent are semi-detached - and 15,5 percent are terraced houses. 10.5 million single- and two-family-houses are built before the year 1979. So they were built before the first Ordinance on Thermal Insulation (1977) and the first Ordinance for heating systems (1978) came into force.

The dena EPC-database contains about 35.000 certificates. The database comprises information about energy efficiency of several types of buildings and building ages. By this way it offers information about energy consumption of heating and hot water. Currently a single-family-house built before 1979 (refurbished houses included) needs 210 kWh/(m<sup>2</sup>a) on average.

In general, refurbishments of the existing building stock of houses built before 1979 comprise the following measures: Thermal insulation measures of the surface of exterior walls of single- and double-family-houses covers about 20 percent. Nearly the half of the surface of roofs had been insulated afterwards, but only ca. 10 percent of basement ceilings.

All in all there is a big potential of energy efficiency. That's why the German federal government energy goals aim to a reduction of final energy consumption of 60 percent in the building sector in year 2050. The renovation rate is about 1 percent at present. To reach the government goals a rate of 2-2,5 percent is necessary. Current requirements for renovation of buildings are fixed in the Energy Saving Ordinance Germany (2013).

### 4.2.3.2 Market potential for customer segments

Home owners who are living in their own single- or two-family-houses have got different features. Those persons living in houses built until 1990 are mostly (46 percent) non-working people, e.g. retirees. This percentage is quite high in comparison to ownerships of owner-occupied houses built after 1990, where retirees have got an amount of 11 percent. Owners of newer buildings are mostly employees (49 percent). This group of people owns only 26 percent of single- and two-family-houses built before 1990.

People owning houses built until 1990 are in between 60 and 65 years (41 percent), nearly one fifth is in between 50 and 60 years (22 percent) and another one in between 40 and 50 years (19 percent). Compared to newer buildings it looks completely different: Most owners are in between 40 and 50 years old (44 percent), one fifth in between 50 and 60 years (22 percent) and another one younger than 40 years old (22 percent).

This image of households of owner-occupied single- and two-family-houses is emphasized by statistics of children younger than 18 years living in those houses. Only 19 percent of households living in houses built until 1990 include children under 18 years. But in 52 percent of households in newer buildings children under 18 years are living.

69 percent of owners of single- and two-family-houses built until 1990 are living longer than 20 years in their home, 50 percent are even living more than 30 years in this house. 30 percent moved into these old buildings in the last 20 years, so they are not the first owners.

**4.2.4 The Netherlands**

**4.2.4.1 National market for nZEB renovation of SFH**

In 2012 the Netherlands counted 4,1 million owner-occupied homes, of which 3,7 million (85%) were single-family homes. This was 56% of the total number of homes, namely 7,3 million (National Statistics Netherlands: CBS, 2013<http://otb.databank.nl/Quickstep/QsReport.aspx?report=wonvrrd>). Table 10 shows a breakdown of the owner-occupied homes into building age classes.

**Table 10 Year of construction owner-occupied homes in the Netherlands**

Year of construction	Number of homes x 1,000	Percentage
before 1945	869	21,3
1945 – 1964	542	13,3
1965 – 1984	1235	30,3
1985 - 2004	1154	28,3
after 2004	275	6,7
Unknown	8	0,2
<b>Total owner-occupied sector</b>	<b>4083</b>	<b>100%</b>

Source: CBS, 2013.

In 2006, around half of the owner-occupied single-family homes was terraced, around 25-30% was detached and the remaining 20-25% was semi-detached (AgentschapNL, 2011). Given this figures, there is a large potential market for energy renovations.

Unfortunately there is just inadequate data available about the number of private single-family houses in need for deep renovation, data about energy use and energy performance certificates of houses in the private sector and data about (energy) investments by home-owners. Data about energy performance certification in the owner-occupied sector is unreliable because in the Netherlands the use of those certificates is limited. Transactions of houses are almost all done without these formally mandatory certificates. According to the data almost 20% of private homes in 2012 belong to the classes F and G and 35% to the classes D and E. So, there is room for energy improvements (Tigchelaar and Leidelmeijer, 2013). Available national statistics reveal that owner-occupied houses built before 1945 and in the years directly after 1945 are in poor condition (Lupi, 2013).

**4.2.4.2 Market potential for customer segments**

Available data about home investments by Dutch home-owners indicate that the major part of home investments address the interior of the house and the amenities. Also investments by private home-owners are declining last years, especially by the lack of finance (Vereniging

Eigen Huis, 2014). 30% of the Dutch households has insufficient finances for maintenance. Though national statistics show that investment in energy saving measures by home-owners are increasing (Tigchelaar and Leidelmeijer, 2013). In the years 2007-2011 40% of the owner-occupiers invested in energy saving measures, especially in glass insulation and high efficiency boilers. Most important motivations are cost savings and comfort. Households that just bought the house invested three times more than households living in the house for more than 5 years. In older houses the investment rate is relatively higher. Just 10% of the households got a subsidy for (part of) the energy saving measures.

The nZEB renovation market, especially in the private sector is immature in the Netherlands. Since 2010 several governmental programs, municipality programs and private initiatives have been started to address the mainstream private SFH market and to go beyond single energy efficiency measures. The effects of these initiatives as well at the demand-side as the supply-side are promising.

## 4.2.5 Norway

### 4.2.5.1 National market for nZEB renovation of SFH

In 2011 Norway counted 2,2 million occupied dwellings (including non-occupied the number is 2,4 million). Table 11 shows the numbers of occupied homes specified per category.

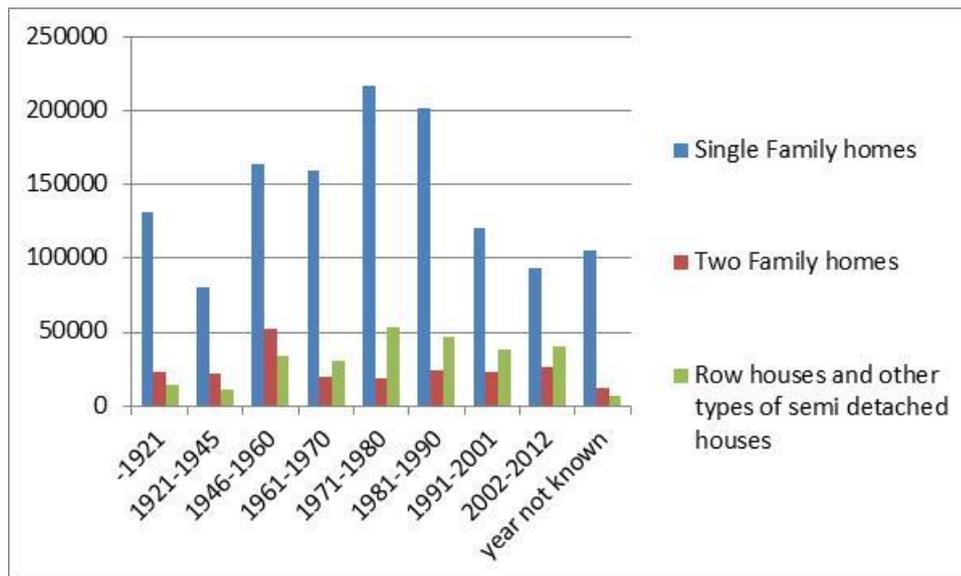
**Table 11 Owner-occupied homes in Norway**

House type	Number of homes x 1,000	Percentage of all homes in the Norway	Owner occupied in %	Owned by cooperative in %
<b>Single Family homes</b>	1,166	53	84	1
<b>Two Family homes</b>	201	9	66	6
<b>Row houses and other types of semidetached houses</b>	260	12	49	30
<b>Multifamily homes</b>	500	23	27	44
<b>Other types</b>	74	3	3	7

Source: National Statistics Norway.

The numbers illustrate clearly that the majority of single family homes are owner-occupied. Figure 22 shows the distribution of houses (including non-occupied) by construction year.

Many of the houses originally built before the sixties have already been retrofitted. By numbers of potential nZEB renovation projects, the single family houses built during the sixties, seventies and eighties represent therefore the major part of the market. In these categories there are about 580,000 houses (almost half of the single family house market). If we included also two family houses and row houses the market is even higher. In IEA SHC Task 37 there was made an "Energy Analysis of the Norwegian Dwelling Stock" (Marit Thyholt et al., 2009) which states that single family homes and other small houses represent for approximately 85% of the energy consumption in Norwegian dwellings. The biggest saving potential is in the small house segment and semi-detached houses built after the Second World War and until the end of the eighties.



**Figure 22 Construction year homes Norway. Source: National Statistics Norway.**

#### 4.2.5.2 Market potential for customer segments

In a research by Prognosesenteret (2013): the yearly renovation market of SHF in Norway was Billion NOK 42 (Billion Euro 5.2) in 2011. This number includes all type of renovation measures (including interior refurbishment). It is expected to grow approximately 3% during the next 2-3 years. (Prognosesenteret, 2013). “It should be possible for energy efficiency means to compete with other type of investments and/or be executed in conjunction with other type of investments to be done anyway” (SuccessFamilies, 2010/2011).

It is difficult to estimate how much of the renovation market can be of energy efficient renovation. But interestingly, the analysis by Prognosesenteret (2010) shows that the yearly renovation market for the residential sector now is bigger in NOK than new construction. By combining the findings from the research among the Norwegian home owners responding the COHERENO questionnaire and renovation rates, it is possible to make some estimates of the market potential. BPIE (2011) states that about 1,5% of the Norwegian dwelling stock is renovated yearly. Using this rate on the total SFH building stock, about 25,000 single family homes will be renovated every year. This number counts for 4,3% of the 580,000 which are pointed out as the main potential for nZEB renovation. This indicates that it takes 23 years before all single-family houses in the target group will be upgraded. This sounds to be a realistic and moderate number. Among the respondents the average size of their renovation projects were in the range of € 120,000 to € 139,999 per project. Combining these numbers: 25,000 SFH x € 120,000 = Bill Euro 2.3 per year. In addition to this number, there will also be renovation in two-family houses and other semidetached houses, as well as for older houses which still are not already renovated.

## 5 Conclusion and discussion

The findings of the on-line questionnaires and interviews with households in the partner countries reveal that the customer segments of nZEB renovations are diverse and differ per country. Most important segments are households between 40 and 60 years old, with an income above average, living in a detached house. The majority of the households that had their house renovated had clear energy saving targets in mind and took decisions by themselves, knowing what they wanted. In other words the majority can, not surprisingly, be characterized as innovators of holistic energy-efficient renovation. Most of the households had multiple reasons to decide to renovate. Reducing the consumption of energy and improving indoor comfort or health conditions was for the majority of the households important to decide to renovate.

As customer channels the notice of similar renovation projects and also knowing the home-owners of the renovated house and the involved professional actors is important. The households particularly appreciated about the involved professional actors the creativeness of finding solutions, the times spent with the household to discuss the project and keeping to agreed costs and delivery time. The role of other professional parties than the general contractor and contractor for building services was not researched in-depth. Interviews made clear that the role of architects and project managers in several countries is important.

Obviously energy cost savings and comfort outcomes motivate home-owners for energy-efficient renovations. Note that Organ et al. (2013) also conclude in their UK-study on motivations for energy refurbishment in owner-occupied housing that the principal reasons are energy bill savings, to increase comfort and to reduce the environmental impact. Whether owner-occupants have a more 'egocentric' or 'altruistic' attitude influences the strength of these principal motivations. Also the technical status of the dwelling could be a motive to renovate, however less important.

Wilson et al. (2013) proposed six conditions which are relevant to the emergence of renovation decisions: conditions ranging from balancing competing commitments to the physicality of living. In respect of energy-efficient renovations they proposed to bundle or package energy efficiency measures into amenity renovations. For business modelling this means that appropriate customer channels are e.g. kitchen contractors and not insulation contractors. If refurbishment is undertaken at the same time as other improvements to a building, then the economies become much more favourable (Tofield and Ingham, 2012). However, house renovations need to go beyond implementing single energy saving measures and have to adopt nZEB principles.

Only about 1.2 per cent of Europe's buildings are renovated each year. It is unlikely that this 1.2 percent is renovated to anything like the highest standards of energy efficiency (BPIE, 2011; Tofield and Ingham, 2012). However, the market potential for single-family homes nZEB renovation in Europe and the partner countries is very big. In most countries the market for energy renovations of single-family houses is clearly growing. Clearly, there is a lack of data about construction years of single-family dwellings and their current condition status. A greater part of research results in the field of energy-efficiency measures are focusing on individual renovation measures and do not provide clear guidance about the

possible uptake of integrated nZEB renovations. In all partner countries governmental initiatives address the private SFH market to go beyond single energy efficiency measures. .

A clear end result targeting nZEB level and an outlined phased approach of the house renovation is needed, because not all home-owners are willing and able to invest in deep retrofitting as a one-of integrated concept.

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## Appendix I: Questionnaire for homeowners

Dear homeowner,

You receive this questionnaire because your home renovation was selected to be amongst the best in your country regarding energy performance. In order to increase such types of renovations, the TU Delft (Netherlands) and national research partners ÖGUT (Austria), Passiefhuis-Platform (Belgium), dena (Germany) and Segel (Norway), are conducting an international survey in the framework of a European project ([www.cohereno.eu](http://www.cohereno.eu)).

Other homeowners like you are struggling with how to start their renovation, whom to contact and what to ask from contractors. Will you help us helping them? You can help us by filling in the following questionnaire, which would take about 30 minutes of your time.

How to fill in the questionnaire?

Read all questions carefully. There are no right or wrong answers. What count is that you fill in what you think or feel. Only your opinion counts.

A beam at the top of the page shows how far you got in your questionnaire. You are free to leave open questions you don't want to answer. Questions indicated with a \* need to be filled in to continue the questionnaire. At each moment you can stop your participation by closing the web page. If you return later, your answers will have been remembered.

You can also go back in the questionnaire by clicking the 'back' button. Click 'next' to continue.

Please note that all research partners respect the privacy laws: all data are strictly confident and treated anonymously.

We like to thank you in advance for participating to this questionnaire.

### Information about your household

1. How many people live in your house?  
[number]
2. What is your age?  
[number]
3. What do you think about the total annual income of your household (including benefits from business, rent, and so on)?
  - very low
  - low
  - below average
  - average
  - above average
  - high
  - very high
  - I don't know

### Data about your renovation

4. What type of house did your household renovate?
  - detached house
  - semi-detached house
  - terraced house
  - other, namely:
5. In which year was the house originally built?
  - <1901
  - 1901-1920
  - 1921-1930
  - 1931-1945
  - 1946-1960
  - 1961-1970
  - 1971-1980
  - 1981-1995
  - 1996-2001
  - >2001
  - I don't know
6. According to your estimation how much did your household invest in your major renovation?
  - Less than € 10,000
  - € 10,000 to € 19,999
  - € 20,000 to € 39,999
  - € 40,000 to € 59,999
  - € 60,000 to € 79,999
  - € 80,000 to € 99,999
  - € 100,000 to € 119,999
  - € 120,000 to € 139,999
  - € 140,000 to € 159,999

- € 160,000 to € 179,999
- € 180,000 to € 199,999
- € 200,000 or more
- I don't know

7. Would you please indicate below if the following issues were applicable to the situation of your household. Please tick every statement that applies [multiple answers possible]

- My household had extra money to invest from occasional income (for example lottery, heritage)
- The major renovation was largely financed with own savings
- My household applied for a new mortgage
- My household already had an existing mortgage
- My household applied for a loan specifically for home renovation
- My household applied for a loan specifically for energy-efficient renovation

### Timing of the renovation

8. When was the major renovation completed?

- Not yet completed
- <1 year ago
- 1-2 years ago
- 2-3 years ago
- 3-4 years ago
- 4-5 years ago
- 5-10 years ago
- > 10 years ago
- I don't know

9. How long has your household been living in this house?

- My household did not live there
- <1 year
- 1-2 years
- 2-5 years
- 5- 10 years
- 10- 15 years
- 15- 20 years
- 20- 25 years
- 25-30 years
- > 30 years
- I don't know

10. [If not 'My household did not live there'] Did your household live in the house during the major renovation?

- yes, most of the time
- yes, but not so often
- no

### Motivation for energy renovation

11. Did your household have clear energy saving targets in mind before renovating your house?

- Yes, my household knew from the beginning what energy performance level to aim for

- No, specific target came later on, for example after discussion with professionals
  - No, my household did not aim for a specific energy performance target
  - I don't know
12. Did the renovation lead to achieving the targets/aspired end result you had in mind?
- Yes
  - No
  - Partially (please specify):
  - I don't know
13. Would you state that someone else influenced your household's decision to choose for high energy efficiency? Please tick every person that had an influence on your decision to choose for high energy efficiency [multiple answers possible]
- Household member or relatives
  - Friends or neighbors
  - Other people who renovated towards high energy efficiency
  - Architect or designer
  - Material provider
  - Contractor or craftsman
  - Energy auditor or energy expert
  - Bank or financial expert
  - Other, namely:
14. Would you please indicate below which communication channels influenced your household to decide for very high energy efficiency? Please tick every issue that had an influence on your decision to choose for high energy efficiency [multiple answers possible]
- My household noticed similar projects
  - My household noticed applicable subsidies, grants or green loans
  - My household got information on a public event, for example a building fair or information session
  - My household was pointed to energy efficiency by acquaintances
  - My household was pointed to energy efficiency by an independent third party, for example a non-profit organization, energy agency or municipality
  - My household was pointed to energy efficiency by other professionals or professional organizations
  - My household was pointed to energy efficiency by a bank or financial expert
  - My household learned about energy efficiency by reading internet web pages or e-mail
  - My household learned about energy efficiency via social media such as facebook, twitter, linkedin,..
  - My household learned about energy efficiency from magazines or (news)papers
  - My household learned about energy efficiency from television or radio
  - My household noticed public information campaigns about energy efficiency
  - Other, namely:

### **Motivation for a major renovation**

15. Would you please indicate below what type of BUILDING CONDITIONS were important to your household in order to decide to renovate? Please tick every building condition that applies [multiple answers possible]
- Need for changes in the available space
  - Parts of the building envelope breaking down, not working properly or needing

upgrade

- Technical services breaking down, not working properly or needing upgrade
- To improve indoor comfort or health conditions
- To improve the aesthetical appearance of the building
- To reduce the consumption of energy
- Other, namely:

16. Would you please indicate below what indoor comfort or health conditions were important to your household in order to renovate? Please tick every comfort or health condition that applies [multiple answers possible]

- Reduce draught from windows or doors
- Solve mould or moisture problems
- More comfortable indoor temperature in winter
- More comfortable indoor temperature in summer
- More comfortable temperature of sanitary hot water
- Improve indoor air quality
- Improve lighting or daylighting
- Reduce noise problems
- Make the interior cleaner
- Avoid dust or airborne allergies
- Avoid unhealthy building materials
- Other (specify)

17. Would you please indicate below what FINANCIAL reasons were important to your household in order to decide to renovate? Please tick every reason that applies [multiple answers possible]

- Save on living expenditures/ energy bills
- Obtaining a first mortgage
- Obtaining a second mortgage
- Obtaining a loan specifically for low-energy measures
- Obtaining income tax reduction for low-energy measures
- Obtaining grants or subsidies for low-energy measures
- Value added tax reduction for renovation
- The payback time of the investment was reasonable
- The financial offer from the bank was very attractive
- The offer from the contractor was very attractive
- Cost guarantees from contractors
- The property value would increase
- No financial reasons were important
- Other, namely:

18. Would you please indicate below what ENVIRONMENTAL reasons were important to your household for your renovation? Please tick every environmental reason that applies [multiple answers possible]

- Obtain a low energy use
- Obtain a minimum energy use
- Produce own energy
- Avoiding an electricity, gas or fuel connection
- Reduce the impact on the environment
- Use of natural/renewable materials

- A healthy indoor environment
- A green building environment
- A quiet environment without noise
- No environmental reasons were important
- Other, namely:

### Activities during the renovation

19. Would you please indicate below if your household performed the following thermal insulation activities during the renovation? Please tick every thermal insulation activity that was performed [multiple answers possible]

- Thermal insulation of roof(s)
- Thermal insulation of attic(s)
- Thermal insulation of outside wall(s) from the outside
- Thermal insulation of outside wall(s) from the inside
- Thermal insulation of outside wall(s) by cavity filling
- Thermal insulation of floor(s) above cellar
- Thermal insulation of floor(s) above crawl space
- Thermal insulation of cellar
- Thermal insulation of crawl space
- Measures to increase airtightness of windows and doors
- Thermal insulation of windows, doors and glazing
- Other thermal insulation activities, namely:
- None of these

20. Would you please indicate below which building service systems your household changed? Please tick every building service system that was modified or added [multiple answers possible]

- Gas or fuel supply
- Space heating production system
- Space heating distribution system
- Ventilation production system
- Ventilation distribution system
- Space cooling system
- Electricity production system
- Electricity distribution system
- Tap water heating system
- Tap water distribution system
- Sanitary equipment
- Solar boiler
- Other changes in building services, namely:
- None of these

21. Did your household contract other parties to do renovation works?

- Yes
- No

22. Your household did NOT consult a contractor, what were the reasons? (multiple options possible)

- Couldn't find a suitable contractor
- Didn't trust a contractor
- Too much administrative burden

- Extra cost
- My household wanted to do the renovation
- Friends or family wanted to contribute to the renovation
- Other reasons, namely:

### **Experiences with contractors**

23. Which contractors were involved in your renovation? [multiple answers possible]

- General contractor (walls, roofs, floors, windows)
- Contractor building services (heating, ventilation, plumbing)
- Project manager, working independent from other actors
- Architect
- Interior architect
- Energy expert
- Building cost expert
- Other contracting party, namely:

24. Was your household quite sure before the renovation that the contractors had the proper skills and experience for dealing with energy-efficient renovation?

- Yes
- No
- I don't know

25. Would you please indicate below how you checked whether the contractors your household engaged for had the proper skills and experience for the job? Please tick every issue you find to be applicable for your renovation.

- The contractors spoke to us about handbooks, guidelines, guidebooks they used or got their knowledge from
- The contractors spoke to us about training programs and courses followed in the past
- My household checked whether the contractors had previous actual on-site experience with renovation works
- The contractors spoke to my household about independent guidelines/codes of good practice specifically on energy saving renovation they comply with/follow
- The contractors were endorsed by an independent third-party e.g. the company name was on a recommended list of actors
- The contractors were recommended to us by people I/we know
- The contractors have a quality label/ complies with a certification schemes for actors
- Other, namely:

### **General contractor**

26. Would you please indicate if the general contractor offered your household the following? Please tick every issue applicable [multiple answers possible]

- Brochures or technical specifications about energy saving
- A calculation of the energy saving or cost savings on energy
- Assessment protocols, for example specific on-site testing or an energy monitoring schedule
- A contractual guarantee on energy saving
- A contractual cost guarantee
- A contractual guarantee regarding renovation time
- A maintenance protocol or maintenance contract

- Including other professionals, for example a quality surveyor, project coordinator or energy expert
  - Other, namely:
27. According to your household's opinion, did the general contractor delivered an EXCELLENT job?
- Yes
  - No
  - I don't know
28. Would you please indicate below what issues your household particularly appreciated about the general contractor? Please tick every issue applicable [multiple answers possible]
- Keeping to delivery time
  - Keeping to agreed costs
  - The creativeness of finding solutions
  - The time spent with the household to discuss the project
  - The time spent with other professionals to discuss the project
  - The ease of which the professional could be contacted
  - The environmental commitment of the professional
  - The commitment of the professional towards energy saving
  - The professional used certified products with an energy or environmental declaration
  - The professional aimed for a project with an independent energy or environmental declaration
  - Other, namely:
29. How did your household get to know the excellent general contractor? [multiple answers possible]
- The contractor was involved in a project my household knew
  - The contractor was on a public event for homeowners, for example a building fair or information session
  - The contractor was referred to my household by acquaintances
  - The contractor was referred to my household by an independent third party, for example a non-profit organization, energy agency or municipality
  - The contractor was referred to my household by other professionals or professional organizations
  - By reading internet web pages or e-mail
  - The contractor was referred to my household by social media like facebook, twitter, linkedin,..
  - The contractor was mentioned in magazines or (news)papers
  - The contractor appeared on television or radio
  - My household accidentally found the contractor
  - Other, namely:
30. In which construction phases was the excellent general contractor involved? (multiple options possible)
- Initiative to choose highly energy-efficient renovation
  - Financial advice (for loans, mortgage etc.)
  - Conceptual design of whole building
  - Design and execution of walls, floors, roofs
  - Design and execution of windows, doors
  - Design and execution of heating system
  - Design and execution of ventilation system

- Design and execution of cooling system
- Calculation of building costs
- Selection of other contractor(s)
- Follow-up of execution
- Checking the delivery of the renovation
- Adjustments after completion
- I don't know
- Other, namely:

31. Would you please indicate below which of these issues your household was informed about for the first time by the excellent general contractor? [multiple answers possible]

- The possibility to obtain grants or subsidies for highly energy-efficient renovation
- The possibility to obtain green loans for highly energy-efficient renovation
- The possibility to get a better energy performance certificate for the house
- The possibility to get a passive house certificate
- The possibility to require energy performances from actors
- The possibility to require energy cost guarantees from actors
- The possibility to check the performance of building services (e.g. ventilation flow rates, space heating calibration)?
- The possibility to check correct placement of thermal insulation with infrared thermography
- The possibility to check building airtightness and air leakages
- None of these

### **Contractor building services**

32. Would you please indicate if the contractor building services offered your household the following? Please tick every issue applicable [multiple answers possible]

- Brochures or technical specifications about energy saving
- A calculation of the energy saving or cost savings on energy
- Assessment protocols, for example specific on-site testing or an energy monitoring schedule
- A contractual guarantee on energy saving
- A contractual cost guarantee
- A contractual guarantee regarding renovation time
- A maintenance protocol or maintenance contract
- Including other professionals, for example a quality surveyor, project coordinator or energy expert
- Other, namely:

33. According to your household's opinion, did the contractor building services delivered an EXCELLENT job?

- Yes
- No
- I don't know

34. Would you please indicate below what issues your household particularly appreciated about the contractor building services? Please tick every issue applicable [multiple answers possible]

- Keeping to delivery time
- Keeping to agreed costs

- The creativeness of finding solutions
- The time spent with the household to discuss the project
- The time spent with other professionals to discuss the project
- The ease of which the professional could be contacted
- The environmental commitment of the professional
- The commitment of the professional towards energy saving
- The professional used certified products with an energy or environmental declaration
- The professional aimed for a project with an independent energy or environmental declaration
- Other, namely:

35. How did your household get to know the excellent contractor building services? [multiple answers possible]

- The contractor was involved in a project my household knew
- The contractor was on a public event for homeowners, for example a building fair or information session
- The contractor was referred to my household by acquaintances
- The contractor was referred to my household by an independent third party, for example a non-profit organization, energy agency or municipality
- The contractor was referred to my household by other professionals or professional organizations
- By reading internet web pages or e-mail
- The contractor was referred to my household by social media like facebook, twitter, linkedin,..
- The contractor was mentioned in magazines or (news)papers
- The contractor appeared on television or radio
- My household accidentally found the contractor
- Other, namely:

36. In which construction phases was the excellent contractor building services involved? (multiple options possible)

- Initiative to choose highly energy-efficient renovation
- Financial advice (for loans, mortgage etc.)
- Conceptual design of whole building
- Design and execution of walls, floors, roofs
- Design and execution of windows, doors
- Design and execution of heating system
- Design and execution of ventilation system
- Design and execution of cooling system
- Calculation of building costs
- Selection of other contractor(s)
- Follow-up of execution
- Checking the delivery of the renovation
- Adjustments after completion
- I don't know
- Other, namely:

37. Would you please indicate below which of these issues your household was informed about for the first time by the excellent contractor building services? [multiple answers possible]

- The possibility to obtain grants or subsidies for highly energy-efficient renovation

- The possibility to obtain green loans for highly energy-efficient renovation
- The possibility to get a better energy performance certificate for the house
- The possibility to get a passive house certificate
- The possibility to require energy performances from actors
- The possibility to require energy cost guarantees from actors
- The possibility to check the performance of building services (e.g. ventilation flow rates, space heating calibration)?
- The possibility to check correct placement of thermal insulation with infrared thermography
- The possibility to check building airtightness and air leakages
- None of these

### Products used on site

38. Would you please indicate below how your household made sure that the products used on site were of the appropriate quality? Please tick every issue you find to be applicable for your renovation.

- Where possible the products used were endorsed by a third-party for example they were listed as recommended products
- The products used were recommended to us by people I/we know
- Where possible the products used had a quality label
- Other, namely:

39. Would you please indicate for each point below with a number from 1 to 5 whether the following aspects/elements would give you trust in supplied products?

1 (does not provide confidence at all) .... 5 (extremely important in providing confidence) + I don't know

- The products are endorsed by a third-party e.g. list of recommended products
- The products are recommended to us by people we know
- Where possible the products have a quality label

40. Would you please indicate for each point below with a number from 1 to 5 whether the following aspects/elements would give you trust in achieving the overall end result?

- An energy advice, comfort assessment or general assessment of the house should first of all be performed
- My household should appoint an energy advisor that is on a list of recognized experts/advisors
- My household should appoint an energy advisor whose advice complies with a quality label
- Once decided what renovation measures had to be taken, all actors involved should be informed and agree to deliver the aspired end result
- My household should require the actors to make sure the renovation complies with a quality label/certification scheme e.g. passive house standard

- My household should require the actors to sign a contract that specifies the required performance, for example energy performance level after renovation, the comfort level after renovation or other specific performance criteria
  - Protocols, checklists, self-assessment instruments should be used by the actors to help them to perform and keep track of the required renovation works
  - A quality surveyor/coordinator should be appointed in charge of coordination and risk management
41. Let us imagine you will undertake another renovation project. Would you please indicate for each point below with a number from 1 to 5 whether the following aspects/elements would give you trust in supplying actors?
- The actor speaks to me about handbooks, guidelines, guidebooks he uses/he gets his knowledge from
  - The actor speaks to me about a training programs and courses he followed in the past (with or without on-site practice)
  - The actor has previous actual on-site experience with renovation works
  - The actor ensures me he complies with/follows independent guidelines/codes of good practice
  - The actor is on a list of recommended actors that deliver a good job
  - The actor was recommended to us by people we know
  - The actor has a quality label/ complies with a certification schemes for actors
42. What would your household recommend we should develop to help other people that plan to renovate to find good contractors?  
[free comment]
43. What would your household recommend we should develop to help other people that plan to renovate to avoid negative experiences with contractors? [free comment]

### Summary

44. To sum up, what would your household consider your biggest challenge in your renovation project? [free comment]
45. What was your household's biggest challenge in reaching high energy efficiency? [free comment]
46. According to your household's current experiences, what would your household do different in similar renovation projects? [free comment]
47. How successful does your household consider your renovation project (scale 1: very unsuccessful - 10 very successful)?
48. Is your household satisfied with the result of the renovation project? Please give a score on a

scale from 1 (extremely dissatisfied) to 10 (extremely satisfied)

49. In a next project, would your household choose again for a highly energy-efficient renovation?

- yes
- no
- I don't know

50. Do you have any other comments you wish to mention about achieving highly energy-efficient renovations? [free comment]

### **End of questionnaire**

51. Can we contact you if we have further questions?

- yes
- no

52. Would you like to be contacted by the researchers for an additional face-to-face interview?

- yes
- no
- I don't know

53. Would you like to be kept informed about the results of this research?

- yes
- no

54. In case you want to be contacted or informed about the results, please mention your contact details here. These will not be disclosed and are treated according to privacy laws.

Name:

e-mail:

telephone number:

**Thank you very much for your cooperation**



The sole responsibility for the content and analysis of this questionnaire lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EACI nor the European Commission are responsible for any use that may be made of the information contained therein.

## Appendix II: Interviews with homeowners

Name in report	Living place interviewee	Name of the interviewer	Date of the interview
<b>Austria</b>			
Household 1	Tannheim	Hannes Warmuth	18-2-2014
Household 2	Untermieming	Hannes Warmuth	13-2-2014
Household 3	Schleißheim	Hannes Warmuth	25-2-2014
<b>Belgium</b>			
Household 1	Brussels	Irati Artola	17-2-2014
Household 2	Antwerp	Irati Artola, Wouter Hilderson	29-1-2014
Household 3	Leuven	Irati Artola	10-2-2014
<b>Germany</b>			
Household 1	München	Raili Münke	21-2-2014
Household 2	Hamburg	Raili Münke	3-3-2014
Household 3	München	Raili Münke	5-3-2014
<b>Netherlands</b>			
Household 3	Amsterdam	Ad Straub	22-1-2014
Household 2	Den Haag	Ad Straub	11-2-2014
Household 1	Amersfoort	Ad Straub	10-3-2014
<b>Norway</b>			
Household 1	Trondheim	Silje Strøm Solberg, Tommy Kleiven	13-1-2014
Household 2	Åndalsnes	Judith Thomsen	19-2-2014
Household 3	Rissa	Judith Thomsen	19-2-2014