



## Deliverable D2.2 Mapping the demand drivers

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# Summary

In the REFURB project a market segmentation that is relevant for NZEB-renovation and demand aggregation schemes was developed (report D2.1). These segments are linked with drivers and barriers homeowners face when deciding on NZEB-renovation.

Barriers are the psychological, social, financial and other negative arguments not to carry out a renovation. These originate in motivations, desires, needs and the financial situation of homeowners.

Drivers are the counterpart of the barriers: they are the psychological, social, financial and other positive arguments to carry out a renovation. These also originate in motivations, desires, needs and the financial situation of homeowners.

In regions participating in the REFURB project research is available on the drivers and barriers homeowners face to implement energy efficiency renovations. Also on EU-level studies are available. This report is based on this research, combined with the knowledge and experience of the partners.

In REFURB a thematic clustering of drivers and barriers is proposed (Figure 1), based on the insights of the projects, the country reports and the conclusions of task 2.1 (housing market segmentation):

- **Technical drivers and barriers**, linked with the dwelling characteristics and the challenge to renovate to NZEB.
- **Financial drivers and barriers**, linked with the financial possibilities of the dweller and the cost of the NZEB-renovation.
- **Social and behavioural drivers and barriers**, linked with the decision-making process of the dweller, so including the behaviour, attitude of the dweller, as well as the (social) conditions to take a decision.
- **Context drivers and barriers**. These are rather external factors, not directly linked with the dweller or dwelling characteristics, but deal with the particular situation or context the homeowner has to deal with. E.g. legal and administrative issues, tenant-landlord issues, organisation of the building sector etc.

Using these clusters of drivers and barriers and applying them to the segments that can be defined using the method described in the REFURB-report D2.1 gives a better insight into focus areas for removing barriers and using drivers of the identified segments. Based on this report on drivers and barriers in the different segments (D2.2), better ways to organise the demand side will be examined (report D2.3), local differences in demand side drivers and barriers will be examined (report D2.4), and improved approaches to seduce homeowners to integrate NZEB-ambitions within their renovation will be designed (report D2.5).

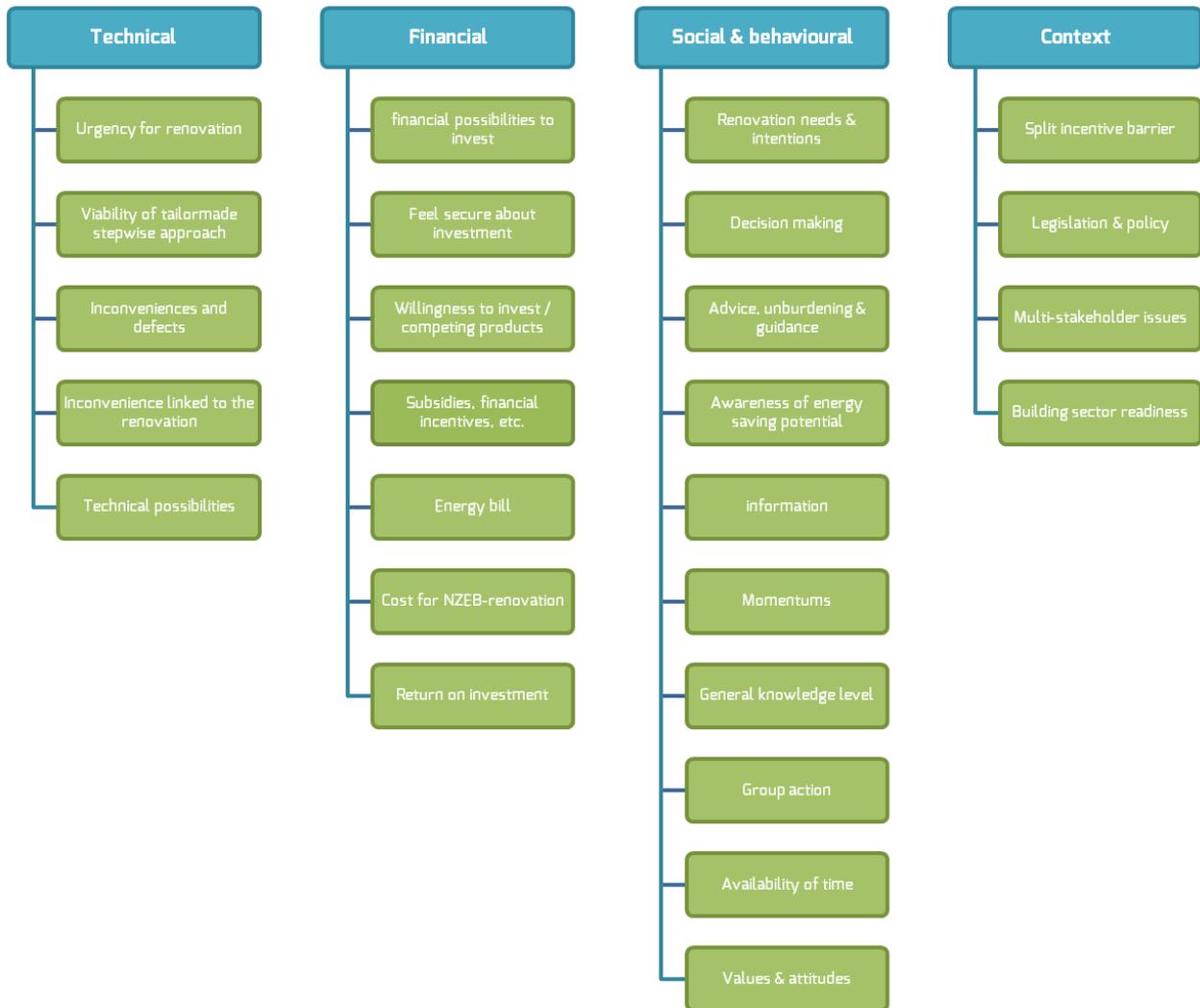


Figure 1: Clustering of drivers and barriers for NZEB renovations

# 1 Introduction

Renovation in the residential sector towards increased energy efficiency is seriously lagging behind the political targets for energy renovation. As more than sufficient technological solutions are available, focus must be on removing non-technological barriers and introducing effective drivers. The main barriers relate to fragmentation of the renovation offer, resulting in inefficient or only partial solutions. One way to solve this is the use of a '1-stop-shop concept'. Many have been put in practice. Some were successful, others not. They might lack an understanding of the concerns and demands of homeowners.

The REFURB project focuses on the complex interplay of barriers through coordinated process organization, innovation and optimization. Work package 2 and work package 3 are dedicated to analyze demand and supply side drivers. This report is part of work package 2 ("demand side mapping"), and focuses on the existing barriers and drivers of the demand side. The demand side of the REFURB project refers to private homeowners, which is a diverse group of decision makers in energy efficiency investments that is not well organised and has a limited capacity and ambition to inform themselves on technical details of energy efficiency solutions.

In Work Package 2 a segmentation of the demand side is being established, and insights are gained into the wishes, needs and motives of homeowners (not) to invest in energy efficiency measures. This improves the understanding of the possible ways to better organise the fragmented demand side, and define improved approaches to seduce homeowners to integrate NZEB-ambitions within their renovation, with energy saving translated into their 'language'.

In the REFURB project a market segmentation that is relevant for NZEB-renovation and demand aggregation schemes was developed (report D2.1). These segments are linked with drivers and barriers homeowners face when deciding on NZEB-renovation.

**Barriers** are the psychological, social, financial and other negative arguments to not carry out a renovation. These originate in motivations, desires, needs and the financial situation of homeowners.

**Drivers** are the counterpart of the barriers: they are the psychological, social, financial and other positive arguments to carry out a renovation. These too originate in motivations, desires, needs and the financial situation of homeowners.

In all regions participating in the REFURB project information is available on the drivers and barriers homeowners face to implement energy efficiency renovations. This report is based on available research, combined with the knowledge and experiences of the partners, such as the FP7- project ZenN (Nearly Zero energy Neighbourhoods), the IEE-project COHERENO, the Dutch programmes Energiesprong, Blok voor Blok and Energieplein 20, the Danish Project Zero experiences etc.

All partners prepared a country report to summarize their conclusions. This report builds on the country reports.

Throughout the remainder of this chapter a general framework of clusters of drivers and barriers is made based upon the results of existing studies and projects. Then in the following chapters 2 to 5 these clusters of drivers and barriers are described in detail. In chapter 6 they are linked to the identified potential demand-side segments from report D2.1. Chapter 7 concludes.

Based on this report on drivers and barriers in the different segments, better ways to organise the demand side will be examined (report D2.3), local differences in demand side drivers and barriers will be examined (report D2.4), and improved approaches to seduce homeowners to integrate NZEB-ambitions within their renovation will be designed (report D2.5).

## 1.1 INTERPLAY BETWEEN SEGMENTATION (REPORT D 2.1) AND DRIVERS AND BARRIERS (REPORT D 2.2)

To segment the housing market (report D2.1) from a demand-side perspective, characteristics were defined to make the distinction between the different groups (segments). Two main types of characteristics were used to define segments:

- dwelling-related characteristics; and
- dweller-related characteristics.

The segmentation (report D 2.1) is somehow related to the listing of the drivers and barriers of homeowners to decide on NZEB-renovation (report D2.2). Segments are groups of dwellings and/or dwellers that have similar characteristics and meet similar barriers and drivers. The characteristics to segment can be a driver or barrier at the same time, but not necessarily always, e.g.:

- People with high access to financing can be a separate segment, as they do not face similar financial barriers as people in energy poverty<sup>1</sup>, which can be a second segment. For people in energy poverty, the access to financing is a major barrier. As a result, different (financial) solutions and persuasion strategies are needed to tackle the specific barriers of these two segments separately.  
In this example access to financing is a feature to design segments as well as a barrier for the two segments of homeowners.
- For different construction types of a dwelling (massive masonry, cavity walls, timber frame, cassette façade etc.) different NZEB-renovation concepts are needed. So the construction type is an obvious characteristic to segment the dwellings. But the construction type as such is not a barrier for NZEB-renovation.

The relationship between dwelling characteristics, dweller characteristics, drivers and barriers is shown schematically below (Figure 3).

It must be stressed that drivers and barriers are primarily connected to the people living in the dwellings and making the decisions.

Only up to a minor extent, barriers can relate to dwellings e.g. to technical impossibilities to implement NZEB-solutions, for example with historical buildings. But this type of barrier has a very different nature and has little to do with the decision-making process of a homeowner. Drivers are in general less related to dwelling characteristics.

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<sup>1</sup> The common definition of energy poverty is a share of +10% of the household budget is being spent on energy for heating. Energy poverty is more frequent with households with low income, and with households with a high energy bill.

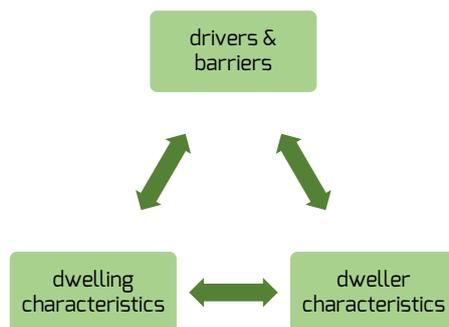


Figure 2: The relationship between dwelling characteristics, dweller characteristics, drivers and barriers

## 1.2 LEARNING FROM OTHER PROJECTS

In this report the REFURB project builds upon the results of other projects, surveys and research. In all six REFURB countries, partners conducted a desktop research on the available studies within the country. In this chapter, the findings of two pan-European reports are presented: the ZenN-project (EU 7th Framework-project), and the study “Europe’s buildings under the microscope” from the building Performance institute Europe (BPIE).

### 1.2.1 ZenN

The project Nearly Zero energy Neighbourhoods (ZenN)<sup>2</sup> is being implemented from 2013 – 2017 and is funded through the EU's Seventh Framework Programme (FP7). In the ZenN- project, residential areas in Sweden, Norway, Spain and France will function as nearly zero energy building (NZEB) renovation demonstration projects where a number of measures will be implemented in connection with renovations.

Whereas REFURB focusses on drivers and barriers at the decision-making level in renovation projects, ZenN only identified the **barriers**. The ZenN project also identified the challenges in practice of retrofitting processes, in the renovation projects with high energy efficiency goals.

Based on a literature study, five major challenges and barriers were identified (Table 1).

Table 1 Barriers and challenges of forerunning retrofitting / renovation projects as identified by the ZenN project. Source: ZenN, D1.1. Report, 2013

Barriers and Challenges	Main issues
Technical	Technologies and innovative solutions
Financial	Schemes and financial incentives, balance between cost and solution
Social	Engagement, awareness, behaviour of all stakeholders, architectural and cultural heritage
Environmental and health	Life cycle perspective in design; quality of the indoor environment
Organisational/legal	Legislation, governance and policy; Project management; Stakeholder/ Ownership structure

<sup>2</sup> <http://zenn-fp7.eu/>

It is recognised that there are financial challenges for NZEB but there are also a number of fiscal incentives and business models available.

- There is a long payback period taking between 15-30 years and residents do not stay long enough in a house to benefit from this payback period.
- There are issues where the landlord cannot raise rents.
- There are very little financial instruments available in the EU that are aimed directly and exclusively at supporting NZEB renovations.

The ZenN project concludes that many barriers and challenges in connection with realizing residential NZEB renovations are similar among countries. But it was recognized that there are also other challenges and barriers that are more country-specific and who are just as important as the common ones. The main common barriers and challenges in current practice in Europe are outlined:

**Barriers in the decision-making process:**

- Technical barriers: Existing building structure and technical system limit the choice of technical solutions that can be used but where technical solutions can be found, they are often costly and not financially viable.
- Financial barriers: Investment cost too high
- Social barriers: Lack of knowledge and/or interest in energy efficiency among residents and building owners, often due to lack of awareness combined with challenges with architectural and cultural values
- Environmental/health barriers: No common environmental/health barriers were highlighted

**Organisational/legal barriers:**

- The ownership structure and need for consensus among several homeowners can hinder an NZEB renovations

**Challenges of the retrofitting process:**

- Technical challenges: Existing building structure and technical systems limit the choice of technical solutions possible for NZEB renovations.
- Financial challenges: Building owners are unlikely to make a return on investment
- Social challenges: The need for communication and information early in the renovation process to increase acceptance among residents
- Environmental/health challenges: The risk of moisture must be taken into consideration when making a building more airtight
- Organisational/legal challenges: The need for an extensive communication between involved organisations and actors early in the process

## 1.2.2 Europe's buildings under the microscope (BPIE, 2013)

BPIE, the Buildings Performance Institute Europe, has undertaken a survey across all EU Member States, Switzerland and Norway reviewing the situation in terms of the building stock characteristics and policies in place.<sup>3</sup> The data collected was also used to develop scenarios that show pathways to making the building stock much more energy efficient, in line with the EU 2050 roadmap.

In this study, BPIE researched what is important for policy making to better understand the factors that affect decisions of homeowners. This should allow to design and implement policies that will more effectively promote energy efficiency investments and actions. The BPIE survey included the collection of information on specific barriers within the individual countries, reflecting the priorities and differing circumstances affecting implementation and improvements.

BPIE observes that in simple economic terms, the fact that there is a large untapped cost-effective potential for improving the energy performance of buildings proves that consumers and investors, as well as society in general, are not keen on investing in energy saving. Market dynamics, however, do not always follow a straight path and there is a multitude of reasons why consumers or building owners make specific decisions. **There is a need for a better understanding of why consumers act the way they do, often defying the logic of conventional economic theory.**

This study points out that it is clear that a multitude of barriers is severely limiting the achievement of the full potential. A combination of barriers is responsible for this underperformance. There are many ways to classify barriers and over the years they have been described in many different ways. The BPIE survey identified the following four main categories of barriers that have a particular impact on existing buildings (Figure 3):

- Financial
- Institutional and administrative
- Awareness, advice and skills
- Separation of expenditure and benefit

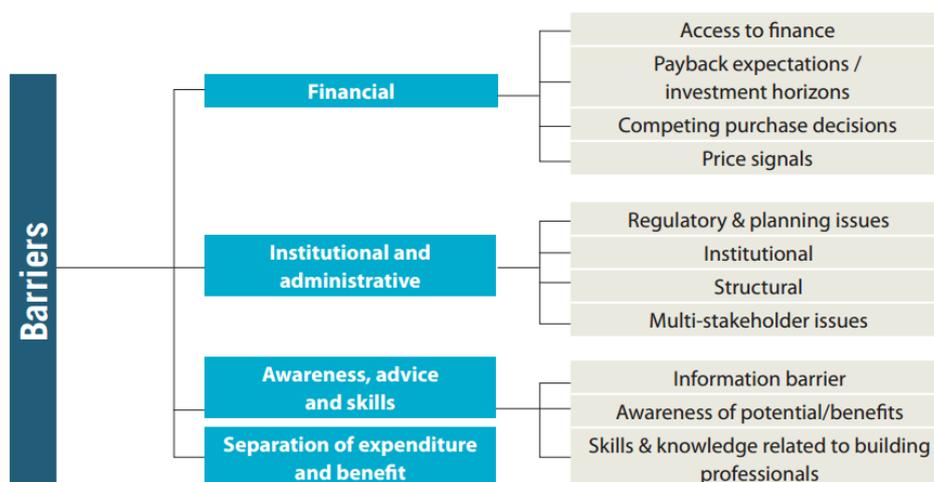


Figure 3: Classification of barriers as identified by the BPIE survey. Source: BPIE, 2011

<sup>3</sup> BPIE, 2013

### 1.2.3 Drivers & barriers in different stages of decision making proces

A decision-making proces for NZEB renovation goes through several stages. Homeowners meet different barriers at every stage. This is illustrated in Figure 4, from a study of Christian A. Klöckner, a social psychology academic (Klöckner, 2013). Klöckner focusses on the several stages of intention.

Four stages of intention are defined: "no intention", "goal intention", "behavioural intention", "implementation intention". From moving from each stage to the next, a number of barriers are detected, and a set of facilitators are described.

For example, barriers to move from "no intention" to "goal intention" are: homeowners are renting their house, or they have no money available, or they need to agree with the neighbours. Examples of barriers to move from "behavioural intention" to "implementation intention" are to be unsure about information about insulation, or a payback period that is too long.

Examples of "facilitators" to move from "behavioural intention" to "implementation intention" are an increased quality of the house, more comfort, or reduced energy costs. These "facilitators" are similar to what in the REFURB project are called "drivers".

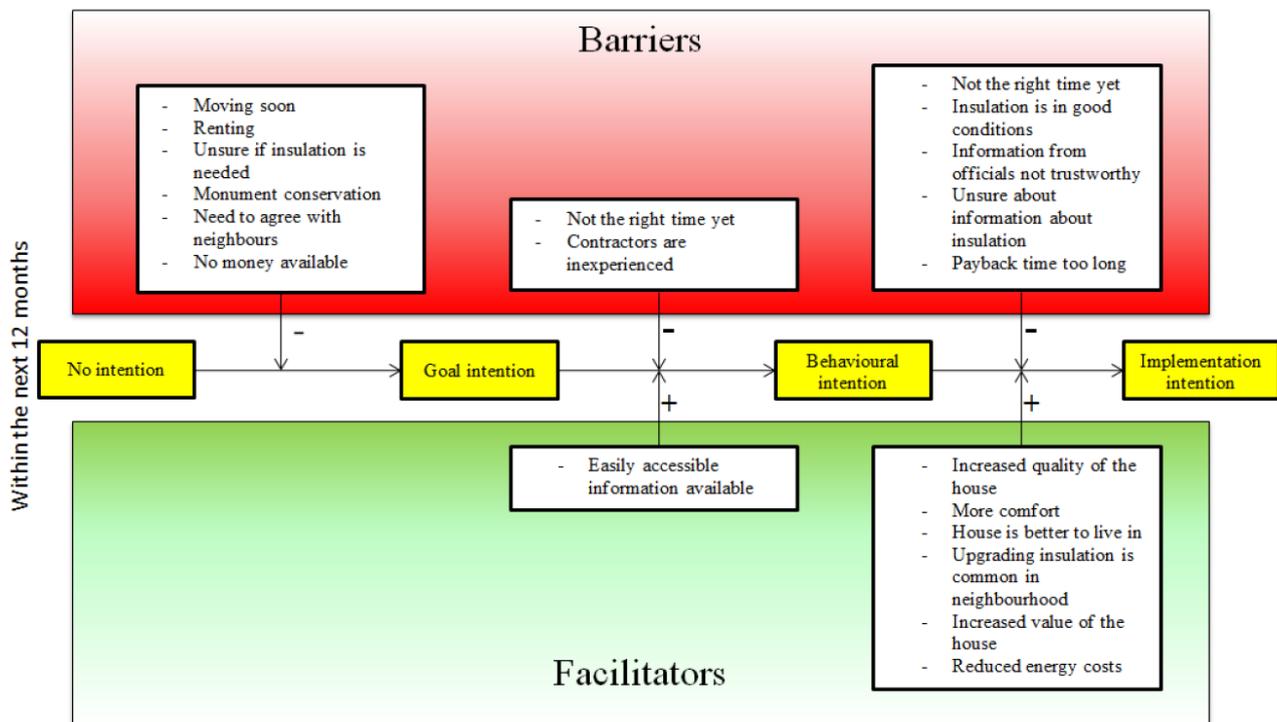


Figure 4: Christian A. Klöckner, NTNU, Norway, 2013

## 1.3 REFURB FRAMEWORK FOR CLUSTERING DRIVERS AND BARRIERS

Based on the insights of the abovementioned projects, the country reports and the conclusions of task 2.1 (housing market segmentation), a thematic clustering of drivers and barriers will be used in the REFURB project (Figure 2):

- **Technical drivers and barriers**, linked with the dwelling characteristics and the challenge to renovate to NZEB standards.
- **Financial drivers and barriers**, linked with the financial possibilities of the dweller and the cost of the NZEB-renovation.
- **Social and behavioural drivers and barriers**, linked with the decision making process of the dweller, so including the behaviour, attitude of the dweller, as well as the (social) conditions to take a decision.
- **Context drivers and barriers**. These are rather external factors, not directly linked with the dweller or dwelling characteristics, but deal with the particular situation or context the homeowner has to deal with. E.g. legal and administrative issues, tenant-landlord issues, organisation of the building sector etc.

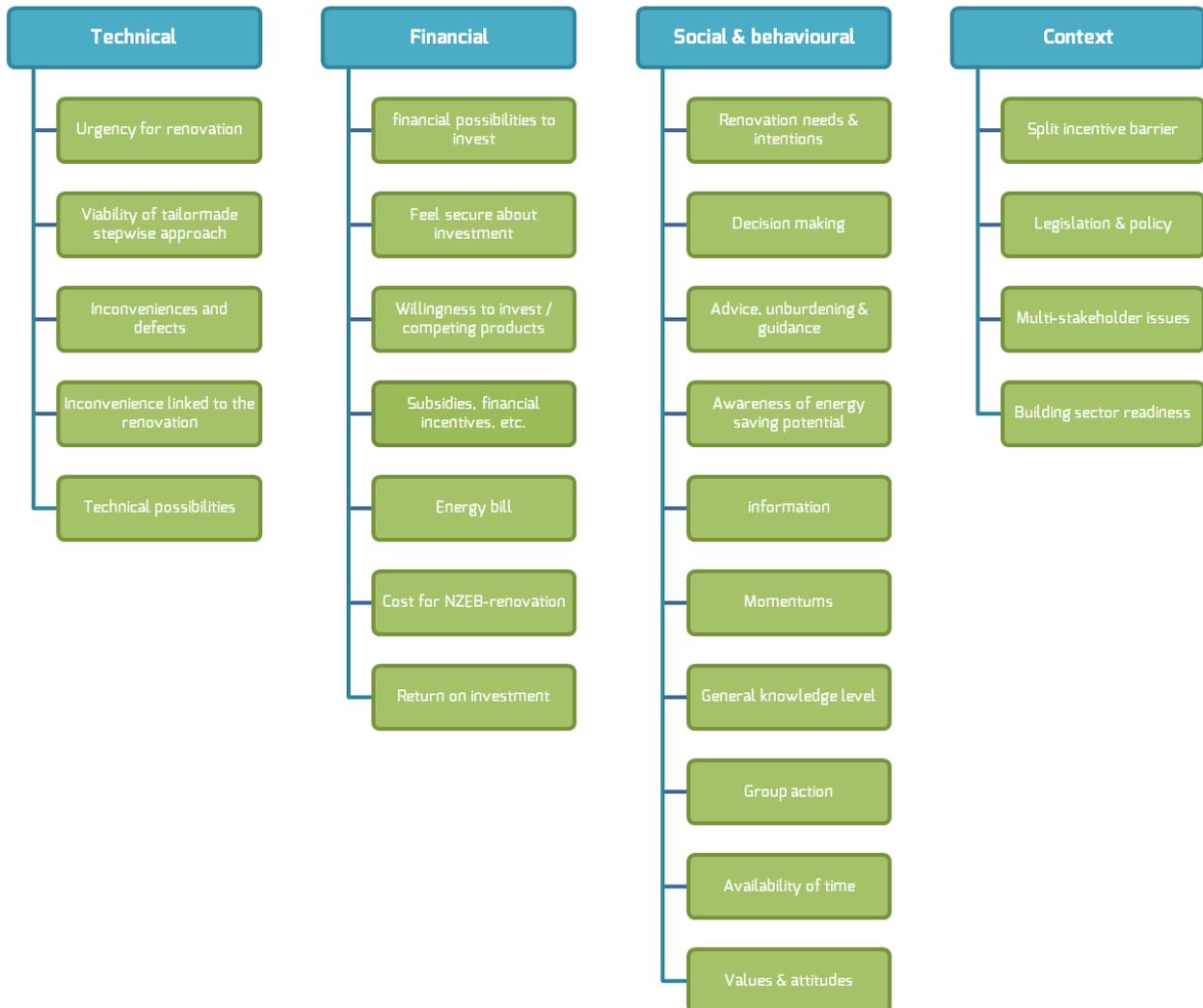


Figure 5 Clustering of drivers and barriers for NZEB renovations, based upon BPIE and ZenN

Within these clusters, especially in the clusters on financial and on social and behavioural drivers and barriers particular attention will be paid to 2 segments of homeowners:

- **Owners that are aware that their house needs renovation:** for this group the goal will be to gain insight in the motivations that the owners have to invest or not.
- **The latent demand side:** owners that are not enough aware that their house needs renovation. For this group it is important to understand why people are not aware of the fact that renovation brings added value. The central question is: how can one be made aware that his/her house needs renovation?

## 2 Technical drivers & barriers

A first set of drivers and barriers is linked with the dwelling characteristics and the challenge to renovate to NZEB, and have a technical dimension.

### 2.1 URGENCY FOR RENOVATION & LOCK-INS

This is identified as the most important driver for NZEB-renovation: to create win-wins between urgent or necessary renovations and NZEB renovations through integrating the energy renovation in one single renovation process.

E.g. houses that need refurbishment (e.g. new roof, new kitchen, painting, flooring, bathroom...), houses with safety and/or sanitary issues (e.g. risk for CO-intoxication, moisture, mould), worn-out doors and windows, leaking roof, sagging timbers, end-of-lifetime heating installations etc. **Investments need to be done anyhow**; the integration of NZEB-ambition results in an additional investment but this creates a win-win in terms of investment and efforts to organize a renovation process.

A lock-in situation is a frequent technical barrier to implement a cost-optimal NZEB-concept. A lock-in appears when recent partial renovations were not on the NZEB-level. E.g. if the thermal performance of a roof is 0,30 kWh/m<sup>2</sup>.a whereas it should be maximum 0,24 kWh/m<sup>2</sup>.a for an NZEB-building.<sup>4</sup> It is not interesting to re-renovate the roof as the cost will not be in balance with the benefits. Other (more expensive) solutions will be needed to compensate this situation.

**If a house is in good state, then this can be a barrier for deep NZEB-renovation.** Especially if the thermal performance already reaches a certain level. Every building element has a certain lifespan before it needs renovation, and this creates lock-ins. Another examples of a lock-in is a high-temperature heating system (incl. radiators), which is not compatible with a heat pump (a common technique in an NZEB building).

### 2.2 AVAILABILITY OF TAILOR-MADE STEPWISE APPROACH FOR NZEB-RENOVATION

Carrying out a deep renovation can be unfeasible, e.g. because of practical or financial reasons (no budget, no possibility to move out of the house etc.). The option to stage the deep NZEB-renovation into **several phases** which can be carried out over a longer period, can be a convincing driver for NZEB-renovation.

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<sup>4</sup> Exemplary values.

## 2.3 INCONVENIENCES AND DEFECTS

If a house is dealing with a lot of inconveniences and shortcomings, energy renovation becomes a driver. Wind leaks, condensation on windows, moisture problems, noise, creaky floors etc. can be solved because of the NZEB-renovation measurements, e.g. ventilation and new windows. People do not only choose for better energy performance, but also to experience the comfort of living in a house with reduced inconveniences and defects. Of course, the related required financial possibilities for investment might be a barrier (Chapter 3).

To **create a healthy dwelling** is a driver to tackle the inconveniences and defects as moisture and draft problems. A better indoor climate should be the result of an energy renovation, if this is done properly. If not, there is a risk to create unhealthy houses, e.g. when installing airtight windows without implementing an appropriate ventilation system. Poorly executed renovations, unfortunately, set bad examples and make people doubt. They turn the positive health-argument a (false) barrier due to misperception.

## 2.4 INCONVENIENCE LINKED TO THE RENOVATION

An NZEB-renovation which is feasible within a short timeframe is definitely an important driver, with the possibility to continue living in the house during the renovation, with little dust caused by the renovation works etc.

The contrary is a barrier: the need to move out of the house for a certain period, the dust, the noise, the long period of works. Some people just don't want to have any works in or around their house.

In some projects of the 'Blok voor Blok' renovation program in the Netherlands<sup>5</sup>, homeowners can stay for e.g. 2 days in a hotel during the works. This way, the barrier is overcome and for some people this even became a driver for NZEB-renovation. Another example is from Denmark, where a temporary dwelling was made in a container and set up in the garden as part of the renovation project.

## 2.5 TECHNICAL POSSIBILITIES

**Technical possibilities** are a barrier. E.g. not every house with a pitched roof allows for the installation of solar PV panels when the roof has the wrong orientation. Is district heating available, and is the district heating fed by renewable energy?

Resistance to the installation of new techniques or energy efficiency measures is also possible, due to concerns about the **maintenance** of the new installations (e.g. solar thermal, heat pump), or justified and unjustified concerns about repercussions that are associated with energy efficiency measures (e.g. poor indoor air quality, moisture problems, reduced cell phone coverage etc.)

The homeowner also might resist available technical possibilities for other reasons, e.g. their **aesthetics**. This can be the case for solar energy, or for external wall insulation which changes the appearance of the building. If the technical possibilities can't overcome this, then limited technical possibilities are a barrier.

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<sup>5</sup> <http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/blok-voor-blok>

## 2.6 LESS IMPORTANT DRIVERS & BARRIERS

Numerous drivers and barriers can be listed. In some cases or contexts, these will prove to be (very) important. In general, they can be considered as less important:

- A dwelling with historically valuable facade, interior, plan, in a conservation area etc. faces more technical barriers as the house needs very different NZEB-concepts in order to preserve these valuable characteristics.
- The energy performance of the house can be a driver if the EPC is bad, so the energy renovation is interesting to save energy and money. When the house has a good EPC, this can be a barrier if there are lock-ins.
- The house is too old to invest in, no need for any renovation.

## 3 Financial drivers & barriers

A second set of drivers and barriers is linked with the financial possibilities of the dweller and the cost of the NZEB-renovation.

### 3.1 AVAILABILITY OF FINANCIAL POSSIBILITIES TO INVEST

**Lack of funds** and/or inability to secure financing on acceptable terms is generally the most cited barrier to investing in energy efficiency measures. E.g. the homeowner has no savings, can't afford an extra loan etc. If people reach their financial limit when buying a house, they have no money left for renovation. People in energy poverty have a low income and have no budget to invest but need to spend a considerable amount of income to their energy bills, in proportion with their income this exceeds 10%.

Having an amount of **money to invest** (e.g. savings, a legacy) can be a huge driver, and create the right momentum to invest.

### 3.2 FEEL SECURE ABOUT INVESTMENT & SAVINGS

Spending money is connected with a feeling of insecurity, which is a barrier. Homeowners need to feel confident about the NZEB-investment; that it is the right investment: it must be worth the money. Homeowners must feel confident that the solution is future-proof: it needs to be enough for the future.

The same feeling of insecurity can exist with the expected energy savings and related cost savings. Is the amount of savings calculated by the building experts feasible i.e. will it become true?

### 3.3 WILLINGNESS TO INVEST IN ENERGY EFFICIENCY VS COMPETING PRODUCTS

Although the homeowner can have enough financial possibilities, the lack of the will to invest in energy efficiency is a huge barrier. In many cases if it is stated that there is a lack of funds, it is more due to the **lack of awareness or lack of interest rather than the actual lack of funds**. A cause can be the competition with other household needs, e.g. preference to spend the budget on comfort improvement, the need to tackle defects, a new car, family holidays etc. Or homeowners are just unwilling to take out (another) loan.

On the contrary, this will to invest in energy efficiency is a huge driver, but only if the homeowner has financial possibilities or access to finance.

### 3.4 SUBSIDIES, FINANCIAL INCENTIVES ETC.

The availability of subsidies, tax deductions, financing schemes etc. are recognized as a driver. It convinces homeowners to invest. It increases their budget, e.g. to cover additional cost for NZEB-renovation. If the financial incentive only is awarded when meeting NZEB-criteria, this definitely is a driver for NZEB-renovation.

**Categories of financial instruments** that are used throughout Europe can be divided into: (1) grants/subsidies, (2) soft loans, (3) tax/VAT incentives, (4) energy supplier obligations (white certificates), and (5) third party financing / energy performance contracting.

The **complexity** of such systems, e.g. complex administrative procedures, pre-financing of the homeowner and so forth are discouraging and undermine the effect. A lot of convinced homeowners also apply, although it was not necessary for their decision and financing (icing on the cake).

### 3.5 ENERGY BILL

The energy bill is the result of energy prices, the energy performance of the dwelling, and the energy use pattern of the dweller. So this driver/barrier can be attributed to the dwelling and dweller.

Reducing the energy bill is a main driver for NZEB-renovation. It is a short-term effect of the renovation which can last for a long time. This short-term effect is important.

On the contrary, a low energy bill can be a barrier for a NZEB-renovation. Even if the house has a bad energy performance, the low energy bill can be the result of the energy use pattern. Or, e.g. the house is heated with “free” wood that the owner gets from his property.

For most households, energy bills for the home account for 3-4% of disposable income, hence they are not a major concern. The higher the income, the lower the proportion of the energy bill in the household income. Energy poverty (energy bills account for more than 10% of the income) occurs mainly with low-income homeowners. But here the financial possibilities are limited.

### 3.6 COST FOR NZEB-RENOVATION

Usually the (high) cost of NZEB-renovation is the barrier, although a low cost for NZEB-renovation can be a driver. This barrier must be seen in relationship with the access to finance the homeowner has, his, or her willingness to invest, the expected return on investment, “competing products” (e.g. a new car) etc. For example, the investment cost is too high because the return on investment is too low, or because the homeowner does not have the financial possibilities to invest.

The high cost of a deep NZEB-renovation can be an argument to stage the renovation into several phases. So a concept for a staged NZEB-renovation might be a technique to tackle this barrier.

## 3.7 RETURN ON INVESTMENT

Most building owners and investors across Europe, in particular in the eastern part, tend to focus on solutions with short or medium payback periods (less than 10 years).<sup>6</sup> Ambitious energy and climate policies require savings up to 80% energy in buildings, which can only be reached through NZEB renovations. An NZEB renovation's payback time is between 15 to 30 years (depending on energy prices) and it is often not appreciated by most property owners nor financial institutions. Requirements for a short return on investment is therefore a barrier to the NZEB.

## 3.8 LESS IMPORTANT DRIVERS & BARRIERS

Numerous drivers and barriers can be listed. In some cases or contexts, these will prove to be (very) important. In general, we consider them less important.

- The value of the house is secured after renovation; thus this is a driver, but there is uncertainty on the impact on the value.
- Energy prices (cost per unit of electricity, gas, oil, heat, wood) can be a driver (if rising) and a barrier (if they are too low, if prices go down).

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<sup>6</sup> ZenN, 2013

## 4 Social and behavioural drivers & barriers

A third set of drivers and barriers is linked with the decision-making process of the dweller, so including the behaviour and attitude of the dweller, as well as the (social) conditions to take a decision.

### 4.1 RENOVATION NEEDS & INTENTIONS: INCREASE COMFORT LEVEL, COSINESS, PERSONALIZATION, TASTE, ADJUST ARCHITECTURAL CONCEPT ETC.

This is considered the main driver for NZEB-renovation. **For the overall majority of the homeowners, energy efficiency is not a main reason to start a renovation.** They want to increase comfort level, cosiness, personalization, taste, the looks, adjust architectural concept etc. Integration with NZEB-ambitions is a key challenge.

Simultaneously, the non-energy renovation needs are a barrier, as they are competing with the energy efficiency needs and might block NZEB-ambitions.

If homeowners have the intention to renovate (also non-energy), this is a driver. However, there might be the issue of “competing needs” which is a barrier, e.g. the intention is limited to non-energy renovations, and energy renovations are hard to integrate (practically, financially etc.)

An energy renovation might change the look of the house, e.g. as a consequence of a facade insulation, a new external wall finishing is needed. If homeowners are attached to the looks of the ancient facade, the idea of changing the look of the house can be a barrier.

### 4.2 DECISION MAKING, SELF-RELIANCE & EMPOWERMENT

Homeowners need to make a decision to invest in NZEB-renovations. Homeowners take decisions in a different way, based on their personality. **Most of the decisions are not taken on the basis of rational arguments** like energy savings, cost savings etc. and this is a major barrier from a classical traditional economic point of view (see REFURB report D 2.1). Homo rationalis or homo economicus doesn't exist. For some people it is very difficult to take decisions, they need to feel safe about their choice (am I doing the right thing?), want to base their choice on people they trust etc.

In particular cases, e.g. in apartment buildings with multiple owners, **leadership** also is important. A lack of leadership in the homeowner association is a barrier, good leadership is a driver. It makes the situation more difficult if there is no competence in construction business available. A decision-making process requires cooperation and trust.

## 4.3 ADVICE, 'UNBURDENING' & GUIDANCE

The availability of tailor-made advice, renovation guidance and 'unburdening'<sup>7</sup> processes are drivers for homeowners to renovate. This can be very intense (e.g. homeowners are being helped in every step of the renovation), but also be very limited (e.g. a group purchase of solar photovoltaics).

Assisting people in the many choices they make during the renovation process is a driver, as well to overview the correct execution of the work, as to complete the administration, the application for subsidies etc.

This driver is a concrete example of how the barrier of the heavy burden or hassle of a renovation has been overcome.

## 4.4 AWARENESS OF ENERGY SAVING POTENTIAL

Many homeowners are not aware of the energy and cost saving potential, even if there a general appreciation that energy saving is a "good thing". Householders may feel they are helping the planet by installing solar panel systems, without realising that far greater savings could be achieved from roof insulation.

## 4.5 ACCURATE, RELIABLE & TAILOR-MADE INFORMATION

The availability of independent, accurate and complete information that is trustworthy is a driver. Why should people renovate to NZEB-standards? What should they do? Who should they work with? Which renovation assistance or subsidies can they get? etc.

**The medium** conveying the information is also very important, and depends on the personality. Some people prefer to get processed information from an expert, others like to look up all information on the internet.

**Tailor-made** (non-generic) information is also considered a driver. This encompasses specific information relevant for the dwelling and the dweller. A current barrier is that homeowners have too little information on the current energy performance of their house.

Many homeowners need **an example**. The possibility to visit exemplary houses that went through a deep NZEB-renovation and similar to the own house, is a driver.

Too much **inaccurate, unreliable and contradictory information** is a barrier for people. Many people can't judge and remain undecided. The construction sector sometimes takes advantage of ignorance of homeowners by making offers that are overpriced and/or technically unsuitable. As a result, some people have no confidence in craftsmen.

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<sup>7</sup> Unburdening, deburdening, dehasling are all synonyms

## 4.6 MOMENTUMS FOR RENOVATION (WHY NOW?)

There are some very important moments to decide on an NZEB-renovation. These **momentums or stages in life** are drivers for renovation. E.g. the change of ownership is a very important momentum, or the moment a rented house changes tenant, but also the moment one has a financial windfall, or the availability of time.

Many of those moments come unannounced, so it is hard to anticipate on them. Some type of moments can be a barrier, e.g. uncertainties about the future (threat of unemployment, financial crisis, single parents etc.)

## 4.7 GENERAL KNOWLEDGE LEVEL

(NZEB-)renovations require knowledge and competences, to process the information, take decisions and manage a renovation project. A lack of knowledge is a barrier.

## 4.8 NEIGHBOURHOOD ACTION, GROUP ACTION

A neighbourhood approach or a group action has proven to be a big driver. The concentration of similar houses in a neighbourhood allows for a replication of NZEB-solutions.

A social network –neighbourhood-based or not- allows to create a renovation dynamic amongst homeowners, e.g. with homeowners who pioneer and others who like to follow, homeowners who cooperate in finding craftsmen etc.

## 4.9 AVAILABILITY OF TIME TO MANAGE RENOVATION PROJECT

Homeowners need time to manage a renovation project. If they do not have time available, this is a barrier. This is e.g. the case with families with young children.

A renovation project also can bring a lot of **stress**. Some homeowners fear the dirt and the stress that come with renovating (cf. 4.3).

## 4.10 VALUES (IDEAS) & ATTITUDES TOWARDS

### ENVIRONMENTAL ISSUES, SUSTAINABILITY AND CLIMATE

Having positive values and attitudes towards environmental issues is a driver, having opposite values is a barrier. E.g. homeowners who buy energy-efficient electric devices, are happy with their PV solar system and so forth.

## 4.11 LESS IMPORTANT DRIVERS & BARRIERS

Numerous drivers and barriers can be listed. In some cases or contexts, these will prove to be (very) important. In general, they are considered less important for the REFURB project:

- A low intensive energy use patterns can be a barrier. E.g. if the house is only partly heated, a deep renovation is not an accurate answer to the needs. The return on investment will be low.
- If people consider they will not own the house for a long period, this might be a barrier for deep NZEB-renovation. Older owners sometimes think that long-term investments are not profitable in for them anymore.
- A good technical knowledge level is a driver.

## 5 Context drivers & barriers

A fourth set of drivers and barriers is linked with rather external factors, not directly linked to the dweller or dwelling characteristics, but deal with the particular situation or context the homeowner has to deal with. E.g. legal and administrative issues, tenant-landlord issues, organisation of the building sector etc.

### 5.1 SPLIT INCENTIVE BARRIER

The split incentives barrier can be considered as a financial barrier because there are financial implications. The problem arises when one person or organization owns a building and someone else uses it. As for the owner, any investment has to bring a benefit which is not necessarily through energy savings, unless it is a situation where the landlord pays the energy bills. Since the tenant does not own the facility, any investment in lowering energy bills has to be seen as financially beneficial for both parties. This often leads to a point where nothing is happening and the investor does not want to invest his or her own money if he or she is not the one who will benefit from it. Moreover, it can happen that the value of the building after renovation does not go along with the market price.

So for tenants, the main barrier (mostly the single barrier) is that they rent the house. And for landlords, the main barrier is that they do not pay the energy bill.

### 5.2 LEGISLATION & POLICY

Legislation & policy can be both drivers and barriers. The obligation to build according to the NZEB-standards from 2021 (EPBD) on should be a huge driver. Whether people are happy or unhappy with it, it needs to be done.

But legislation and policy are not always very consistent, and can be a barrier. E.g. does legislation allow for insulating a facade from the exterior if the wall is bordering the sidewalk? Many inconsistencies exist either at local, national and international level regarding inconsistent subsidies, opposing or constraining legislation etc.

Furthermore, for renovation, EPBD-related legislation does not always apply. For example, if it is a partial renovation of the house (roof, windows...) where no building permit is needed.<sup>8</sup> Then it is not guaranteed that these elements are renovated up to NZEB-standards.

### 5.3 MULTI-STAKEHOLDER ISSUES

Various barriers exist where multiple owners and/or occupiers of buildings need to decide. Ownership and responsibility can be opaque, while it can be very difficult to agree on energy saving

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<sup>8</sup> E.g. in Belgium, only 15% of all renovations happen with a building permit. (Escensia, 2013).

investments in multi-family residential buildings if many different property owners have to either approve a decision or make a financial contribution.

The **multi-stakeholder barrier can interfere with the split incentive barrier** (5.1). E.g. in Slovenia, Estonia and elsewhere, blocks of flats some flats can be owned by the municipality. Discussion between managers of blocks of flats, tenants and local communities arise about availability of funds for the budget. Local communities approach the refurbishment based on plans and budget available for refurbishment. The tenants of such flats are people with low income, families with children or people with other difficulties and they pay reduced rents.

## 5.4 BUILDING SECTOR READINESS

Skill shortages exist in both the contractor market responsible for effective installation of energy saving measures, as well as in professional services, with few architects and designers familiar with how to specify a low energy renovation. A lack of knowledge, competence and focus on energy efficiency among building professionals is a huge barrier.

Contrarily, an engaged building sector would be a high potential driver to convince people for NZEB renovations.

## 6 Mapping the drivers & barriers in the segments

In this chapter, some distinctive drivers and barriers are applied to the 5 exemplary segments defined in task 2.1 (report D2.1) to get a better view on what these drivers and barriers mean for the different segments. This segmentation is the first step to better understand the homeowners, a diverse group of decision makers in energy efficiency investments. The REFURB D2.1 report offers a framework to create a tailor-made segmentation or define a set of segments that fit a certain context in a country. In a second step the drivers and barriers of these segments are looked at.

Based on the insights from studies, best practices and experiences, the REFURB partners created **a matrix as a tool to design tailor-made segments**. This matrix organizes the interplay of dweller characteristics (interesting for demand aggregation schemes) and dwelling characteristics (interesting for NZEB-renovation).

To illustrate this matrix, a set of 5 high-potential segments for integrated NZEB-renovation packages and demand aggregation schemes were described: “young families”, “Post-war suburbs with detached houses”, “Empty nesters”, “Terraced houses with a high energy bill” and “convinced energy savers”. Next to these 5 high-potential segments, other segments can be defined and designed, relevant for specific countries, regions or contexts.

It is acknowledged that many drivers & barriers need to be analysed in order to get a better idea about possible motivators for the demand side. Below this analysis is constrained to the main barriers & drivers.

### 6.1 SEGMENT 1: “YOUNG FAMILIES”: MAIN DRIVERS & BARRIERS

These homeowners typically are 25-45 years old and have young children. They remodel their own house to fit future needs, with the intention to live for a long time in the house. So there is the “momentum” of a major renovation, an opportunity to integrate with deep NZEB-renovation. Unfortunately, their financial possibilities are limited and they have very limited time to manage a renovation project.

This segment is designed based on dweller characteristics. As a result, technical drivers & barriers are not dominant for young families.

**Financial barriers** are important for young families. The availability of financial possibilities to invest is a very important barrier, linked with the limited willingness to invest in energy efficiency because young families have a lot of competing needs to be financed.

Social and behavioural drivers & barriers are important as well. They have renovation needs: they need to increase comfort level, or adjust the architectural concept to house the family. The **need & intentions for comfort improvements** are an important driver for NZEB-renovation. But they have **limited time** to manage a renovation project, and the **inconveniences linked with the renovation** (dust, noise etc.) can't be too high.

## 6.2 SEGMENT 2: “POST-WAR SUBURBS WITH DETACHED HOUSES”: MAIN DRIVERS & BARRIERS

The homogeneity of dwellings, their poor thermal performance and general urgency for renovation makes this a high-potential segment. But energy renovation is expensive, and the changing homeownership makes it more difficult: the “old” owners have too little perspective to live in the house to start to renovate, and “new” owners have limited renovation budget. This segment offers opportunities to create a “renovation dynamic” in the neighbourhood.

This segment faces important technical drivers such as the **urgency for renovation**, emerging inconveniences and defects etc. to integrate energy renovation with. An important financial barrier in this segment is the **high cost for NZEB-renovation and the unfavourable return on investment** for detached houses, but also the limited budget of new homeowners that already spent most of their budget to buy the house.

The **renovation needs and intentions** to increase comfort level, cosiness, personalization, taste, adjust architectural concept and so forth are drivers. The change of homeownership creates right momentums, and there is a clear potential for **neighbourhood action** (group action).

## 6.3 SEGMENT 3: “EMPTY NESTERS”: MAIN DRIVERS & BARRIERS

These homeowners typically are 45-65 years old, and the grown-up children have left the house: the nest is empty now. They need to remodel the house to their new future needs. They are aware of environmental issues, they have more time and more financial possibilities to manage a renovation project. With empty nesters, energy investments do not necessarily need to be integrated with other planned renovations. The momentum is very important here.

An interesting subsegment are the empty nesters living in a terraced house (cf. segment 4).

Empty nesters don't face particular technical drivers & barriers. The segment has financial drivers, as there is a larger availability of **financial possibilities** to invest. And their housing needs are changed so they have **renovation needs or even intentions**. They have **time available** to manage a renovation project. These empty nesters need to be tackled at the moment they are planning their remodelling: this is the window of opportunity (**momentum**).

## 6.4 SEGMENT 4: “TERRACED HOUSES WITH AN ENERGY BILL OF >€180/MONTH”: MAIN DRIVERS & BARRIERS

Terraced houses generally represent an older part of the building stock with high energy saving potential, and often in homogeneous neighbourhoods. A high energy bill indicates a high energy saving potential. Due to their age these terraced houses need renovation (structural, architectural, comfort and style, inconveniences and defects). The cost for NZEB-renovation is lower than for other dwelling types. In

homogeneous neighbourhoods, very similar solutions can be applied and a renovation dynamic can be created.

This segment faces particular technical drivers - such as more urgency for renovation, e.g. because of more frequent inconveniences and defects - and barriers such as limited potential for renewables (ground heat pumps, solar energy), or complex facade insulation when the external wall borders the limits of the plot. But the cost for NZEB-renovation is lower in comparison with detached and semi-detached houses, and the return on investment is better, especially because the energy bill is over €180/month. Very often with terraced houses a neighbourhood action is possible.

## **6.5 SEGMENT 5: “CONVINCED ENERGY SAVERS”: MAIN DRIVERS & BARRIERS**

This is a small segment of potential pioneers and frontrunners, essential to start a transition towards NZEB-renovation, to be followed by other homeowners. They have the right environmental values, the right attitude and good experience, and are willing to invest in NZEB. But they might have a low perspective on energy saving, and might doubt to take the decision for NZEB-renovation. They are the first ones to meet all kinds of barriers.

An interesting subsegment are the idealistic rebuilders with a technical background.

Convinced energy savers have the willingness and intention to invest in energy efficiency, have the right attitude and feel secure about the investment. They do not have high expectations on return on investment, so that is not a major barrier. But with their ideas, they face resistance in legislation & policy, which is not always ready, and in a conservative building sector which rather sticks with ancient building standards.

## 7 Conclusion

In the REFURB-project a market segmentation relevant for NZEB-renovation and demand aggregation schemes was developed (report D 2.1). These segments are linked with drivers and barriers homeowners face when deciding on NZEB-renovation.

Barriers are the psychological, social, financial and other negative arguments not to carry out a renovation. These can originate in motivations, desires, needs and the financial situation of homeowners.

Drivers are the counterpart of the barriers: they are the psychological, social, financial and other positive arguments to carry out a renovation. These also can originate in motivations, desires, needs and the financial situation of homeowners.

In REFURB a thematic clustering of drivers and barriers in the REFURB project will be used, based on the insights of the projects, the country reports and the conclusions of task 2.1 (housing market segmentation):

- Technical drivers and barriers, linked with the dwelling characteristics and the challenge to renovate to NZEB.
- Financial drivers and barriers, linked with the financial possibilities of the dweller and the cost of the NZEB-renovation.
- Social and behavioural drivers and barriers, linked with the decision making process of the dweller, so including the behaviour, attitude of the dweller, as well as the (social) conditions to take a decision.
- Context drivers and barriers. These are rather external factors, not directly linked with the dweller or dwelling characteristics, but deal with the particular situation or context the homeowner has to deal with. E.g. legal and administrative issues, tenant-landlord issues, organisation of the building sector etc.

Out of a long list of potential drivers and barriers 26 of them are discussed in this report. It is demonstrated that multiple sub-categories could be developed to strictly categorize in pure drivers or barriers. For example, “financial possibilities” can indicate a lack of financial possibilities (barrier), or an availability of financial possibilities the homeowner wants to invest (driver). The report uses a more detailed description to explain the complexity instead of a multitude of subcategories.

The figure below (Figure 5) is an updated version of Figure 4, and gives insight in the dominant nature by making use of a colour:

- Green are the interesting drivers, with potential to convince homeowners.
- Red are the barriers.
- Grey can cover barriers and drivers

As explained in this report, the nature of drivers versus barriers is not always very clear and depends on the particular situation and nature of the homeowner. E.g., an insulated facade can imply a new style of the house. This can be attractive for one homeowner, but a barrier for another.

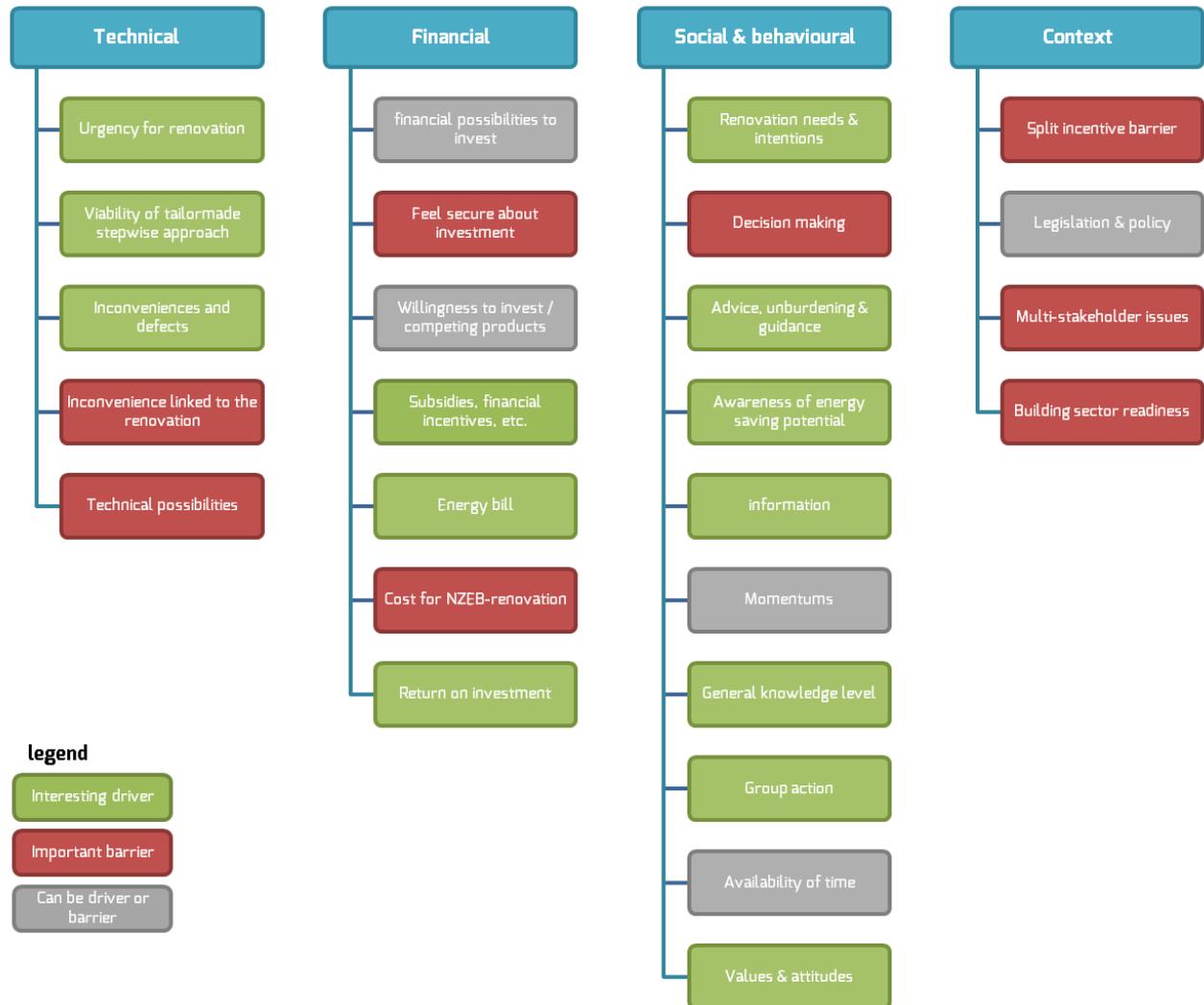


Figure 6: Overview of drivers & barriers

Using these clusters of drivers and barriers and applying them to the identified segments in report D2.1 gives a better insight into focus areas for removing barriers and using drivers of the identified segments.

Based on this report on drivers and barriers in the different segments, better ways to organise the demand side will be examined (report 2.3), local differences in demand side drivers and barriers will be examined (report 2.4), and improved approaches to seduce homeowners to integrate NZEB-ambitions within their renovation will be designed (report 2.5).

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