Overview and one-stop shop solutions for private homeowners

DEMAND SIDE SEGMENTATION IN EU AND REGIONS

REFURB DELIVERABLE REPORT 2.1

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<th>Author</th>
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<td>Leiedal</td>
<td>First draft from the WP lead</td>
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<td>1.1</td>
<td>2 November 2015</td>
<td>VITO</td>
<td>First comments and changes by Coordinator</td>
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<td>Leiedal</td>
<td>Adapted version for partners</td>
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<td>3 December 2015</td>
<td>Leiedal and others</td>
<td>Pre-final version including all partners’ comments</td>
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Summary

Renovation in the EU’s residential sector towards increased energy efficiency is seriously lagging behind. As more than sufficient technological solutions are available, focus must be on removing non-technological barriers. 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 ‘one-stop-shop concept’. Many have been put in practice. Some were successful, others not. They often 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 to improve this one-stop-shop concept. Work package 2 and work package 3 are dedicated to analyse demand and supply side drivers. This report is part of work package 2 ("demand side mapping"), and the result of task 2.1 establishes a segmentation of the demand side (dwellings and dweller typologies). This segmentation is the first step to better understand the homeowners, which is a diverse group of decision makers in energy efficiency investments. A segmentation that is relevant for NZEB-renovation and demand aggregation schemes is created. This type of segmentation of the demand side is not commonplace. Usually market segmentation is very much technology driven from the point of view of the supply side of the renovation market. Based upon REFURB partners’ experience and research it was, however, possible to create such a segmentation based upon dwelling but also — and more importantly— upon dweller characteristics.

With this report the REFURB project offers a framework to create a tailor-made segmentation or define a set of segments that fit a certain context in a country, rather than fix a pan-European set of segments to cover the entire demand side.

Market or customer segmentation has proven its value in concepts such as the Business Model Canvas as to avoid targeting heterogeneous groups with value propositions which are too general and customers cannot identify with at all.

A multidisciplinary view to the creation of this segmentation is essential. For the purpose of the segmentation, many different points of view have to be explored to fully gain understanding of how homeowners decide, plan and think, and more in particular how this could affect their choice to either invest in NZEB-renovation or not. Behaviour study, psychology, sociology, economics, technology, legislation, architecture, building physics, urbanism are all relevant research fields and the list of them illustrates the complexity of the task.

With a single technical, architectural or financial approach it appears hard to generate segments to design successful one-stop-shops for. Likewise it is not useful to develop such a segmentation purely based upon the building typology as -after all- it is not the building which decides to go for a renovation, but its owner or occupant.

In task 2.1, the segmentation of the demand side was developed for the purpose of the REFURB project. A segment is a group in the market with similar characteristics. For the segmentation in the REFURB project the following categories of characteristics were used:

- dwelling characteristics (e.g. flat/houses, year of construction, energy efficiency, neighbourhood, architectural characteristics, building techniques and materials etc.), and
• dweller characteristics, the decision makers (e.g. owner vs tenant, financial possibilities, stage in life of inhabitant, household composition, technical building skills and knowledge etc.).

In the REFURB project, 2×3 clusters of characteristics that are relevant to underpin the segmentation were identified:

Three clusters of dwelling characteristics, which are important to design consistent NZEB-renovation packages (Figure 1):

• Cluster 1: **similar dwellings**, with the interlinked characteristics “neighbourhood type”, “construction type”, “dwelling typology”, “construction era”, and “historical value”.

• Cluster 2: **state of the dwelling**, with the interlinked characteristics “urgency for renovation”, “inconvenience linked with the renovation”, “inconvenience and defects” and “value of the house”.

• Cluster 3: **energy saving potential**, with the characteristic “energy performance”.

*Figure 1: Clusters of relevant dwelling characteristics*
Three clusters of dweller characteristics, which are important to design consistent demand aggregation schemes (Figure 2):

- **Cluster 1: the right moment for NZEB-renovation for the dweller**, with the interlinked characteristics “stage of life”, “expected period to own the house”, “available time to manage renovation project”, “age of dweller”, “energy use pattern” and “home occupation pattern”.

- **Cluster 2: possibilities and intentions of the dweller**, with the interlinked characteristics “financial possibilities”, “owner status”, “intentions to renovate”, “environmental values and attitudes”, “willingness to invest in energy efficiency”.

- **Cluster 3: the different personalities of the dweller**, with the interlinked characteristics “type of decision maker”, “renovation needs”, “access to information”, “male/female”, “general knowledge level” and “technical knowledge level”.

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**Figure 2: Clusters of relevant dweller characteristics**

Based on these characteristics and 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). The set of 3x3 clusters with dwelling and dweller characteristics offer a framework for a balanced design of segments.
The tool can be used in different contexts to help to define tailor-made segments. This is necessary as it is shown in chapter 2 that in different EU-countries or regions housing markets can be very different. As a consequence, the REFURB project does not propose generic, pan-EU-valid segments for housing renovation.

Table 1: Matrix as a tool to segment for demand aggregation schemes for NZEB-renovation in the residential sector

<table>
<thead>
<tr>
<th>Clusters of dwelling characteristics</th>
<th>Clusters of dweller characteristics</th>
<th>State of the dwelling characteristics</th>
<th>Energy saving potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMILAR dwellings</td>
<td>Neighbourhood type</td>
<td>Urgency for renovation</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Dwelling type</td>
<td>Inconvenience linked with renovation</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Construction era</td>
<td>Inconveniences and defects</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Construction type</td>
<td>Value of the house</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Historical value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The right MOMENT</td>
<td>Stage of life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Time to manage renovation project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Expected period to own the house</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Age of dweller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Energy use patters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Home occupation pattern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Different PERSONALITIES</td>
<td>Type of decision maker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Renovation needs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Access to information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>General knowledge level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Technical knowledge level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Male/female</td>
<td></td>
<td></td>
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<tr>
<td>Available POSIBILITIES</td>
<td>Financial possibilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and INTENTIONS</td>
<td>Owner status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Willingness to invest in energy</td>
<td></td>
<td></td>
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<tr>
<td>•</td>
<td>efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Intentions to renovate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>Environmental values and attitudes</td>
<td></td>
<td></td>
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</tbody>
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The matrix offers flexibility to focus on mainly dwelling or dweller characteristics, or a combination of both. 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. E.g. Germany has a large private rental sector, the Netherlands have a large social housing sector, Estonia a majority of apartments. These conditions are important to design appropriate segments.

Based on the segmentation of this report, drivers and barriers (financial, social, psychological...) will be linked with different segments (report 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).
1. Introduction

Renovation by the private sector towards increased energy efficiency is seriously lagging behind. As more than sufficient technological solutions are available, focus must be on removing non-technological barriers. 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 ‘one-stop-shop concept’. Many have been put in practice. Some were successful, others not. They often 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 analyse demand and supply side drivers. This report is part of work package 2 (“demand side mapping”), and establishes a segmentation of the demand side. This segmentation is the first step to better understand the homeowners, which is a diverse group of decision makers in energy efficiency investments.

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 to their ‘language’.

In task 2.1 the segmentation of the demand side is being developed. A segment is a group of different types of dwellings with similar characteristics, based on:

- dwelling characteristics: typology/morphology of various private houses (e.g. flat/houses, year of construction, energy efficiency, neighbourhood, architectural characteristics, building techniques and materials etc.), and
- Dweller characteristics of decision makers (e.g. owner vs tenant, financial possibilities, stage in life of inhabitant, household composition, technical building skills and knowledge etc.).

1.1 Interplay between segmentation, dwelling and dweller characteristics, drivers and barriers

To segment the demand side (homeowners) and the housing market, characteristics need to be defined which make the distinction between the different groups (segments).

There are 2 main types of characteristics to define segments: dwelling-related characteristics and dweller-related characteristics. But not all potential or interesting characteristics to define these segments can be clearly attributed to a dweller or a dwelling characteristic: sometimes it is a mixture, e.g.:...
- The building era is a dwelling characteristic
- The stage of life is a dweller characteristic
- The energy bill is the result of the energy performance of the building, the energy use pattern of the dweller, and the energy prices (external agent).

The segmentation (report D 2.1) also interferes with the listing of the drivers and barriers of homeowners to decide on NZEB-renovation (report D 2.2). 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 with low access e.g. people in energy poverty, 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. Here access to finance 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 in Figure 3.

![Figure 3: The relationship between dwelling characteristics, dweller characteristics, drivers and barriers](image)

### 1.2 Segmentations for Energy Efficiency

"Market segmentation can be defined as the subdividing of a market, or population, into distinct, but possibly overlapping, subsets, where any subset may be selected as a target for tailored marketing efforts. In this sense, segmentation falls into the broad category of procedures for taxonomic
classification which enable enterprises to better understand how best to interact with populations of interest.”

The basic assumption is that the process of segmentation will generate a number of individual segments whose behaviour is endogenously homogeneous, with maximum heterogeneity between segments.

Literature shows that segmentation can be done from the view of different disciplines. These all describe the pathways by which new ideas, behaviours, technologies, products and services are absorbed into the marketplace. The concept of market segmentation, in particular, is broadly based on studies of how innovations in goods, services, and behaviours diffuse through different populations, as partially informed by social psychology and sociology.

As an example, Table 1 shows some different methodological options to segment for energy efficiency programs. The table shows the relation between the approach of the segmentation, such as classical traditional economics, and the approach of consumers, marketing and technology diffusion. This implies that the methodological approach for segmentation influences the approach of consumers. This relation is also elaborated in report D2.5 of the REFURB project and elsewhere in the REFUB project, for the adoption of NZEB-renovation in the residential sector. For example, some homeowners will be convinced to invest in NZEB-renovation because of the benefits it brings such as a lower energy bill (arguments originating in classical traditional economics), others will only be convinced because of the advice of intimates (behaviour economics).

Table 2: Approaches to segment a market, from CIEE, 2008, Market Segmentation and Energy Efficiency Program Design, Oakland

<table>
<thead>
<tr>
<th>Methodological Approach</th>
<th>Basis for Segmentation</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classical Traditional Economics</td>
<td>Preferences, usually exhibited through supply-demand equilibriums</td>
<td>Traditional way of marketing energy efficiency programs, in which incentives (e.g., subsidies) are provided to lower costs and information about the benefits of adoption is provided. In-depth segmentation is often not conducted, under the assumption that rational consumers will respond appropriately to price signals if they are provided with sufficient explanatory information</td>
</tr>
<tr>
<td>Behavioural Economics</td>
<td>Same as classical economics, modified by understanding decision heuristics and context dependent preferences</td>
<td>Typical of consumer products segmenting approaches, in which the product is linked with trusted messengers or deep emotions/desires, and marketing is tailored based on triggering an attachment to the product based on the identified linkages.</td>
</tr>
<tr>
<td>Technology Diffusion</td>
<td>Patterns of technological adoption</td>
<td>Dominant in agricultural marketing, in which key change agents are identified to be early adopters of a technology, signalling to others that it’s worth purchasing. Now embedded in a host of products which are linked to celebrities, hipsters, or technosavvy consumers, in which segmenting focuses on catering to early adopters first, and then linking these with follower population</td>
</tr>
<tr>
<td>Social Psychology</td>
<td>Psychological and demographic characteristics</td>
<td>Applied in product areas in which there is a multiple of niches (e.g. beverages). Intermittently popular as a basis for energy efficiency marketing, though it’s unclear how successful it’s been.</td>
</tr>
</tbody>
</table>

Segments might be developed around a host of different characteristics, for example demographics, geographic (e.g. neighbourhoods), decision pathways, knowledge, needs, values, attitudes, motivations, preferences, energy use patterns, access to financing, access to information, trust levels, competing products etc.

### 1.3 Existing Generic Typologies

In order to target the information and thereby increase the level of new deep renovation projects, it is necessary to consider the different dweller typologies. The following section will describe some of the results found in recent European research projects.

One approach is to divide the homeowners into three *segments/typologies* as suggested by Aune (2007). She describes the three typologies as “home as haven”, “home as project” and “home as arena for activities” and also suggests how the approach for energy savings in the three groups should be handled. As seen in Table 2 the communication will highly depend on the typologies.

**Table 3: Description of the three dweller typologies as suggested by (Aune 2007).**

<table>
<thead>
<tr>
<th>Typology</th>
<th>Description of the typology</th>
<th>Communication regarding energy savings for this typology</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Home as haven”</td>
<td>Prefers the home as a cosy and comfortable home. Examples are the right lighting, a comfortable indoor temperature or an open fireplace. The use of hot water is also mentioned but not seen as an energy consumption or possibility for saving but instead seen as rest and meditation. This typology prefers a personal and private home.</td>
<td>The important parameters for this typology are privacy, cosiness and stability. The communication need to take this into consideration in order to change their energy consumption. Aune suggests: “High energy costs, new energy-efficient technologies, information champagnes and other instruments implemented to reduce private energy consumption should probably not challenge “the home as haven”“ mentality, but rather try to address it.” (Aune, 2007)</td>
</tr>
<tr>
<td>“Home as project”</td>
<td>&quot;The home as project” is a typology where the dwellers like retrofitting and designing the home, which they see as a material and symbolic expression of themselves. They are motivated by improved comfort rather than energy saving, but still, aiming for improved energy-saving measures in this type of home can be the highly effective because the house is constantly being rebuild.</td>
<td>For this group the design, functionality, availability and usability are important factors for energy saving products and these are the parameters that should be enhanced in the communication for this group. They value products in the market that fulfil both the demand for low energy and high aesthetic value and Aune suggests that “It is possible to influence the domestication of this home in a more sustainable direction by specifically developing and marketing energy-saving technologies towards this group.“ (Aune, 2007)</td>
</tr>
</tbody>
</table>
“Home as arena for activities”

This typology finds the feeling of home from the unity of people and activities going on in the home. They do not see style or materials as important in order to create a home.

The span of family typologies in this category is large and goes from a more intentional “alternative and green” lifestyle to a traditional way of life. But common for all in this typology is that they are non-spending, non-wasting and environmental friendly.

As Aune writes: “No big rebuilding activities are performed unless they are necessary. The artefacts in these homes, whether it is a couch, a television or a refrigerator, are worn out before they are replaced.” (Aune, 2007)

As the span in this group is large, the communication also needs to be varied. A “green message” will interest some. A message of responsibility and common interest will catch the interest of others.

For this typology economy is a very important parameter, and besides the economic savings caused by energy savings they will also feel a moral obligation for saving energy. When promoting new technology to this group, it is important to point out both the practical and the financial factors.

The dilemma for this typology is the fact that even though they seem to live a simple life, old technologies are more energy demanding and old houses often require more energy for heating. They thereby can end up with a large consumption.

The importance of targeting the information at specific dweller typologies is also stressed by Haines & Mitchell (2014), who have developed personas for this specific aim. The personas are developed based on a qualitative study with interviews of 33 owner-occupier householders in the East Midlands region of the UK. All householders are living in solid-wall-houses, which hold a great potential for energy renovation.

The overall difference between segments and personas is the amount of data behind the development. While segments are derived based upon large data samples which result in a general description of each segment, personas are based on small and very target-specific data samples. The advantage of the personas is the more personal description which makes it easier for the designer or developer to target a specific design or offer towards the persona.

The personas developed by Haines and Mitchell (2014) are described in Table 3 together with the opportunities to get them to renovate their building.

\[
\text{Table 4: Description of the personas developed by Haines and Mitchell for building renovations in solid-wall-houses.}\n\text{Table is cited from (Haines & Mitchell, 2014).}\n\]

<table>
<thead>
<tr>
<th>Persona (including subtype)</th>
<th>Key features</th>
<th>Opportunities for retrofit</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Idealist Restorer: The property is a project</td>
<td>Motivated to live in an older property because of the character and the opportunity it provides for restoration and improvement. Values the aesthetic period features and space afforded by older homes. Wants to restore as many original features within the home as possible but not at the expense of aesthetics, comfort and convenience. Although they wish to keep the sash windows, they have replaced the quarry tile floor in the hallway with laminate flooring.</td>
<td>Very open to retrofitting and energy efficiency measures and in an optimal order if the aesthetics of the home are respected. Interested in “clever” energy saving technologies but only if the character of the home can be maintained.</td>
</tr>
</tbody>
</table>
### Motivated to learn new DIY skills and wants to do things thoroughly.

Energy efficiency is perceived as a construct of quality but aesthetics and comfort are valued higher.

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<thead>
<tr>
<th>The Affluent Service Seeker: The property is a pleasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivated to live in an older property because of the character, idyllic rural location, large garden and useful outbuildings. Accepts that older properties are expensive to maintain and views spending on the property as a way to preserve and add value to the investment in the property.</td>
</tr>
<tr>
<td>Seeks luxury and quality but also value for money. Known to be financially savvy. Values comfort over financial saving.</td>
</tr>
<tr>
<td>Carries out very little DIY through choice but likely to be less physically able than when they were younger.</td>
</tr>
<tr>
<td>Energy efficiency is perceived as difficult to achieve in a large old property but this persona is keen to take advantage of any grants or incentive schemes available.</td>
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<td>Open to incentive schemes and policies that generate income for the homeowner or add value to the property.</td>
</tr>
<tr>
<td>Will choose to use specialist professionals to ensure a quality job.</td>
</tr>
</tbody>
</table>

### Motivated to live in an older property by the potential it offers to add value to its resale value through renovation.

Happy to borrow money in the short term to finance home improvements, paying these back when the property is sold.

Enjoys developing his/her DIY skills as the projects get bigger with each property they buy.

Open to consequential improvements as they are thinking at a whole-house level but these improvements must lead to financial gain at the point of resale.

Energy saving beyond current building regulations is not a priority.

<table>
<thead>
<tr>
<th>The Property Ladder Climber: The property is a step up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open to the use of finance schemes if these are cost-effective within the context of ‘improving to sell’.</td>
</tr>
<tr>
<td>Unlikely to consider technologies with long payback times unless the cost of installation is passed on.</td>
</tr>
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### Motivated to live in an older property because of the layout and room size that accommodates a full and active family life.

Home improvements are seen as a hassle rather than a hobby; the latter are considered time-consuming, reducing time for more important things - hobbies and family time.

Not particularly interested in keeping older features of the property, but places greater value on convenience.

Concerned about the environment and climate change, as a result of their family values.

<table>
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<tr>
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Concerned about the environment and climate change, as a result of their family values.
### The Pragmatist: Subtype - Aesthetic

The property is a home

Motivated to live in an older property because of the character and space it offers.

Enjoys having a project on-the-go but improving or updating the decoration, furniture and appliances within the home will be of higher priority than repurposing of space or non-essential maintenance.

Likely to cover up some issues like damp through frequent redecoration rather than fix the underlying cause.

Values ‘on the shelf’ solutions, preferring to finance these from savings or windfalls rather than loans. Want a neat and tidy job to be done, with a good-quality finish.

When they first purchase the property or within the regular cycle of decorating and refurbishment.

The order of retrofit will be driven by aesthetic priorities, e.g. the desire for new kitchen may lead to a new boiler.

### The Stalled: Subtype - Lack of Finance, The property is a shelter

Wants a warm, comfortable home, but is not extravagant in his/her requirements.

Wants to feel safe and secure in his/her home and be assured that any work undertaken by tradespeople is not exploiting them financially or putting them in danger.

Frugal and interested in saving energy primarily to save money. They are positive towards opportunities to improve the warmth and security of their home.

Leaves parts of the property unheated through the winter, but uses draught proofing to increase comfort.

Limited to when grants are available.

Will undertake consequential improvements if dictated by grant scheme.

### The Stalled: Subtype - Pressures of Life, The property is a necessity

Does not have the time, emotional energy or financial resource to undertake home improvements at present.

Will use a trusted, known professional to help with any essential jobs around the property but won’t undertake any major projects.

May consider taking a loan to fund essential maintenance but they prefer to wait and use savings when they can afford.

Almost none at present.

### 1.4 TOWARDS A REFURB-TAILORED SEGMENTATION

The academic insights described in part 1.2 and the examples of chapter 1.3 show that segmentation of the demand side can be made in multiple ways. Every type of segmentation serves a certain goal, e.g. social research, economic research, market research, social policy, energy policy etc.

For example, very commonly segmentations focus on the dwelling typology (single family house, semi-detached single family house, terraced house, apartment), the age of the house (categories of construction year), the type of ownership (private ownership, social housing company, private rental), the size of the house (studio, one-room dwelling, 2-room dwelling). But segmentations also make use of dweller
typologies (young family, elderly, high income, low income), the neighbourhood (suburbia, rural, city centre, along busy roads) etc.

In the REFURB project a segmentation that is relevant for NZEB-renovation and to design demand aggregation schemes is being made. There is research available which allows creating this segmentation. Also on EU level there is material available, e.g. the Tabula typology (see 3.1). Which aspects will be taken into account for a segmentation?

1.4.1 A segmentation based on dwelling and dweller characteristics

The segmentation makes use of a set of relevant and distinctive characteristics. In the REFURB project, 2 main categories of distinctive characteristics are being distinguished:

- **Dwelling characteristics**: typology like flats/houses, year of construction, energy efficiency, neighbourhood, architectural characteristics, building techniques and materials etc.
- **Dweller characteristics (decision makers, homeowners)**: e.g. owner vs tenant, financial possibilities, stage in life of inhabitant, household composition, technical building skills and knowledge etc.

1.4.2 A demand-side perspective to underpin demand aggregation schemes

Two main options to tailor a segmentation which is relevant for NZEB-renovation remain: from a demand-side perspective and from a supply-side perspective. Both perspectives lead to different segmentations, e.g.:

- For the supply side an interesting segmentation is based upon building traditions, e.g. houses with a cavity wall, or houses with single glazing etc. The supply side could make a direct link with their NZEB-renovation solutions, e.g. cavity wall filling insulation. This mapping of the supply side solutions is used in work package 3 (“supply side mapping”), e.g. in report D3.2. (“mapping existing renovation solutions according to housing and homeowner typology”)
- For the demand side an interesting segmentation is for example based on stage of life. Elderly people with no intentions to renovate and that stick to ancient standards have a very different attitude towards NZEB renovation than a young family that just wants to start a renovation and has NZEB-ambitions. For both segments, a different one-stop-shop offer can be developed, tailored to their particular needs.

The central perspective in the REFURB project is the demand-side perspective. This is essential: in the REFURB project it is acknowledged that there is too little known about the motives of the demand side, the heterogeneous group of homeowners, for (not) integrating NZEB-ambitions in renovation concepts. Most NZEB-implementation strategies nowadays concentrate on the supply side and technological solutions in particular. In the REFURB project this perspective is largely abandoned, and replaced by a demand-side perspective.

1.4.3 Overlapping segments

The segmentation of the REFURB project does not have the ambition to cover the entire demand side, and create a segmentation to fit the entire demand side into juxtaposed categories (Figure 4).
The ambition is to identify some high potential segments for deep NZEB-renovation to design demand aggregation for. Based on the academic insights (multiple perspectives to segment), it is chosen to allow segments to overlap. Different segments can share similar characteristics, but differ because of a different perspective they have been designed for (Figure 5).
2. Regional housing markets in the EU

Buildings account for the most significant CO₂ emissions sources in Europe. Unfortunately, the energy performance of our buildings is generally poor in relation to the ambitions of the European Energy Performance Building Directive (EPBD). While new buildings can be constructed with high performance levels, it is the older buildings, representing the vast majority of the building stock, which are predominantly of low energy performance and subsequently in need of renovation.

The different EU countries have different housing markets with different characteristics like building tradition, building age, share of protected heritage, ownership, typologies, building and renovation dynamics, energy mix etc. In the REFURB project, 6 EU countries are represented. To understand their REFURB solutions, their housing markets need to be understood. In this chapter, a brief overview of a few relevant parameters is given. These are based upon country reports provided by the REFURB partners. Examples can be found in the annexes to this report.

The information in this chapter is based on Eurostat⁵, the statistical office of the European Union, the Data Hub⁶ of the Building Performance Institute Europe (BPIE) and underlying data sources of the Data Hub. The Data Hub collects data on energy efficiency in European buildings, and is (partly) the result of several IEE and FP7-projects of the European Commission, e.g. Episcope, Tabula and Entranze.

2.1 SHARE OF SINGLE FAMILY HOUSES

In 2008 in the EU, the share of single family houses ranged between 25% (Estonia) and 89% (Ireland).⁴ For REFURB partners, the share of single family houses ranges from 25% (Estonia), 46% (Germany), 73% (Belgium), 59% (Denmark), 36% (Slovenia) to 70% (the Netherlands) (Figure 6).

Figure 6: Share of single-family dwellings in total stock. Source: http://www.entranze.enerdata.eu/

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² http://www.eurostat.eu
³ http://www.buildingsdata.eu
⁴ http://www.entranze.enerdata.eu/
2.2 OWNERSHIP

In the EU, the majority of dwellings are privately owned. Private ownership in all EU countries is higher than 68% (Netherlands), up to 94% (Belgium, Denmark) and even 100% like in Spain. In REFURB countries Estonia and Slovenia, the private ownership was installed in the early nineties, after privatisation of the residential sector.

Most of the dwellings are owner-occupied, on an average 74% in EU, varying between 46% (Germany) and 97% (Bulgaria). In the other REFURB countries, this ranges from 52% (Netherlands), 58% (Denmark), 73% (Belgium), 81% (Slovenia) to 89% (Estonia) (Figure 7).

![Image of a map showing the share of owner occupied dwellings in residential stock. Source: http://www.entranze.enerdata.eu/](http://www.entranze.enerdata.eu/)

Other homes are private rented or public rented. The private rental sector accounts on an average for 13% in EU-countries, but differs per country. Some countries have a large private rental sector, like Germany (54%), Austria (31%) and Finland (30%), whereas this sector (almost) doesn’t exist in Estonia, Hungary, Lithuania, Malta, Poland, and Romania. The social rental sector accounts on an average for 10% in EU-countries, is very large in the Netherlands (36%) and Poland (31%), but (almost) inexistent in Germany, Italy, Romania and Slovakia.

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5 BPIE, “Europe’s Buildings under the Microscope”, Brussels, 2011
6 [http://www.entranze.enerdata.eu/](http://www.entranze.enerdata.eu/)
7 [http://www.entranze.enerdata.eu/](http://www.entranze.enerdata.eu/). However, this depends on the definition of “social rental sector”. E.g. in Germany the public sector plays to a certain extent a role in the private rental market.
2.3 AGE OF HOUSES

Of all the single family houses in the EU (not the apartments), 28% was constructed before 1945, and 25% between 1945-1969. Thus more than half of the EU single family houses are over 45 years old.  

In some EU countries, the share of old single family houses is significantly higher. In Belgium, Estonia and the UK, more than 40% of is built before 1945. The Netherlands have a relatively lower share of pre 1945-houses (23%), but not as low as Portugal or Romania (around 17%). In many countries, the share of pre 1970-houses is over 60% (Belgium, Cyprus, Denmark, Estonia, Italy, Lithuania, Luxemburg, Sweden, and UK). Cyprus, Ireland, Poland and Spain have many recently constructed houses (after 2000).

Estonia has a very particular building stock: family homes only account for 25% of the total housing stock but are older; most of the Estonian houses are built as apartments in the period 1960-1990. And Estonia also has a limited number of recent buildings (after 1990): less than 10%.

2.4 ENERGY USE AND CO2 EMISSIONS

The residential sector is responsible for 27% of the final energy consumption in the EU (2013)\(^\text{10}\), and is one of the 3 large sectors that use energy. The other important sectors are transport (32%) and industry (25%) (Figure 9).

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\(^{8}\) http://www.entranze.enerdata.eu/
\(^{9}\) BPIE, “Europe’s Buildings under the Microscope”, Brussels, 2011
\(^{10}\) http://ec.europa.eu/eurostat, Final energy consumption per sector (GWH)
In the EU residential sector, the use of electricity accounts for 24% of the total residential energy use (Final energy consumption in GWh). Electricity is mainly used for electrical appliances, but in some countries electricity is commonly used for heating (e.g. France). In most countries non-electric energy sources (at the dwelling level) are being used for heating. Gas is the most important source for households (37%), as well as renewable energies (15%), petroleum products like heating oil (13%) and derived heat like district heating (8%) (Figure 10).

This energy mix in the residential sector differs country by country.

- Gas is very important in Holland (+70%), but not in Estonia and Slovenia (less than 10%) and Denmark (15%).
- Electricity can be very important, e.g. in non-REFURB countries like Sweden and Bulgaria (+40%).
Petroleum products have an EU average share of 13%, and are significantly more important in some countries like Belgium (30%) and Germany (23%), and are less important in e.g. Estonia and the Netherlands (1%).

Renewable energies account for 15% in the EU, with higher shares in Estonia and Slovenia (+40%) and lower shares in Netherlands (3%) and Belgium (7%).

Between the EU-countries, there is a big difference in energy use per m² living space in the residential sector\(^{11}\) (kWh/m²/year), but we have to be careful with comparisons between countries\(^ {12}\). In Malta, the energy use is 69 kWh/m²/year, in Luxemburg it is 5.5 times more: 381 kWh/m²/year.\(^{13}\) As the map below shows (Figure 11), there seems to be little correlation between the climatic zone and the energy consumption: both in Northern and Southern countries, the energy intensity can be high. From the REFURB countries, Estonia (325 kWh/m²/year) and Belgium (288 kWh/m²/year) have the most energy intense residential sector. In Denmark and the Netherlands the figure is lowest: around 190 kWh/m²/year. Germany (232 kWh/m²/year) and Slovenia (218 kWh/m²/year) are in between.

Figure 11: Total unit consumption per m² in residential sector (at normal climate). Source: [http://www.entranze.enerdata.eu/](http://www.entranze.enerdata.eu/)

The energy use and energy mix of the residential sector is closely linked with the emissions of CO₂ of the residential sector. Electricity has high emissions of CO₂ per energy unit, for renewables the emission is very low (up to zero). For example, the extent to which renewable energy is used in the residential buildings, the use of district heating and cogeneration and the electricity mix in each country heavily affect the CO₂ emissions related to residential buildings.

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\(^{11}\) The total energy use for electricity, space heating and water heating.

\(^{12}\) It is a major challenge to compare the energy requirements between several Member States, even when they are expressed in the same units (e.g. kWh/m²). Source: Asiepi-project, [http://www.asiepi.eu/](http://www.asiepi.eu/)

\(^{13}\) [http://www.entranze.enerdata.eu/](http://www.entranze.enerdata.eu/)
The amount of CO₂ emission per useful floor area differs a lot in the EU: from 15 kg CO₂/m²/year (Sweden) to 125 kg CO₂/m²/year (Ireland). The average CO₂ emission in Europe is 54 kg CO₂/m²/year. The building performance and heating source are key components.

For REFURB partners Belgium, Denmark, Estonia, Germany and Netherlands, the CO₂ emissions per useful floor area are about 60-70 kg CO₂/m²/year.

2.5 ENERGY PERFORMANCE

The age of a building is strongly linked to the energy performance for the majority of buildings that have not undergone an energy renovation. For example, in Germany it is quite clear that the average heating consumption levels in terms of final energy use of single family homes decreases by construction year (Figure 12).

![Figure 12: Average heating consumption levels in terms of final energy use (kwh/(m² a) of single family homes by construction year, Germany (source: BPIE, "Europe's Buildings under the Microscope", Brussels, 2011)](image)

Building traditions and energy performance regulations differ from country to country. This had a major effect on the energy performance of buildings in the different EU countries. The scheme below illustrates the path of improvement of the thermal resistance of external walls in different EU-countries (Figure 12).

---

As a result, building parts like walls, floors, roofs and windows do not have the same thermal performance in the EU-countries. This is illustrated in the map below (Figure 14): the thermal resistance of a wall (the U-value), the weighted average based on the existing residential building stock, varies between 2.23 W/m²K in Malta (which is the worst) and 0.38 W/m²K in Estonia (which is the best). For other REFURB countries, this value is very good in Denmark (0.70 W/m²K), average in Germany (1.11 W/m²K), Slovenia (1.25 W/m²K) and the Netherlands (1.26 W/m²K) and worst in Belgium (1.64 W/m²K).

Figure 13: U-values (W/(m²K)) for external walls in different countries for different construction periods, (source: BPIE, “Europe’s Buildings under the Microscope, Brussels, 2011)

Figure 14: Wall U-values (weighted average based on stock). Source: http://www.entranze.enerdata.eu/

15 http://www.entranze.enerdata.eu/
2.6 CONCLUSION

It is clear from the above illustrations that characteristics of the housing markets in the EU clearly differ regionally. That’s why there are no “one-size-fits-all solutions” for the EU market as a whole. Only a general method for segmentation can be proposed and needs to be applied to the market at hand, the target market for the market player who wishes to introduce his solutions into the market.
3. A generic housing market segmentation: dwelling typology

It is the objective of the REFURB project to develop a dwelling typology to set up housing market segmentation, based on existing material. Some efforts have already been made and it is preferable to start from this basis and evaluate what can be used, rather than to develop a completely new typology. An interesting dwelling typology is the so-called TABULA typology.

3.1 THE TABULA TYPOLOGY

Tabula and Episcope are Intelligent Energy Europe (IEE) projects, funded by the European Commission. The Tabula project developed a concept of residential building typologies which is continued and expanded in the Episcope project towards the elaboration of building stock models to assess refurbishment processes\(^\text{16}\).

The Tabula typology is designed for modelling purposes, in order to assess refurbishment processes and project the future energy consumption. The question is whether this typology is useful for the REFURB project.

Starting from the common Tabula concept national building typologies have been designed, representing the residential building stock. The typologies consist of the following elements:

- a classification concept for existing residential buildings according to age, size and further parameters,
- a set of example buildings which represent specific building types of the national stocks,
- typical energy consumption values for the example buildings,
- showcase calculations of the possible energy savings,
- Statistical data for buildings and supply systems.

The parameters for classification of residential buildings according to the Tabula concept are:

- the country
- the region or climate zone, if available
- the construction year class
- the building size class
- an additional parameter

An overview of the national building typology is given by the "Building Type Matrix". The columns of the matrix are representing different building sizes, the rows represent different construction periods. The cells of the grid define the "Building Types" of a country. According to the general Tabula concept there are 4 building size classes and a certain number of construction year classes.

\(^{16}\) \url{http://episcope.eu/}
The Tabula typology definitely is useful as a starting point to segment the housing market. It offers insights into the relevant housing characteristics to segment, and how they relate to energy performance and energy saving potential. The Tabula typology proves to be generic, applicable in all EU-countries. But, due to its specific intended use (modelling, pan-EU-applicability), it is not designed to reveal the subtleties in the housing market in all EU-countries, to detect the high potential NZEB-renovation segments. Within REFURB, it was concluded a further refinement of segmentation is needed.

### 3.2 DWELLING CHARACTERISTICS FOR MARKET SEGMENTATION FOR NZEB-RENOVATION

In all six REFURB countries, partners assessed the Tabula typology and conducted a desktop research on the available studies within the country. Based on the Tabula typology, the desktop study of the partners and the expertise of the project partners, a set of dwelling characteristics was listed to base the segmentations on.
In order to prioritize the importance of the different characteristics they were scored on their relevance for dwelling segmentation to define the housing categories for NZEB-renovation in all countries / regions. The scoring was done through a semi-quantitative assessment of every characteristic: a figure between 0 (not important) and 3 (very important), and a motivation for the score. The central questions for the REFURB project are:

- Is a separate NZEB-renovation concept required for these groups of dwellings? (Group needs similar energetic-technical solutions, faces similar barriers, and is interesting for a grouped approach...)

- Which are the interesting categories for NZEB-renovation? (Energy efficiency & renewable energy potential, significant size of the group...)

The characteristics are grouped in order to be able to identify the high-potential segments (Table 5).

**Table 5: Dwelling characteristics for market segmentation for NZEB renovations**

<table>
<thead>
<tr>
<th>Very high relevance</th>
<th>High relevance</th>
<th>Medium relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• urgency for renovation (beyond energy)</td>
<td>• dwelling type</td>
<td>• inconveniences and defects</td>
</tr>
<tr>
<td>• neighbourhood type</td>
<td>• construction era</td>
<td>• historical value</td>
</tr>
<tr>
<td>• energy performance (EPC-value)</td>
<td>• construction type</td>
<td>• value of the house</td>
</tr>
<tr>
<td></td>
<td>• inconvenience linked to the renovation</td>
<td></td>
</tr>
</tbody>
</table>

Below the listed characteristics are further explained starting with the characteristics which were identified by the REFURB consortium as most relevant.

### 3.2.1 Urgency for renovation (beyond energy)

**Examples of categories:** no urgent renovation, small non-urgent renovation required, urgent renovations required, deep renovation required, re-build required

**Relevance for segmentation:** very high

**Relation with NZEB-renovation:**

- Create win-wins: integrate the energy renovation with other renovations in one process.
- The full/staged NZEB-renovation concept depends highly on the state of the dwelling and its components. E.g. are only HVAC-installations to be re-installed but is the building envelope OK?
- For some dwellings, demolition and re-building can be the best solution.

**Most interesting categories for NZEB-renovation**

- Dwellings with shortcomings (condensation, moisture, noise, cracking floors, colds etc.), dwellings that need refurbishment (e.g. new kitchen, painting, flooring, bathroom etc.), dwellings 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 etc.
• Any moment is the right moment for NZEB-renovation; but other needed renovations offer opportunities for NZEB-renovation; but NZEB-investment compete with other investments either home investments or other needs or desires of dwellers.

3.2.2 Energy performance certificates - value (EPC)

Examples of categories: 25% worst EPC-values; 26-50%; 51-75%; 76-100%

Relevance for segmentation: very high

Relation with NZEB-renovation:

• The EPC-value is the result of many (objective) parameters. The EPC value represents a calculated or theoretical value.
• Indicates the potential for energy reduction and cost saving
• The EPC is not known for all buildings, but can be estimated by most important parameters that define an EPC-value: building type, building era, and surface and condition of the building envelope.

Most interesting categories for NZEB-renovation

• 25% worst EPC-values: highest potential for energy reduction and cost saving. Theoretically, because in practice the energy use pattern of the dweller also is very important and can highly influence the actual energy performance of a dwelling.

3.2.3 Neighbourhood type

Examples of categories: centre, rural, suburban, high-rise, identical housing types, heterogeneous

Relevance for segmentation: very high

Relation with NZEB-renovation:

• Analysis in Denmark\textsuperscript{17} reveals the first and easiest steps towards deep renovations by pointing out geographical areas with houses with a certain age and thereby an energy-saving potential, high concentration of families with children which are typical first-time buyers (who most often carry out the deep renovations), and finally the analysis also shows where the income also can promote the choice.
• concentration of building types & building era ⇒clusters with similar energy performance & NZEB-solutions
• sometimes identical houses ⇒upscaling of renovation : replication or scalability and standardisation of technical solutions
• Other possibilities for renewables (e.g. heat pump, solar thermal, solar PV, district heating etc.)
• interesting for neighbourhood aggregation schemes

\textsuperscript{17} Gram-Hanssen et al. (2015). The socio-economic values are pointing towards the greatest possibilities to renovate in the urban areas around the larger Danish cities. The rural areas also have the energy saving potential but the other parameters do not indicate potential for energy renovation. The analysis also shows that other strategies in rural areas might be necessary to promote energy efficiency and renovation of the Danish single-family houses.
Most interesting categories for NZEB-renovation

- Consistent neighbourhoods (dwelling and dweller characteristics) with low energy performing dwellings (see for example Figure 16).

![Figure 16: Neighbourhoods can be very homogeneous in terms of energy performance, illustrated for Leeuwarden (the Netherlands). source: www.energielabelatlas.nl](image)

3.2.4 Dwelling typology

Examples of categories: detached, semi-detached, terraced, apartment, other

Relevance for segmentation: high

Relation with NZEB-renovation:

- There is a strong link with energy performance. Detached houses have relatively the worst energy performance compared to other building types with similar insulation and airtightness levels. This has to do with compactness and heat loss surface. The heat loss surface is a major parameter in the energy performance: the more heat loss surfaces versus usable area, the worse the energy performance. The larger surface also allows more wind leaks: the air tightness is less performing.

- Other opportunities in renewable energy production, e.g. heat pump (ground-water type) is difficult in terraced houses, renewables like solar-photovoltaic (PV) or solar thermal are difficult with apartments if legislation doesn’t allow for collective PV-schemes.

Most interesting categories for NZEB-renovation

- Detached houses, because of great energy saving potential per dwelling.
• Terraced houses, because they have a good ratio between NZEB-renovation cost and energy saving. This is due to the smaller heat loss surface.

3.2.5 Construction era


Relevance for segmentation: high

Relation with NZEB-renovation:

• Interesting years to partition into categories are related with the introduction of new legislation, e.g. EPC or earlier energy performance legislation.
• There is a strong link with construction type. Construction era is a second best option if there is no insight in the construction type.
• The age of the building indicates the urgency for renovation: older buildings are usually more in need of a renovation.
• Relevant because of its correlation with energy performance. Statistically speaking: the older the dwelling, the less energy performing.
• Dominant building tradition at a certain era, and dominant insulation techniques & standards (e.g. single glazing, double glazing, cavity wall etc.)
• Renovation cycle. At least the first 30 years, a profound (energy) renovation is unlikely. For older buildings this is more likely, and even urgent. Although new houses can add extra techniques like renewable energy production, to improve the energy performance to NZEB-standards.

Most interesting categories for NZEB-renovation

• For older dwellings deep renovation can be more appropriate.
• For recent buildings, e.g. built after introduction of recent energy performance regulations, building envelope renovation is not appropriate but sustainable energy techniques could be more relevant as the costs of envelope renovation might outweigh the financial benefits for the dweller.
3.2.6 Construction type

Examples of categories: masonry - non-cavity walls, massive masonry, wood-skeleton structure, concrete frame construction, flat roof, pitched roof...

Relevance for segmentation: high

Relation with NZEB-renovation:

- There is a strong link with the technical options for NZEB-renovations: for these groups very homogeneous solutions can be applied and a similar renovation concept can be put in place, e.g. cavity wall insulation is only an option in cavity walls.
- Strongly linked with the building era
Most interesting categories for NZEB-renovation

- Many categories are interesting, as different NZEB-renovation concepts are needed, but especially those with a large share in the housing stock due to the high market potential.

3.2.7 Inconvenience linked to the renovation

Examples of categories: 1 day / 2 days / 1 week / 1 month interventions, (im)possible to continue living in the house during the renovation...

Relevance for segmentation: high

Relation with NZEB-renovation:

- Renovating an occupied dwelling is not always obvious. Some measures can be implemented while the house is inhabited (e.g. cavity wall insulation, PV solar cells...), for other measures a temporary moving out of the house is appropriate (e.g. floor isolation). Some measurements take a long time (e.g. integrated building envelope renovation); others can be done in a short time. Some bring a lot of dust and inconvenience, others can be done neatly. The renovation concept will depend on what is possible for the dwellers.
- Important for phasing of renovation

Most interesting categories for NZEB-renovation

- low-inconvenience renovations
- no-moving-out needed
- short renovations

3.2.8 Less relevant dwelling characteristics

3 characteristics are scored as less relevant for NZEB-renovation:

- Inconveniences and defects of the dwelling, e.g. wind leaks, condensation on windows, moisture problems, noise, creaky floors, etc. are drivers for non-energetic renovations (to link with energetic renovations), but have little influence on the NZEB renovation concept. It can be expected that a part of the problem will be solved because of the NZEB-renovation measurements.
- Historical value. A dwelling with a historical valuable facade, interior, plan, in a conservation area... needs very different NZEB-concepts in order to preserve these valuable characteristics. But the share of these buildings is too small to define a separate segment. A neighbourhood-oriented approach can overcome this issue, since there is usually a spatial concentration of historical buildings.
- Value of the house. The value of the house does not relate to a different NZEB-renovation concept.
3.3 CLUSTERING THE DWELLING CHARACTERISTICS

There are many options to segment the housing market, too many to be workable within the REFURB segmentation. Based on the interrelations between different characteristics the above-listed characteristics can be clustered into 3 clusters with strong links (Figure 18).

3.3.1 Cluster 1: SIMILAR dwellings

NZEB-integrated renovation packages should be designed towards similar dwellings, if the goal is to provide similar technical solutions. For example, terraced houses with full masonry walls and pitched roof, dating from the same era in the same climatic zone will need very similar solutions for insulating the building envelope and for technical installations. A terraced house differs from a detached house, because e.g. the ratio between habitable floor surface and building envelope surface is much more advantageous in a terraced house (cost to insulate building envelope is lower), but the insulation of exterior walls is more complex due to adjacent buildings.

Figure 18: Clusters of relevant dwelling characteristics
There are very strong links between neighbourhood, building era, construction type, dwelling type and historical value. The expansion of the built environment happens via new neighbourhoods that were built in a certain era when certain building traditions were dominant. Historically valuable buildings need tailor-made solutions (e.g. insulation of a protected facade is not obvious), but they also are very often concentrated in historical city centres, neighbourhoods, or protected areas.

3.3.2 Cluster 2: STATE of the dwelling

A house in good condition needs other solutions than a house in poor conditions. NZEB-renovations can be done at any time, both staged deep renovations\(^{18}\) and full deep renovations, but the state of the building is very relevant to design the NZEB-packages. It is important to understand that energy renovation is not the main argument to start a renovation project, but mostly needs to be integrated with other home improvements, small and major, like changing the architectural concept, restyling, repairing defects, improve comfort etc. The necessity for these renovations may be an opportunity to apply other NZEB-solutions. A typical entry point for offering renovation solutions, for example, is upon buying an old dwelling as many decide to start renovating at that point in time.

The state of the dwelling is linked with the inconvenience the renovation will cause. For dwellings in good state, the inconvenience is supposed to be limited, so the NZEB-packages must be different.

3.3.3 Cluster 3: energy saving POTENTIAL

The investment cost of an NZEB renovation is very often balanced with the energy savings and the energy bill reduction.

It is logical that the main focus for NZEB-renovation is on dwellings with a high saving potential. A very bad energy performance is of course a very good indicator. Dwellings with a poor energy performance require deep renovations. Recent dwellings with a pretty good energy performance can be improved with a different type of renovation package, e.g. focussing on more performant heating and ventilation installations.

The actual energy bill also indicates the energy saving potential. A high bill indicates a high energy saving potential. But dwellings with a poor EPC can have an unexpectedly low energy bill, e.g. due to low energy use of the dwelling. This is commonly known as the prebound and rebound effects\(^ {19}\). Price awareness, next to way of living determines what is perceived by the dweller as good. If the anticipated level of comfort requires too much energy –and as a consequence increases energy bills- dwellers tend to be content with less and thus renounce that level of comfort. In those cases the cost of the investment will not be in balance with the return (reduction of the energy bill) as those dwellers, after renovation, will usually not decrease their energy use as much as expected and theoretical calculations on savings usually heavily overestimate possible gains.

\(^{18}\) A renovation that is carried out in different phases over a longer period, in which the house is most of the time in use (e.g. 3 phases in 10 years)

\(^{19}\) The prebound effect is the effect that causes actual energy consumption prior to renovation to be lower than can be expected. The rebound effect causes the calculated savings after a renovation to be lower (as people adapt to the increased comfort and might consume more than expected. Both effects require adaptation factors to theoretical energy consumption calculations.
4. A generic housing market segmentation: dweller typology

4.1 DWELLER CHARACTERISTICS FOR MARKET SEGMENTATION FOR DEMAND-SIDE AGGREGATION SCHEMES

In all six REFURB countries, partners conducted a desktop research on the available studies within the country on market segmentation, from different points of view: behaviour studies, classic economic studies, decision making psychology etc. Based on this desktop study and the expertise of the project partners, a set of dwelling characteristics was listed to base the segmentations on.

In order to prioritize the importance of the different characteristics they were scored on the relevance for segmentation to define the homeowner categories to design demand aggregation schemes in all countries or regions. The scoring was done through a semi-quantitative assessment of every characteristic: a figure between 0 (not important) and 3 (very important), and a motivation for the score. The central questions for the REFURB project are:

- Is a separate demand aggregation scheme required for the homeowners? (Group needs similar persuasive arguments, financial solutions, faces similar barriers, are interesting for a grouped approach etc.)
- Which are the interesting categories for demand-side aggregation? (Significant size of the group etc.)

The characteristics are grouped in order to identify the high-potential segments (Table 6). As financial characteristics are considered to be a specific category, the characteristics were split-up in financial characteristics and non-financial characteristics.

Table 6: Dweller characteristics for demand aggregation schemes for NZEB renovations

<table>
<thead>
<tr>
<th>Very high relevance</th>
<th>High relevance</th>
<th>Medium relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>financial characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Availability of financial possibilities to invest</td>
<td>• Willingness to invest in energy efficiency</td>
<td></td>
</tr>
<tr>
<td>non-financial characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Stage of life / household type</td>
<td></td>
<td></td>
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<tr>
<td>• The expected period to own the house</td>
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<tr>
<td>• Owner status</td>
<td></td>
<td></td>
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<tr>
<td>• Decision making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Available time to manage renovation project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Values (ideas) and attitudes (behaviour) towards environmental issues, sustainability and climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• renovation needs: increase comfort level, cosiness, personalization, taste, adjust architectural concept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• General knowledge level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Technical knowledge level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Home occupation pattern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Male / female</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.1.1 Availability of financial possibilities to invest

Examples of categories: high income, medium income, low income; high access to finance, medium access to finance, low access to finance; energy poverty

Relevance for segmentation: very high

Relation with demand-side aggregation:

- Investments in energy efficiency and NZEB-renovation require investments. The homeowner needs funding, e.g. own saving, a bank loan etc.

Most interesting demand-side aggregation segments

- Homeowners with high financial possibilities

4.1.2 Owner status of dweller

Examples of categories: individual or institution owner (small-large); owner-occupier, tenant vs landlord; co-ownership (e.g. apartment building or house owned by several owners); etc.

Relevance for segmentation: very high

Relation with demand-side aggregation:

- The different groups encounter very different barriers, e.g. with rented houses there is a split-incentive issue (the landlord needs to finance, the tenant saves on the energy bill), with co-ownership the decision making processes are very different.
- There is a need for different (non-technical) solutions, e.g. financial and legal (to solve split incentive).

Most interesting demand-side aggregation segments

- owners-occupiers
- landlords in regions with high percentage of tenancy
- co-owners in regions with high percentage of co-ownership

4.1.3 Stage of life / household type

Examples of categories: first-time-buyers, young family growing children, empty-nesters, retired, singles, elderly

Relevance for segmentation: very high
Relation with demand-side aggregation:

- Stage of life combines several relevant dweller characteristics, such as the age, the availability of time to manage a renovation project, the availability of finances, and the expected time to own the house...
- The typical “first-time-buyers” are families with small children, and the typical time for larger renovations is when the house is bought. The other typical type of renovation is the step-by-step renovation which goes on during a longer period. It is only for the older group of people that the age is expected to minimize the initiation of renovation projects\(^{20}\).
- Danish research\(^{21}\) showed that deep energy renovations are most likely to happen as long as children under the age of 18 years are living in the house, because the homeowners here have a higher than average interest in conducting similar project, hence a higher investment limit.

Most interesting demand-side aggregation segments

- Empty nesters (age 40-65, children left the house) usually have money and time available for a renovation project.
- Young families will own the house for a long period, have a more intensive energy use pattern, but have limited time and finances for NZEB-renovations.

\(^{20}\) Gram-Hanssen et al., 2015
\(^{21}\) Mortensen et al., 2015
4.1.4 The expected period to own the house

Examples of categories: less than 3 years, 4-9 years, 10-19 years, 20-29 years, 30 years or longer

Relevance for segmentation: very high

Relation with demand-side aggregation:

- Danish research\textsuperscript{22} showed that deep energy renovations are most likely to happen before the homeowners have lived for one year in their house, since the investment limit is lowered as time

\textsuperscript{22} Mortensen et al., 2015
goes on, and these homeowners have proven willing to pay more than average for the same benefits and savings.

• This is linked with the intention and the exact motivation to invest in energy renovation. Owners with a short-term perspective are less motivated (“needs to be decided by the next owner”), or can have financial motives (e.g. increased dwelling value). For people with long-term perspective, the financial element is of minor interest (e.g. increasing the comfort level is more important).

• E.g. people who intend to sell the house, elderly with short-term perspective, young families who intend to live in the house for 30 years etc.

• Is linked with stage of life and age e.g. young families have a long-term perspective of living in the dwelling, elderly (75+ years) have a very short-term perspective for their own time living in the dwelling but might have other long-term perspectives for inheritance.

Most interesting demand-side aggregation segments

• People who expect to own the house for a period longer than the expected payback time (indicative: at least 10 years): their motivation will not only be for short-term financial gains, but also for e.g. increase of comfort.

4.1.5 Availability of time to manage a renovation project

Examples of categories: no time available, not willing to invest time in renovation project, plenty of time...

Relevance for segmentation: very high

Relation with demand-side aggregation:

• The organization of a renovation process requires time of the homeowner. The lack of time availability is a major barrier for homeowners to start renovating the dwelling. Some people do not have the time available; others do not want to spend their time to this (want to do more “interesting” things).

• The demand aggregation schemes for people with time and people without time available can be totally different, e.g. different marketing, a service to assist homeowners in the renovation process (unburdening) etc.

Most interesting demand-side aggregation segments

• Homeowners with little time are a very interesting segment to design unburdening processes for. This barrier should become irrelevant with a good renovation package.

4.1.6 Decision-making

Examples of categories: Constrained Strugglers, Consciously Unengaged, Worried Indecisives, Traditional Value seekers, Leading Edgers (illustrated in Table 7)

Relevance for segmentation: very high

Relation with demand-side aggregation:
• This relates to the psychology of decision making. Decision-making is a process which can be more or less rational or irrational and can be based on explicit knowledge or tacit knowledge. The way homeowners make decisions is different and has a very high impact on the way to compose and market integrated renovation packages.
• E.g. importance of social network, friends and family, internet, experts, etc... to convince to take decisions.
• Importance of the confidence level: people who consider a renovation as too complex, people who do not know where to start a renovation process, etc.

**Most interesting demand-side aggregation segments**

• Leading Edgers as early adapters for NZEB and their potential to convince others, Worried Indecisives can be activated if they get the right support.

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**Table 7: Illustration of consumer style segmentation. Based on “Consumer Empowerment Survey Report” (Williams et al., 2015)**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constrained Strugglers</td>
<td>Constrained Strugglers are the least empowered segment, who may be constrained by their personal traits and attitudes as well as their financial situation. As consumers they lack confidence in their ability to find the best products and services, and don’t feel comfortable making decisions. They do not like shopping around or actively seek out the best deals. They lack confidence in their negotiation skills and ability to understand terms and conditions. 17% of population</td>
<td></td>
</tr>
<tr>
<td>Consciously Unengaged</td>
<td>Consciously Unengaged do not share their enthusiasm for shopping around or getting good deals. This lack of interest is a conscious choice rather than linked to any particular financial or personal constraints and they say they would make the same decisions in the future. They just do not want to spend time shopping. They therefore prefer to stick with their current supplier, even if it means they aren’t on the best deals. 15% of population</td>
<td></td>
</tr>
<tr>
<td>Worried Indecisives</td>
<td>While their confidence and lack of decisiveness may hold them back, the Worried Indecisives do engage with the market to some extent but it appears that members of this segment may need more support to empower them further as consumers. This segment like to spend time shopping around but tend to find it hard to make decisions and worry about making the right choice. They tend to have low levels of confidence as consumers: they like to seek advice from trusted sources (e.g. friends, family and consumer experts), and they don’t like to negotiate or feel confident understanding terms and conditions or making complaints. 22% of population</td>
<td></td>
</tr>
<tr>
<td>Traditional Value-seekers</td>
<td>Traditional Value-seekers are highly engaged and confident consumers, who enjoy shopping around and are prepared to spend the time to find the best value. They have willingness to invest the time, and to negotiate for the best deal. Members of this segment are doing well financially. They feel confident making decisions and with all aspects of their consumer experience (e.g. making complaints, negotiating, understanding terms and conditions). They appear to feel satisfied with the outcome of their purchases as they would make the same decision again. They are inclined to be more conservative:</td>
<td></td>
</tr>
</tbody>
</table>
Leading Edgers

Leading Edgers are one of the most empowered of all the segments in terms of their consumer behaviour and personal attributes. They have the willingness to try new things and lead the opinion of others. Leading Edgers tend to have higher qualifications and be getting on well financially. They are not particularly brand loyal, but are instead early adopters who are happy to switch around and try something new. They like to share their views on their purchases. Members of this segment are confident consumers: successful negotiators and confident finding the best deals and products for them, negotiating and making complaints.

22% of population

4.1.7 Willingness to invest in energy efficiency

Examples of categories: no willingness, medium willingness, high willingness

Relevance for segmentation: very high

Relation with demand side aggregation:

- It is not only the availability of financial possibilities to invest that is relevant, but especially the degree in which homeowners are willing to invest in energy efficiency. It is possible they prefer not to invest, or prefer to invest in competing products, like a new car, a new kitchen, etc. Or, they want to invest in comfort improvement but do not recognize the link with energy renovation.
- A positive experience in energy efficiency investment can increase the willingness to invest more.

Most interesting demand-side aggregation segments

- High willingness to invest in energy efficiency

4.1.8 Age of dweller

Examples of categories: 18-25; 26-35; 36-45; 46-65; 66-75; 75+

Relevance for segmentation: high

Relation with demand-side aggregation:

- Research demonstrated strong links with stage of life, environmental values and attitude, available time, decision making, financial possibilities, etc.
- Danish research\(^{23}\) revealed that the older the homeowner gets, the lower the interest in renovation (Figure 20).

\(^{23}\) Mortensen et al., 2015
Most interesting demand-side aggregation segments

- The categories of 25-44 years and 45-65 appear to be the most interesting, mainly due to the stage of life these homeowners are in (see 4.1.3), and have the highest willingness to renovate.

![Figure 20: The willingness and reasons for conducting renovation divided according to the age of the respondents (Mortensen, 2015)](image)

4.1.9 Values (ideas) and attitudes (behaviour) towards environmental issues, sustainability and climate

**Examples of categories**: many theories and models are available, e.g. the Transtheoretical Model (Stages of Change) which contains following categories: precontemplation, contemplation, preparation, action, maintenance, termination (Table 8)

**Relevance for segmentation**: high

**Relation with demand-side aggregation**:

- The willingness to accept NZEB-renovations requires a positive attitude and behaviour towards NZEB, environmental issues, sustainability and climate in general. This insight originates from behaviour science, in which several theories have been developed to describe behaviour change.

- The marketing strategy of the renovation packages and one-stop shop concepts towards homeowners should / can differ for the groups with a different values and attitudes towards environmental issues. People with no intention to change behaviour need a different approach than people who have developed a positive behaviour towards environmental issues.

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24 Described in e.g. “Theories of Behaviour Change” (World Bank), and in GSR Behaviour Change Knowledge Review
Most interesting demand-side aggregation segments

- Homeowners that already maintain an environmentally-friendly behaviour e.g. by purchasing energy efficient electric appliances will be easier to convince for NZEB-renovation.

Table 8: The transtheoretical model proposes change as a process of six stages. Source: World Bank

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pre-Contemplation</td>
<td>People are not intending to change or take action in the near future (next 6 months).</td>
</tr>
<tr>
<td>2. Contemplation</td>
<td>People are intending to take action within the near future, but are not ready to take action; doubts about the effectiveness of action and of uneven costs and benefits may stall people at this stage for some time (in a state of “chronic contemplation”).</td>
</tr>
<tr>
<td>3. Preparation</td>
<td>People are intending to take action in the near future; they are very aware of the costs and benefits of change and some behaviour change may already have taken place, including having a plan of action.</td>
</tr>
<tr>
<td>4. Action</td>
<td>People have made or are making specific overt modifications to their behaviour.</td>
</tr>
<tr>
<td>5. Maintenance</td>
<td>People are actively working to prevent a relapse to the previous behaviour.</td>
</tr>
<tr>
<td>6. Termination</td>
<td>Changed behaviour has become normative; there is no chance of relapse.</td>
</tr>
</tbody>
</table>

4.1.10 (Energy) use patterns

Examples of categories: economical, high energy users, moderate energy users...

Relevance for segmentation: high

Relation with demand-side aggregation:

- The interpretation of the energy use pattern is complex: it can be the result of a certain need (e.g. comfort: high temperatures for elderly, illness, babies...), the pursuit of a low energy bill (e.g. people in energy poverty), a positive attitude towards climate, the compensation of the thermal characteristics of the dwelling (e.g. permanent heating because of a slow warm-up time), a behaviour (open windows while heating, not to turn off heat while absence) etc.
- Has a strong relation with the house occupation pattern (e.g. all day at home, often away)
- After NZEB-renovation, the energy use pattern should be irrelevant.

Most interesting demand-side aggregation segments

- High energy users have the largest energy saving potential; with economical users there is a higher ambition to reduce energy consumption.
4.1.11 Intentions to renovate

Examples of categories: no intentions, considering small/large investments, decided on renovation, decided on renovation concept and budget, preparing execution of works, carrying out a renovation project, just renovated

Relevance for segmentation: high

Relation with demand-side aggregation:
- NZEB-renovation can happen any time, but is more likely if intentions and plans are present.
- Create win-wins: integrate the energy renovation with other renovations in one process.

Most interesting demand-side aggregation
- Homeowners with intentions and plans to renovate

4.1.12 Renovation needs: increase comfort level, cosiness, personalization, taste, adjust architectural concept

Examples of categories: homeowners with renovation needs, homeowners with no renovation needs

Relevance for segmentation: high

Relation with demand-side aggregation:
- Existing renovation needs offer an opportunity to integrate those with energetic ambitions. They can be a driver (technically easy to integrate), but also a barrier (no extra budget available, already fixed concept...)
- Homeowners with no renovation needs need to be approached differently.
- However, every moment can be the right moment for an energy renovation, the existence of renovation needs is not a condition for energy renovation.

Most interesting demand side aggregation segments
- all segments

4.1.13 Access to accurate & reliable information

Examples of categories: hard to find access to information, can easily find information

Relevance for segmentation: high

Relation with demand-side aggregation:
- Is related with the personality and education of the home-owner. Some people easily find information on the internet and can assess the value of the information; others are suspicious about information and rely on family and friends, others on experts etc.
- Is important for the marketing of the renovation packages and the means of communication. E.g. professional advisors (like consultants) could be part of the solution.
Most interesting demand-side aggregation

- All categories are relevant.

4.1.14 Less relevant dweller characteristics

7 characteristics were scored as less relevant for segmenting for demand aggregation. Some of these are identified as an important driver or barrier.

- Subsidies, tax deductions etc.
- availability of financing schemes
- General knowledge level
- home occupation pattern
- Technical knowledge level
- Demographics: male / female
4.2 CLUSTERING THE DWELLER CHARACTERISTICS

As exemplified above there are many options to segment the demand side, too many to be workable within the REFURB segmentation. Based on the interrelations between different characteristics the above-listed characteristics can be clustered into 3 clusters with strong links (Figure 22).

4.2.1 Cluster 1: the right MOMENT for NZEB renovation

Not every moment is the right moment for NZEB-renovation for the homeowner. A demand aggregation scheme needs to serve the needs and challenges the homeowners face in their stage of life.

The stage of life is a central idea in this cluster: e.g. elderly with a short-term perspective to live in the house often consider that energy renovation is for the next generation, although they might have intense energy use patterns due to a high home occupation pattern. Whereas “empty nesters”, 40-65 years old have the time and financial possibilities to manage a renovation project. Young families often lack the time but often have intensive energy use patterns and are usually first time buyers which are rebuilding and renovating their new home.
In the different stages of life of homeowners, different drivers and barriers need to be met. Demand aggregation schemes can be developed for these different segments, coping with shared challenges within these groups.

4.2.2 Cluster 2: the right approach towards different PERSONALITIES

Homeowners need to decide on an NZEB-renovation project. But people take decisions in a different way and should be convinced in a different way. They have different values and attitudes. Some act very rationally, others very intuitively, others copy the decision of their neighbour, others rely on what intimates say (social proof, peer pressure). People also have different needs for renovation (e.g. increase comfort, increase cosiness, reduce the energy bill, or simply to brag), and have a different knowledge levels.

Demand aggregation schemes need to convince many different kinds of people for NZEB-renovation, and the success of the scheme will lie in the match between a customized marketing and personality segmentation thereof.

4.2.3 Cluster 3: make use of available POSSIBILITIES and INTENTIONS

A set of conditions is already available for the homeowners to build upon for the design of demand aggregation schemes. People have possibilities and intentions. This is a capital to build on, and can offer many opportunities.

People have financial possibilities, e.g. a high income or savings. For others, innovative financial solutions like partial ESCO constructions\(^\text{25}\) must be part of the integrated renovation package.

People can have a positive attitude towards environmental issues, or had good experiences (e.g. happy to have invested in solar photovoltaics). People can already have the intention to renovate; then the challenge is to integrate this with NZEB-ambitions.

\(^{25}\) ESCO constructions: Energy Service Companies constructions usually refer to the upfront financing by a third party and payback on the energy bill. These constructions are becoming more and more commonplace in office buildings in both the private and public sector. However, for the residential sector the scope is still limited mainly because of the lack of knowledge on the rebound effect which increases financial risk.
5. REFURB segments for NZEB-renovation through demand-side aggregation

A range of characteristics to segment the NZEB renovation market from the demand-side point of view has been defined in the chapters above. These characteristics will allow for demand-side aggregation. They were either

- based upon the dwelling characteristics (chapter 3); and
- Based upon the dweller characteristics (chapter 4).

5.1 A MATRIX AS FRAMEWORK FOR SEGMENTATION

Based on the characteristics and insights from studies, best practices and their own experiences, the REFURB partners propose a framework as a tool to define segments. This framework is a matrix-style combination to organize the interplay of dweller characteristics (interesting for demand aggregation schemes) and dwelling characteristics (interesting for NZEB-renovation).

The tool can be used in different contexts to help to define tailor-made segments. This is necessary as it is shown in chapter 2 that in different EU-countries or regions housing markets can be very different. E.g. in Estonia the housing market is dominated by privately owned apartment buildings, whereas in Germany the private rental housing sector is very important. As a consequence, the REFURB project does not propose generic, pan-EU-valid segments for housing renovation.

The matrix (Table 10) combines the 2 main dimensions to segment for NZEB demand aggregation schemes: dwelling characteristics and dweller characteristics. In order to avoid an explosion of possible combination, the matrix makes use of the clustered characteristics as described in sections 3.3 and 4.2. This results in a 3x3 matrix, with 9 fields in total.

With this matrix, segments can be designed. The matrix offers flexibility to focus on mainly dwelling or dweller characteristics, or a combination of both. For instance the post-war suburb houses can easily host both empty nesters, young families and convinced energy savers but the approach for them to renovate will be different. It can be an option to focus on all post-war suburban houses, or on just these post-war suburban houses owned by convinced energy savers.

It should be taken in to account that segments are either dweller or dwelling focused. This makes them still ‘broad’. Basically the dwelling-focused typologies need technical solutions, the dweller-focused typologies need different types of approach (e.g. communication and marketing) to initiate the renovations. For example: within the segment young families still a number of technical solutions is needed for all the different housetypes these young families live in. It might be necessary later on to subsegment even more.
Table 9: Matrix as a tool to segment for demand aggregation schemes for NZEB - renovation in the residential sector

<table>
<thead>
<tr>
<th>Clusters of dwelling characteristics</th>
<th>SIMILAR dwellings</th>
<th>STATE of the dwelling</th>
<th>The right MOMENT</th>
<th>Different PERSONALITIES</th>
<th>Available POSSIBILITIES and INTENTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neighbourhood type</td>
<td>Urgency for renovation</td>
<td>Stage of life</td>
<td>Type of decision maker</td>
<td>Financial possibilities</td>
</tr>
<tr>
<td></td>
<td>Dwelling type</td>
<td>Inconvenience linked with renovation</td>
<td>Time to manage renovation project</td>
<td></td>
<td>Owner status</td>
</tr>
<tr>
<td></td>
<td>Construction era</td>
<td>Inconveniences and defects</td>
<td>Expected period to own the house</td>
<td></td>
<td>Willingness to invest in energy efficiency</td>
</tr>
<tr>
<td></td>
<td>Construction type</td>
<td>Value of the house</td>
<td>Age of dweller</td>
<td></td>
<td>Intentions to renovate</td>
</tr>
<tr>
<td></td>
<td>Historical value</td>
<td>Energy saving POTENTIAL</td>
<td>Energy use patterns</td>
<td></td>
<td>Environmental values and attitudes</td>
</tr>
</tbody>
</table>

5.2 EXAMPLES OF HIGH POTENTIAL SEGMENTS

To illustrate the matrix, a set of 5 high-potential segments for integrated NZEB-renovation packages and demand aggregation schemes is described.

- Segment 1: young families (dweller segment)
- Segment 2: Post-war suburbs with detached houses (dwelling segment)
- Segment 3: Empty nesters (dweller segment)
- Segment 4: terraced houses with a high energy bill (dwelling segment)
5.2.1 Segment 1: Young families

This segment is mainly defined by dweller characteristics. Their main characteristic is their stage of life. These homeowners typically are **25-45 years old and have young children or planning to have them**. This stage lasts about 20 years, until the children leave the house.

Young families need a home to raise their children. This means their dwelling has to be large enough and offer the right comfort, e.g. enough rooms, well-equipped kitchen and bathroom, and they love to have a garden. They remodel their own house to fit **future needs**, or they buy a house and remodel it (young families that build a new house are out of the scope for REFURB), with the intention to live for a long time in the house. So there is a “momentum” for a major renovation, an opportunity to integrate their needs with deep NZEB-renovation.

Their **home occupation pattern and energy use pattern can be very intensive**. In a house with a poor energy performance, the energy bill will be high. But young families are more aware of environmental issues, and they are more willing to reduce their energy consumption. Unfortunately, often due to limited budgets, they buy a house with a poor energy performance.

Their **financial possibilities are limited**, as they are at the beginning of their careers. Energy investments compete with other investments, such as improving the comfort and architecture of the house, family holidays or a family car. A staged renovation offers a solution.

Although they have intentions and needs to renovate, they have very **limited time to manage a renovation project**. Their agenda is full. Time is spent on their career and family life. So there are strong arguments needed to also add a renovation to their agenda. Energy renovation is not convincing enough, multiple advantages should be obtained in one renovation project: more comfort, more cosiness, more personalisation, lower energy use etc.

5.2.2 Segment 2: Post-war suburbs with detached houses

This segment is mainly defined by dwelling characteristics. From 1945 on, suburbanization is gaining ground in Europe. In more and more countries suburban neighbourhoods with detached houses were built in the vicinity of cities and villages.
These neighbourhoods are interesting because of their homogeneity of dwellings (thus have similar NZEB-solutions). Not only in building type, also in construction type and construction era they are very homogeneous. Before 1970, the first oil crisis, the thermal performance of these buildings was poor; afterwards there was a limited improvement. The detached house is conceptually the worst when the energy performance is considered: they have a disadvantageous ratio between many energy loss surfaces (external walls, roof, and floor) and living space surface. They have high energy bills.

The houses built before 1965 to 1985 (country-dependent) offer opportunities to integrate NZEB-ambitions in renovation projects. These houses enter in a first big renovation cycle. The building envelope (walls, floors, roof, and windows) needs to be renovated for construction-technical reasons. Moreover, some of these neighbourhoods are changing homeowners. The first generation owners gets older, their housing needs do not match their dwelling anymore, and they sell to younger generations. It is observed that the younger generation sometimes aims at adapting the house to their needs, e.g. improving the comfort and architecture to contemporary standards.

In contrast, the cost for (energy) renovation is high in detached houses due to the large building envelope. As a consequence the return on investment is limited. This may be a problem for both the old owners (not willing to renovate the house because having little perspective to live in it), and for the new owners (limited renovation budget after buying the house).

Post-war neighbourhoods offer opportunities to create a “renovation dynamic”. Because of the similarities between the dwellings, the dwellers and social networks in the neighbourhood, homeowners can copy solutions from pioneers, influence each other, share knowledge, cooperate, or even compete.

5.2.3 Segment 3: Empty nesters

Like the young families, this segment is also mainly defined by dweller characteristics. Their main characteristic is their stage of life. These homeowners typically are 45-65 years old, and the grown-up children have left the house: the nest is empty now.

Empty nesters inhabit a dwelling designed to raise the children, but now need to remodel it to their new future needs. Their home occupation pattern and energy use pattern becomes less intensive. They have the intention to live for a period in the dwelling, but maybe not as long as the young families.

Empty nesters are aware of environmental issues, and have two important features to bring their concerns into practice and manage an energy renovation. Because the children left the house, they have more time. They also have more financial possibilities, because the dwelling is completely paid for (sometimes this means they even have to look for other investments because of fiscal regimes), their income is higher due to their career and/or they have a financial windfall (e.g. a legacy, life insurance).

Their house does not always offer high potential for energy savings. In some cases energy investments have always been postponed before becoming empty nesters. But many empty nesters have a 20 to 30 year-old dwelling with a building envelope in good condition and medium energy performance, so little prospect of large energy savings and return on investment. Then a refurbishment of the installations (heating, ventilation, and renewables) can be most promising.

So with empty nesters, energy investments do not necessarily need to be integrated with other planned renovations, there can be other reasons to start them.
5.2.4 Segment 4: terraced houses with a high energy bill

This segment is mainly based on dwelling characteristics.

In most EU countries, terraced houses represent an older part of the building stock. A large majority is over 40 years old, up to 100 years and older. They have a high energy saving potential due to their low energy performance as they were built in an era when energy saving techniques were not commonplace. When grouped in neighbourhoods, their construction type is quite homogeneous (e.g. full masonry, pitched roof), and very often the houses are identical or have similar architecture.

Due to their age, other renovations become urgent and desirable: structural renovations (roof, floors, walls, windows etc.), upgrade the architecture to contemporary standards, improve the comfort of the house, improve the style etc. Very often these houses deal with inconveniences and defects like wind leaks, condensation on windows, moisture problems, noise, creaky floors etc.

Terraced houses are interesting for NZEB-renovation because the cost for NZEB-renovation is lower than for detached or semi-detached houses, due to a smaller building envelope surface.

In neighbourhoods with homogeneous houses, very similar solutions can be applied. So neighbourhood approaches are possible, thus creating a positive vibe (like in the segment “post war suburbs with detached houses”). Terraced houses share some technical complexities, e.g. on insulation of the facade: how to connect with the (non-)insulated neighbouring houses, can a part of the sidewalk be taken if external insulation is applied (building alignment issues)? etc.

A high energy bill is a very good indicator for the energy saving potential. A high energy bill (e.g. >€180/month\textsuperscript{26}) indicates a bad energy performance of the house (EPC) and/or an intensive energy use pattern. But this high energy bill also creates prospect of a considerable financial return after NZEB-renovation, due to a potentially high reduction of the energy bill.

But, the high energy bill can also indicate some barriers for NZEB-renovation, like an intensive home occupation pattern (not evident for deep renovation works), little awareness on environmental issues and little willingness and intentions to invest in energy saving. A high energy bill can also indicate the lack of financial possibilities, time and/or knowledge of the homeowner to manage a renovation project.

5.2.5 Segment 5: Convinced energy savers

This segment is based on dweller characteristics.

This is a small segment, but an essential one. To start a transition towards NZEB-renovation, there is a need for pioneers, frontrunners. Convinced energy savers offer the fertile ground to become early adaptors within the city, village or neighbourhood, and to be followed and copied by other homeowners.

They have the right environmental values (good ideas), and have the right attitude and good experience (e.g. they are very happy with their solar PV or thermal solar system). They are convinced of doing the right things. They find access to the right information, and want to make decisions that differ from the current

\textsuperscript{26} The definition of a high energy bill is contextual and will differ in countries, regions and over time.
general standard. They are willing to invest in NZEB, and the return on investment is not a decisive criterion.

They might have a **low potential on energy saving**, as they already have increased their energy efficiency and constantly optimize their energy use pattern. They might face some lock-ins (e.g. a medium insulated roof in perfect state), so it is difficult to link energy renovation with other urgent renovations or to realize an interesting return on investment. Consequently a distinct phase in life with increased potential for this group is the moment a new dwelling is purchased.

Some can make decisions easily; others will hesitate to take the decision for an NZEB-renovation. This depends on their personality. They are the first ones to meet all kinds of barriers, before these get solved when NZEB-renovation mainstreams (e.g. find craftsmen with the right skills). They will encounter a lot of resistance with all stakeholders who want to stick with the ancient (non-NZEB) renovation standards. They might not have enough time or skills to manage a renovation project. But they can also make use of subsidies, tax deductions and other financial incentives in which they find confirmation in what they do.

A small but interesting **subsegment** are the pioneers within the convinced energy savers. These are very valuable homeowners because they are able to overcome some barriers. They have the **access to the right information and are not depending on the building sector**. DIY’s (do-it-yourself) are **willing to invest time to renovate the house**. They can reduce the renovation cost, which increases the chance they can/will invest and improve return of investments.

### 5.2.6 Other segments

Next to this set of the 5 high-potential segments for integrated NZEB-renovation packages and demand aggregation schemes, other segments can be defined and designed making use of the matrix (Table 10), relevant for specific countries, regions or contexts. The set of clusters with dwelling and dweller characteristics offers a framework for a balanced design.

In the REFURB project, some additional segments were discussed. Some of these segments were identified to be very relevant in some countries but less relevant in other countries.

- The private rental sector, with very specific barriers on the tenant-homeowner issue (Who invests? How to deal with return on investment? What about split incentives? When to renovate? etc.)
- Social housing corporations, as owners of large housing stocks, but with different decision-making procedures, other views on financial issues etc.
- Privately owned apartment blocks with 1 owner or 1 management authority, but with multiple dwellers.
- Low income homeowners searching to reduce energy cost, but with little financial capacity to invest. Typically homeowners who managed to escape the rental market by spending their last money to become homeowner.
- Open-minded sceptics who are difficult to convince.
- Homeowners who renovate without any energy ambition, but are triggered to renovate to increase the comfort of their home (new bathroom, kitchen, change the architecture of the house etc.)
- Multi-decision makers, for example apartment buildings owned by a condominium owner association. Financing and decision-making processes can be very complex.
6. General conclusions and use of segments within the REFURB project

This report is part of work package 2 (“demand side mapping”) of the REFURB project, and establishes a segmentation of the demand side for the renovation market. This segmentation is the first step to better understand the homeowners, a diverse group of decision makers in energy efficiency investments. A segment is a group in the market with similar characteristics.

In the REFURB project a tailored segmentation is created that is relevant for NZEB-renovation and demand aggregation schemes. This type of segmentation of the demand side is not commonplace. Usually market segmentation is very much technology-driven from the point of view of the supply side of the renovation market. Based upon REFURB partners’ experience and research it was, however, possible to create such segmentation.

It is important to acknowledge that the REFURB project offers a framework to create a tailor-made segmentation or define a set of segments that fits a certain context in a country, rather than fix a pan-European set of segments to cover the entire demand side. It is not the ambition of the project to divide the entire demand side into juxtaposed categories.

In the REFURB project, it is concluded that a multidisciplinary view to the creation of the segmentation is essential. For the purpose of the segmentation, very different points of view must be explored to fully gain understanding of how homeowners can be convinced to invest in NZEB-renovation: behaviour study, psychology, sociology, economics, technology, legislation, architecture, urbanism etc. With a single technical, architectural or financial approach it seems hard to generate segments to design successful one-stop-shops for, as the homeowner profile risks to be too heterogeneous.

For the segmentation in the REFURB project it was possible to describe in short a set of most relevant categories of characteristics for segmenting, without describing these into detail. For each characteristic, the REFURB partnership indicated the importance. This assessment was done from a holistic perspective and based on literature study, practical experience and ongoing insights. An in-depth study was beyond the scope of the project. These six clusters of characteristics are described:

I. Three clusters of dwelling characteristics, which are important to design consistent NZEB-renovation packages:
   • Cluster 1: similar dwellings,
   • Cluster 2: state of the dwelling,
   • Cluster 3: energy saving potential,

II. Three clusters of dweller characteristics, which are important to design consistent demand aggregation schemes:
   • Cluster 1: the right moment for NZEB-renovation for the dweller
   • Cluster 2: possibilities and intentions of the dweller
   • Cluster 3: the different personalities of the dweller
Based on these characteristics and insights from studies, best practices and experiences, the REFURB partners created a matrix as a tool to design tailor-made segments in different contexts. The set of 3x3 clusters with dwelling and dweller characteristics offer a framework for a balanced design.

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.

Based on the segmentation of this report, drivers and barriers (financial, social, psychological etc.) will be linked with different segments (report 2.2), 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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Annexes

Annex 1 – example of Regional Housing market analysis for Belgium – region South-West Flanders
Annex 2 – example of Regional Housing market analysis for Denmark
Annex 3 – example of Regional Housing market analysis for Estonia – Tartu region
Annex 4 – example of Regional Housing market analysis for Germany – Halle region
Deliverable D2.1
Annex 1 Regional housing market - Belgium – Region South-West-Flanders

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1 Description of country context

1.1 HOUSING STOCK

This part is mainly based on the Dwelling Survey 2013, Flanders\(^1\) and statistics on national level\(^2\). The situation will be similar in South West Flanders.

1.1.1 Predominant ownership

Flanders has a high proportion of resident-owners (70,5%), boosted by many former and existing government incentives. The most important is the tax deduction for a home loan. The social rental market is very small (6,7%) and the private rental market (20,4%) is problematic in terms of quality and affordability.

![Figure 1: type of ownership, Flanders, 2013. Source: Groot Woononderzoek Vlaanderen 2013](image)

1.1.2 Predominant housing type

In Belgium, the single family houses In Flanders, cover 74% of the housing market. In Flanders, the private owner market consists mostly of single family homes (85%).

The housing market in Belgium is characterized by a fragmentation: many low-density allotments, the housing stock consists of nearly 47% detached and semi-detached homes. Especially the older homes in urban centers are terraced houses, often with a combination of housing and living quality problems.

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\(^1\) Winters et.al., 2015. This publication reports the dwelling Survey 2013 in Flanders ("Groot woningonderzoek 2013, Vlaanderen")

\(^2\) ADSEI, kadaster data
The private rental market mostly consist of collective housing (74%).

The social housing sector is equally divided (56% multi-family, 44% single family).

In Flanders, the average living space is 90m². In general, houses tend to be large in comparison to other EU-countries. The detached houses are the largest ones, the terraced houses the smaller ones (Figure 3).

Traditionally ( +/- pre-1980), many houses were built by an individual architect for each household, which results in a particular individually-focused housing market. Recently market developers entered the market to realise more uniform housing products. These developers tend to use more prefab solutions, diversifying the typical brick (cavity) wall typology.
1.1.3 Age of the housing stock

In Belgium, a large share of the building stock is old. 20% of the housing stock is pre-1945; only 36% post-1980.

Until 1945, the terraced houses were the dominant housing type. Afterwards, the detached house became dominant, especially after 1970.

![Figure 4: Belgium: building era of buildings. Source: Kadastrale statistiek van het bestand van de gebouwen, 2015, ADSEI](image)

1.1.4 Quality of the housing stock

Based on existing regulations for the assessment of the technical housing quality 37% of homes do not meet the minimum quality standard in Flanders. The biggest problems occur in the private rental market, with low income households, predominantly singles and single-parent families. The most common defects are electricity, moisture problems, steep stairs, poor ventilation and problems with the heating system.

Many homes already dispose of some form of insulation: insulating glass (77%), roof insulation (70%), wall insulation (45%) and floor insulation (31%). 82% of the houses have central heating, mainly through natural gas. In addition, electricity remains a major source of heating.

1.1.5 Existing energy performance

The annual energy performance of an NZEB renovated dwelling is estimated at 100-110kWh/m². (cfr. Flemish Renovation Pact). In the short term this will be the new standard for NZEb renovations.

Currently, the energy performance is performing poorly:

- Only 1.3% of the homes have an energy score below 100 kW/m².

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3 Based on the EPC certificates delivered by sale or rent of dwellings until 2012. Although these are not representative as they do not include dwellings which have not been let or sold since the introduction of the EPC regulation.
20% of the houses have an energy score below 200 kWh/m².
There are 11% homes with an energy score higher than 700 kWh/m².
Single family houses and detached houses have an average score of about 500 kWh/m².
For newly built houses, a maximum energy consumption of 180 kWh/m² is stipulated.

The three most important parameters to assess the energy performance of a home are:
- Property type (detached - semi-detached - terraced housing / apartment).
- Year of construction or deep renovation.
- Surface of the building envelope.

1.2 ENERGY PERFORMANCE

The Energy Performance Certificate (EPC) expresses how much energy a house annually consumes for each square meter, expressed in kWh/m²/year. The lower the EPC, the more energy efficient the home. The energy use mentioned in the EPC is a theoretically calculated use, so no user behaviour is taken into account. This makes it easier for potential buyers and tenants to compare the energy quality of different dwellings. However, the theoretical energy use can differ substantially from the actual energy consumption due to user behavior.

The seller or landlord who lets a dwelling has to apply for an EPC.

Only a recognized energy expert (“type A”) can issue it. The EPC states the energy rating of the dwelling and advises—very concisely—the buyer or tenant on how to save energy. The EPC does not impose any measures. It is used to inform potential buyers or tenants on the energy efficiency of the dwelling. The energy rating of a property is mandatorily included in advertisements for sale or rental. An EPC remains valid for 10 years.

The Flemish government does punctual inspections on the quality of these EPCs. There is no set price nor quality standard for an EPC, but the price is about €100-€250 per dwelling. The obligation exists since November 2008 for buildings that are for sale and January 2009 for dwellings on the rental market.

The EPC score appears to have only a limited impact on the pricing of a home.

Although the instrument has its merits, it is not flawless. The Flemish government is currently investigating a revision of this instrument in the context of the Flemish Renovation Pact.

The energy expert visits the house and inspects roof, walls, floor, windows, doors, ... No destructive testing is executed unless on the specific request of the owner. Afterwards the energy expert calculates the EPC through a software application.

In the long term, all homes will have an EPC after sale or a new renting contract. The EPC score of a home can not be consulted publicly.

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4 It needs to be mentioned that the EPC energy performances are based upon calculations. The older the house and the higher these calculations the more they differ from measured energy consumption.
5 Source: Analysis of the energy performance certificate database of Flanders (until 2012)
6 Essensia, 2013
Some weaknesses of the instrument:

- The calculated energy consumption is theoretical and does not correspond with the actual energy consumption.
- While in most EU Member States the EPC is qualified through the use of a label the Flemish EPC method results in a number along a continuous scale. It can be argued that the use of labels is communicatively preferable.
- The EPC is sometimes perceived a high administrative burden for people selling or letting a house.

Some positive aspects:

- The EPC makes it easy to compare the energy use of dwellings, independent of their size and their occupant
- The colour bar gives a clear indication on the energy quality of the dwelling
- A list of appropriate measures to increase the energy efficiency of the dwelling is included

1.3 REFURBISHMENT ACTIVITY

It is extremely difficult to have a correct view on the refurbishment activity: data exist on the amount of building permits and refurbishment grants:

- +/- 20,000 building permits each year for renovation (0.7% of the housing stock)
- +/- 18,000 Flemish renovation grants each year

A survey indicates that only 15% of all renovations is done with a building permit. That means that in an estimated 133,000 houses refurbishments (4.7% of housing stock) are executed without permit or grant, which are smaller than renovations with building permit. Most improvements in the house don’t require a permit.

There are a lot of grants available for renovation. This is proven to be a trigger for many people to renovate. But there is no coherent system of grants; the approach is a very dispersed and unstable one:

- Many authorities are involved: (national, regional, provincial and local) offer grants or tax deductions, either directly or for example through the grid distributor companies.
- Subsidies change every year. For many homeowners the system is perceived as (too) complex.

In 50% of the purchases, the house needs major interventions. In 92% of the cases this happens right after the purchase.

During the last 10 years 67% of resident-owners carried out some renovation works. The renovation rate in collective housing (apartment buildings) is very low, due to problems of co-ownership, and in the rental market (problems of split incentives, return on investment). Small aesthetical refurbishments are carried out first, after that energy reducing interventions and installation of bathroom, kitchen, toilet, electricity. About 30% of the homeowners have executed energy reduction measures during the last 10 years. For

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7 Source: Aggregated statistics from local authorities (www.lokalestatistieken.be)
8 Essencia, 2013

tenants the number is around 15%. Since 2005 a notable increase in the installation of insulation in roofs and walls has been recorded, probably because of specific tax incentives.

Overall, renovations are mainly performed through DIY of the resident-owner, depending on the type of renovation, 40 to 75% is executed by themselves or by family and/or friends. Resident-owners invest on average €36,000 in the renovation of their dwelling. The highest rate of renovation and the biggest renovation budget is situated with owners between 35 and 44 years: they invest on average €5,000. About half of the households that need a renovation permit apply for a renovation grant.

![Figure 5 Flanders: number of sales of houses (blue), number of building permits (red), number of deep renovations (green), and number of sales of building ground (purple). Source: Groot Woononderzoek Vlaanderen 2013](image)

Certain target groups are underrepresented in the data on renovation grants and perform most probably less renovation works: low-income households, low-skilled households, collective housing, seniors.

Flanders has no specific target for renovation rates. The region of South-West Flanders (Leiedal) aims at renovating thoroughly 100,000 dwellings before 2050, and set up a program ‘Warmer Wonen’. This aims at a little more than the European target of 2% renovations each year.
2 Housing market segmentation: dwelling typology

2.1.1 Tabula typology for Belgium

In the division of segments of Tabula\(^9\) the focus is on residential units, rather than on the building as a whole. This distinction is particularly important for apartments, in which the individual apartment unit is targeted and not on the entire apartment building.

A total of 30 housing types has been elaborated. There were first and foremost six defined building periods (before 1946; 1946-1970; 1971-1990; 1991-2005; 2006-2011; from 2012 onwards). Additionally five housing types were determined. Three types of single family dwellings (detached house, semi-detached and terraced house) and two types of apartments (enclosed apartment and exposed apartment).

A factor of great influence on the energy consumption of an apartment is the total area of the outer shell, where the flat is in contact with the outside environment. For that reason a distinction was made between two extreme situations, especially an apartment that is strongly embedded and an apartment which is heavily exposed. The energy consumption for apartments that fall between these two situations lies in between these two extremes.

Table 1: tabula typology for Belgium

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<tr>
<td>Enclosed apartment</td>
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<td>TYPE 9</td>
<td>TYPE 14</td>
<td>TYPE 19</td>
<td>TYPE 24</td>
<td>TYPE 29</td>
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<tr>
<td>Exposed apartment</td>
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<td>TYPE 10</td>
<td>TYPE 15</td>
<td>TYPE 20</td>
<td>TYPE 25</td>
<td>TYPE 30</td>
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</table>

For each of these 30 housing types two scenarios of improvement were developed, including a renovation to low energy (LE) and a renovation to a nearly zero energy house (NZEB)\(^10\). The LE and NZEB scenarios consist of a number of interventions in the building envelope and technical installations.

The calculation of cost for renovation does not take into account other interventions to improve the overall condition of the property (e.g. only the costs of additional roof insulation and demolition costs are counted, not the possible new roof finishing).

\(^9\) VITO, 2014

\(^10\) The calculations and standards that were posed in the NZEB - scenario are more severe than the current definitions, recently reformulated in the Flemish Renovation Pact (2015). That means that the results for the "low energy scenario" approaches the new Flemish NZEB-definition. The NZEB scenarios were developed at a time where the NZEb definition was not agreed upon yet.

E.g., roof insulation Umax = 0.24 W/m²K in the proposed Flemish NZEB standard for renovation versus NZEB scenario Tabula : Umax = 0.10; Low - energy scenario Tabula : Umax = 0.15.
For each building component specific interventions are proposed. The components are: roof, facade, floor, windows, doors, heating system, sanitary hot water, ventilation, photovoltaic panels.

2.1.2 Towards an aggregated tabula typology

The classification of 30 house types is highly relevant and also used in other projects\textsuperscript{11}. It combines two of the three most important parameters to assess the energy performance of houses: dwelling type and year of construction.

However, the amount of types (30) is very high and raises the question if it makes sense to stick to an individual selection of the whole range of types for the purpose of the REFURB project.

An aggregation to 9 types is possible using following parameters (Table 2; Table 3):

- Investment cost, as calculated in the Episcope project for the low energy scenario
- Return on investment, as calculated in the Tabula project for the low energy scenario
- Renovation needs or technical state of the building. Following criteria are considered to be important:
  - Dwellings that need a \textit{structural renovation} (roof, walls, windows, floors...). Most of these dwellings have a (very) bad energy performance.
  - Dwellings with \textit{no need for a structural renovation} of the building envelope (roof, walls, windows, floors...), but with an insufficient energy performance of the building envelope. It is not possible or likely to become an NZEB through implementation of the right technical installations (HVAC of heating, ventilation, air conditioning, cooling).
  - Dwellings with good to very good energy performance of the building envelope that can become NZEB through an \textit{upgrade of the technical installations} (HVAC of heating, ventilation, air conditioning, cooling).
  - Dwellings that need an \textit{architectural renovation}. These dwellings do not meet the contemporary architectural and comfort norms (e.g. the layout of the dwelling, insulation etc.).

\textbf{Table 2 aggregated Tabula typology for Belgium}

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<td>TYPE 10</td>
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</table>

\textsuperscript{11} E.g. Mlecník et al. 2010; One Stop Shop project 2015.
The aggregated segmentation contains interesting dimensions:

- The focus for older buildings (pre 1970) should be on deep renovations (possibly staged) in which the structure, the architecture, and the energy performance is upgraded to contemporary standards.
- Buildings of 1971-2005 face a lock in. They are structurally and architecturally too good to start a deep renovation to only bring the energy performance to an NZEB-level. This results in high costs and low return on investment.
- Recent buildings (after 2006) offer a set of new opportunities: their building envelope is well-insulated (but not good enough) which allows to turn them into NZEBs with an upgrade of the technical installations (HVAC of heating, ventilation, air conditioning, cooling). These installations have a shorter lifecycle than the building envelope, and need replacement after 10-20 years. So gradually this market will open the next 10 years.
- In semi-detached & terraced houses, the most cost-optimal NZEB-renovations can be realized. In detached houses this is more difficult.
- Apartments face particular problems in decision making (multi-ownership) and unfavourable return on investments.

It needs to be mentioned that this analysis is based upon buildings which are considered to be representative for their typology. Most older buildings might already have gone through some partial improvements in the building envelope or technical installations. Calculated payback times assume that the current situation of the dwelling are more or less ‘as built’ which is not the case in reality.
2.1.3 Spatial aggregation of the Tabula typology

From a spatial point of view, the segments of the Tabula typology are clustered spatially in different neighbourhoods:

- Post-war suburban neighbourhoods 1945-1970, mainly with detached houses.
- Post-war suburban neighbourhoods 1970-2006, mainly with detached houses.
- New neighbourhoods, from 2006 on, mixed typologies detached, semi-detached, terraced, apartments.
- City centers, town centers and paved roads: mainly terraced houses, also apartments
- Dispersed settlements: mainly detached, various building era
- Social housing neighbourhoods 1945-2006: identical buildings, mainly terraced or apartments
- Etc.

2.1.4 Variant: the typology of the LEHR-project.

For the Belgian LEHR-project\(^\text{12}\) (Low energy Housing Retrofit) a set of building segments with the highest potential for retrofit have been proposed as representative for the Belgian situation. They were defined for the Walloon and Brussels Region segments, and evaluated for the Flemish region. These segments match with the TABULA typology because it uses the same 2 main dimensions (building age and building type), but add a geographical dimension.

- The vernacular building: Built before the First World War (WWI) by the owner, usually in local material, detached, in rural areas or small city centers.
- Rural house: Built during the inter-bellum, in towns all over Belgium. These houses can be detached, semi-detached or terraced.
- Suburban villa: The houses form the bulk of the ever-growing suburbs around the cities, certainly since the seventies, and incorporate the dream of the villa.
- Working class house: Very small houses in former flourishing industrial zones and in the far west of Flanders, quickly built in series in the inter-bellum.
- The urban terraced house: Medium sized urban terraced house, built before WWI or during the inter-bellum, with architectural value, certainly on the level of the façade, often owned by the occupants.
- The large urban terraced building: Located in the older urban zones, originally designed as single family houses for the rich and upper middle class, and later converted into apartments, or directly designed as an apartment building; built before WWI; often rented and in bad state, but with good intrinsic qualities and architectural value.
- The suburban semi-detached house: Built after the Second World War, they are part of the suburbanization, mainly built along main roads, creating long ribbons of habitation between cities.
- Post-war low-rise apartment building: Built in large numbers after the Second World War in the emerging suburbs, often built with low construction and architectural quality, often rented. Their

\(^{12}\) Mlecnic et al., 2010
relative proximity to the city center makes them popular, so renovation can be an added value here.

- The high-rise apartment building: Usually built after 1960, concrete slab construction and often prefabricated façades; low building and material quality, and small and outdated apartment units.
- The social housing neighbourhood: Built mainly after the Second World War, as medium sized developments, mostly consisting of terraced houses or medium sized apartment buildings.
- The conversion of an industrial building: Renovation of old industrial buildings into lofts has become trendy.
3 Housing market segmentation: dweller typology

In Flanders, the focus on housing owner typology is emerging, but in a very early stage. No profound academic research has been carried out, except for a classic typology based on socio-economic characteristics (e.g. sex, age, owner / private tenant / social tenant; income class; level of education etc.) as used in the Great Housing Research Flanders 2013. This is useful, but did not comply with the requirements to assemble segments as a function of home renovation programs.

The topic of segmentation was touched upon in the discussion about the “Flemish Renovation Pact” (2015), an initiative of the Flemish Minister of Energy to create more renovation dynamics in the building sector, and in a recent survey on energy awareness in Flanders (2015). To better understand the possibilities of segmentation of the Flemish housing market, a number of foreign segmentations was reviewed.

3.1.1 Classic socio-economic characteristics

In the most recent main academic housing survey, “de grote woonsurvey 2013” these characteristics of homeowners are used to discuss the results:

- Sex (male / female)
- Owner status (owner / private renter / social renter / free living)
- Income
- Age
- Employment status (employed, unemployed, retired, student, disabled...)
- Country of birth
- Family type (single, family, one parent family...)
- Education level
- Urbanization level (rural, city, in-between,...)

3.1.2 Flemish Renovation Pact

In the process of the Flemish Renovation Pact it became clear that a segmentation into target groups should be done, according to the specific communication needed to target those target groups. The observation was made that lots of communication focuses on payback periods, energy savings, while for many people this is not the trigger/barrier to envisage refurbishments.

However, there is a growing need for comfort-related communication at key moments of the housing career of people (purchase of a home, remodeling, moving from place to place at some point of their life) and attention for unburdening through local renovation coaches.
In the discussions, a set of examples of segments was listed. This is not based on academic research, but on the input of stakeholders:\(^{13}\):

- Elderly people owning a house, but not feeling the need to renovate or to have a long term perspective for their house
- Young families with energy ambition, but lacking money to invest in their stage of life
- The D.I.Y. (do-it-yourself) who renovate step-by-step
- The landlord / investor who buys houses to rent
- Persons who do not have the technical knowledge of a renovation process and look for unburdening through construction professionals (architect, contractor ...)
- Private tenant who has no interest in investing in the rental house
- First-house buyers
- People in poverty / no budget
- People who want to invest their money in an interesting way (e.g. people who invested in photovoltaics)
- People who are sensitive to climate and energy issues, and who aspire to invest - regardless of return on investment effects
- Renovators that are not sensitive to climate / energy issues and consider energy standards as a burden.

### 3.1.3 The 7 E-model

In the discussions on the Renovation Pact, another potentially interesting typology of the dweller was presented, based on a theory on behaviour change: the 7E-model. This contains 7 levels of awareness in relation to behaviour changes. This can be very relevant for communication strategies for NZEB renovations.

1. Ignorance: people are ignorant, have no knowledge of your subject
2. Awareness: people know something about your subject, but they are not involved. They focus on their own situation and don’t worry about others.
3. Concern: people have experienced a situation as problematic, but do not know how to resolve, or experience conflicting values
4. Insight: people understand the situation and are willing to contribute, but do not have time, money, space etc.
5. Intention: People thinking to make a contribution, but need to change their habits and that’s hard
6. Scanning behavior: people perform the desired behavior, in occasions
7. Fixed behavior: people exhibit the desired behavior

---

\(^{13}\) The Belgian REFURB partners have been involved in the Renovation pact and are involved in local renovation projects from which these inputs have originated. The REFURB project thus also serves as a pioneer project feeding back into Renovation Pact on these themes.
3.1.4 Energy awareness and behaviour of Flemish households

In a biannual survey the energy awareness and behaviour of Flemish households is examined through a survey of 1,000 heads of family. In the 2015 survey, a segmentation of the households was developed, based on the results of the survey. 5 types were defined:

1. “passieven” (passives)
   - 20% of households
   - No interest in energy as a theme, not energy efficient in everyday life
   - Little intention to reduce energy consumption, no changes in behaviour last years
   - Are no early adopters of energy efficient products or installations

2. “fatalisten” (fatalists)
   - 16% of households
   - Consider energy efficiency to be very important, but have no intention to change their habits, because they have the impression they can’t make a difference
   - More interested in short-term gains than in long-term benefits

3. “relativisten” (relativists)
   - 23% of households
   - Consider energy efficiency to be very important, but think there are more important problems in society than the energy/climate issue. They believe that the government already imposes enough obligations.
   - Mainly interested in an increase of comfort and value of the house, energy saving is a nice gain.

4. “idealisten” (idealists)
   - 22% of households
   - They are very concerned about energy and climate issues. They consider the influence of their activities on energy consumption. They already are energy efficient but are convinced they can save more, and will try to achieve this.
   - Are prepared to change their lifestyle and habits, and convinced they can contribute significantly.

5. “Autonoom gemotiveerden” (the autonomously motivated)
   - 19% of households
   - Like the idealists, they are very conscious about energy and ready to change their lifestyle to reduce their energy use.
   - They do not expect support to undertake action. They do not need a loan or subsidies, or advice for preparation, implementation or supervision of the measurements.

These 5 types show similarities with the segmentation created for the study “environmentally responsible consumption”, in which 6 segments with a different attitude towards environment have been defined.\textsuperscript{14}

\textsuperscript{14} Ipsos marketing, 2012
3.1.5 **Inspiring foreign segmentations**

Due to a lack of tradition in segmentation of the demand side for energy efficiency (and renovation) in Flanders, a few inspiring foreign segmentations are discussed below.

- **Building Future (the Netherlands)**

  In this approach the user of the house is the central focus, and his or her behaviour in relation to energy related aspects, such as comfort, health, indoor air quality, integral energy performance of the dwelling, process of building, aesthetics, behaviour and costs.

  The dweller seems to vary highly in terms of energy consumption. Based on prosperity and luxury the research defines four variables (room temperature in presence, room temperature in absence, room ventilation and the use of a swing door in the hallway). The combinations of these variables lead to five clusters:

  1. Conservative (low ambient temperature + low ventilation)
  2. Luxury (high score on three of the four variables)
  3. Cooling (low ambient temperature, average to good ventilation)
  4. Warm (average to high ambient temperature and low ventilation)
  5. Average (average score on temperature and ventilation)

  The clusters are related to socio-economic parameters, but there is a psychosocial component too. The dwellers can be then be grouped according to their energy awareness. The degree to which people are inclined to accept energy saving measures depends highly on their energy awareness. Research shows that all households can be linked to one of the following drivers:

  - Convenience-people, looking for comfort, do not care about energy, financial certainties or the environment;
  - Environmentally conscious comfort-seekers, opt for comfort but are aware of their impact on the environment and the pattern of expenditure;
  - Cost-reducers, are aware that energy costs money and consume as little power and gas as possible;
  - Climate / Environment fanatics, strongly concerned about the fate of the climate and the environment, all the choices are dedicated to caring for the environment.

Clusters and energy profile converge in an (energy) profile. When applying these profiles to Dutch households the correlation between the profile and energy profile is clear:

- Convenience-people use twice as much energy as the average.
- Environmentally conscious comfort-seekers consume 15% less than the average energy consumer.
- Cost-reducers consume 35% less, and
- Climate / Environment fanatics consume in between the two former profiles or 26% of the average.
• **DEFRA:** Public understanding of sustainable energy consumption in the home (UK)

The segmentation model of 2007 divides the population into seven major groups according to their environmental values and pro-environmental behaviours, namely:

- Greens;
- Consumers with a Conscience;
- Wastage Focused;
- Currently Constrained;
- Basic Contributors;
- Long-Term Restricted; and
- Disinterested.

The research showed that, while participants were conscious of climate change issues, the well-known attitude-behaviour gap seemed particularly acute in the case of energy. The hypothesis is that this is related to the deeply embedded nature of energy within modern lifestyles, posing a particular challenge for policy.

In general, the research participants (in 2007) were:

- Confused and skeptical about environmental issues, in particular: 1) whether climate change is actually man-made or part of a naturally occurring cycle; 2) whether individuals can really have an impact on a global problem; and 3) whether the government is using the green debate as a ploy to raise taxes;
- Unwilling to ‘take on’ climate change, partly due to a perceived lack of effort by the government as well as others in the public eye, while there were signs of a public backlash against climate change.
- Highly cost-conscious (this is the strongest behavioural driver for most people – many do not consider energy or environmental issues);
- Distrustful towards government, local authorities and big business in general and in particular of their motives in helping the public to change their behaviour to ‘save the planet’;
- Unconvinced that ‘being green is normal’ (particularly if ‘being green’ is owning your own wind turbine and signing up to a green energy tariff) - this was still perceived as a niche activity; and
- Skeptical about the use of taxation to change behaviour, preferring incentives rather than taxes (although if green taxes are used the consensus was that they should be safeguarded solely for green issues) - grant schemes appear to be the most positive incentives for encouraging measures to reduce energy consumption (by all segments).

### 3.1.6 Conclusions

In Flanders there is too little research and in-the-field experience with segmenting the demand side for energy efficiency policies and renovation policies. As a result, it is not evident to propose a final segmentation of the demand side, based on dweller characteristics and in order to design a renovation program with NZEB-renovation, to create coherent groups of homeowners that can be approached in a similar way.
However, some interesting insights are available from different disciplines as behaviour studies, psychology, sociology, social geography etc. that can be used to design segments. A classic socio-economical taxation is restraining and is too general to describe the underlying decision making process, but has some assets. The 7E-model gives insight on the decision making process, but mainly to address behaviour change and means of communication. Most promising is the segmentation through identifiable examples, with the underlying motives of dwellers, but this is only emerging in Flanders and not yet tested. Additionally energy-related issues are particularly challenging for dweller segmentations due to their embeddedness with modern lifestyles.

A more detailed delineation of interesting groups for renovation packages is appropriate in order to reap more success.
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Deliverable D2.1
Annex 2 – National Housing Market - Denmark

GA N° 649865

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1 Description of country context

1.1 CHARACTERISTICS OF THE DANISH HOUSING STOCK

The Danish housing stock has improved considerably over the past fifty years or so and, on average, Danes have good dwellings with ample space. However, there are still hard-pressed groups in the Danish housing market, just as there are great differences between the impact of the various housing types on the welfare and financial situation of individual residents.

The Danish housing stock can be divided into categories in many different ways. The various organisational and financial conditions applying to the various ownership types have had a great impact on the social and demographic composition of residents. Previously, in major towns and cities, only the relatively affluent groups could afford to own their own homes, whilst people in low- and middle-income groups would typically be tenants. This picture has changed over the past 50-60 years, during which a large portion of the middle-income group have become homeowners. In rural areas, home ownership has always been predominant.

Denmark has a total housing stock of 2.5 million housing units. 51 per cent of the total Danish housing stock is owner-occupied, 45 per cent are rented dwellings and in 4 per cent of the stock there are no occupiers registered.

The following is a short review of the five predominant ownership and housing types:

- Owner-occupied, detached or semi-detached single-family houses (42 %)
- Social housing (21 %)
- Private rental flats (17 %)
- Cooperative flats (7 %)
- Freehold flats (8 %)

1.1.1 Single-family houses

Single-family houses are the most common type of housing. One-third of all single-family houses in Denmark were built before World War 2, whilst about 50% were built in the period from 1940 to 1980, and only 13% were built after 1980. The floor area of an average single-family house is 139 m², but size varies depending on the year of construction.

1.1.2 Social housing

The idea of providing good, healthy housing for the weak groups in society (servants, blue-collar workers and low-status white-collar workers) emerged in the mid-nineteenth century.

More than half of the houses were built after 1970. On average, social housing units are thus much newer than all other housing types in the Danish housing market. Only 2% of social housing units were built before World War 2.
1.1.3 Private rental flats

Rented private-sector housing as we know it today dates back to the second half of the nineteenth century when industrialisation led to rapid urbanisation.

Private rental flats represent 17% of the total housing stock. More than half of these units were built before 1940, whilst only 15% date from the time after 1980.

1.1.4 Cooperative flats

The concept of cooperative housing dates back to the late nineteenth century, when some of the social housing projects of the time were set up as cooperative housing schemes, usually based on membership and a continual build-up of savings in a housing association which would later arrange for the construction of the dwellings and subsequently transfer them to the members under a collective ownership scheme.

Cooperative housing units are older than units in the other categories: nearly 60% of these units were built before 1940 and about 30% after 1980.

1.1.5 Freehold flats

A ‘new’ type of housing that emerged after the 1966 housing agreement, which made it possible to sell flats in multi-storey buildings individually.

1.2 ENERGY PERFORMANCE

In Denmark, energy labeling is obligatory when selling and letting buildings and also every seven or ten years for large buildings.

Energy labeling of buildings serves two purposes:

- The energy label should make visualize the energy consumption of the building and thereby function as an informative labeling when the building is sold or let.
- The energy label should give an overview of which energy-related improvements will be cost-effective to implement: their objective, implementation costs, and the savings to be made on electricity and heating bills.

Labeling is carried out by an energy consultant, who measures the building and investigates the quality of insulation, windows and doors, heating installations etc. Based on this, the energy consumption of the building is calculated in accordance with standard conditions for weather, household size, operation hours, consumption habits etc.

The calculated consumption is an indicator for the energy-related quality of a building under preset conditions. This consumption does not represent the actual consumption, which is highly influenced by both the weather and the habits of the users of the building. Some people save on heating while others boost up the heating with the windows open. Some families have teenagers living at home who use large quantities of hot water.
So the label shows the quality of the building compared to other buildings, not how it is used or whether the winter was cold or mild. The scale of the label spans from A to G and corresponds to that known from a number of energy-using products, e.g. domestic appliances. The scale is shown in Figure 1.

Figure 1. Scale used for the Danish energy labeling. (Energistyrelsen n.d.)

Including in the calculation of the energy demand for Danish domestic buildings are the building's total demand for energy for heating, ventilation, cooling and domestic hot water per. m² heated floor area (gross area). The limit values for the energy label are shown in Table 1.

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<td>1650/A</td>
<td>2200/A</td>
<td>3200/A</td>
<td>4200/A</td>
<td>5200/A</td>
<td>6500/A</td>
<td>6500/A</td>
<td></td>
</tr>
</tbody>
</table>

Dwellings, public buildings and buildings for commerce and service are all covered by the regulations on energy labeling.

### 1.3 REFURBISHMENT ACTIVITY

A public database with info about refurbishment activity does not exist in Denmark. Therefore, it can be difficult to conclude on the number on actual renovations carried out. Various projects in the Danish regions may give a picture of the refurbishment activity. One of these projects is ProjectZero’s ZEROhome program.

The ZEROhome program focused on engaging homeowners in energy retrofitting the Sonderborg area of app. 16,800 privately owned single-family houses. The program served also as a role model for how energy retrofit of private homes can create new green jobs.

To help answering the homeowners question “what needs to be done?”, the ZEROhome program offered a free energy review/consultation carried out in their homes. During the consultation the energy consumption was reviewed, improvement opportunities and cost discussed and an action plan defined.

More than 1,300 families from the Sonderborg area participated in the program by having the energy consultant on a visit in their home. After the visit the family received a report with recommendations of different kinds of refurbishment. Next step was to connect the homeowners with qualified craftsmen to get the job done in a qualified way.
Ongoing monitoring and analysis shows, that more than 60 % of the families proceed with (one or more) renovation and invest an average of € 20,000. The monitoring is done two times a year and is based on an online questionnaire which is sent by email.

The top-5 renovations are:

1. New doors and windows
2. PV cells
3. Insulation in the attic
4. Cavity wall insulation
5. New roof

The analysis also shows that the families usually do one renovation at a time. But when they feel comfortable about their latest decision, they are ready to make a new renovation. The numbers show that more than 40 % are doing at least two renovation activities (over time).

In the Sonderborg area 24 % of the renovations is DIY, 55 % of the renovations is carried out by local energy educated craftsmen and 13 % of the renovations is carried out by craftsmen in general.
2 Housing market segmentation: dwelling typology

Danish building traditions and the change in requirements for energy performance of buildings in the building regulations have formed the development and performance of buildings in Denmark throughout the last century. Wittchen (2009) analyzed the energy saving potential for five different building categories in Denmark. These categories consisted of farm houses, detached houses, terraced houses, blocks of flats and office and trade. The categories and present standards of the buildings were picked out from the most dominant types of a range of different building types based on reported “buildings energy performance certifications” in the period between 2006 and 2008.

Wittchen divided the amount of houses (and the corresponding area) and their energy related performance into 6 different time periods. These time periods were defined based on both shifts in building practice and shifts in energy requirements in the Danish Building Regulations. The periods are (Wittchen, 2009):

- 1850-1930
- 1931-1950 (introduction of hollow core masonry walls)
- 1951-1960 (insulation of cavity in exterior walls)
- 1961-1972 (first nationwide energy requirements in BR61)
- 1972-1978 (tightening of energy requirements in BR72)
- 1979-1998 (tightening of energy requirements in BR78)

New energy requirements were applied again in BR95/BR-s98, BR08, BR10 and from autumn 2015 also BR15. Buildings built after 1998 are not part of the analysis since the energy saving potential becomes too small for these buildings compared to the costs. The represented building areas in the analysis are shown in Table 2.

Table 2 Area of the five building categories distributed on typical time periods for Danish Buildings. (Wittchen, 2009)

<table>
<thead>
<tr>
<th>Area (Mm²)</th>
<th>Farm houses</th>
<th>Detached houses</th>
<th>Terraced houses</th>
<th>Blocks of flats</th>
<th>Office and trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850-1930</td>
<td>18.74</td>
<td>27.72</td>
<td>4.27</td>
<td>24.84</td>
<td>11.09</td>
</tr>
<tr>
<td>1931-1950</td>
<td>2.45</td>
<td>13.72</td>
<td>2.16</td>
<td>14.92</td>
<td>3.35</td>
</tr>
<tr>
<td>1951-1960</td>
<td>0.84</td>
<td>12.98</td>
<td>2.50</td>
<td>8.02</td>
<td>2.79</td>
</tr>
<tr>
<td>1961-1972</td>
<td>0.91</td>
<td>58.24</td>
<td>5.30</td>
<td>14.35</td>
<td>11.41</td>
</tr>
<tr>
<td>1973-1978</td>
<td>0.72</td>
<td>24.66</td>
<td>4.35</td>
<td>4.57</td>
<td>6.67</td>
</tr>
<tr>
<td>1979-1998</td>
<td>1.08</td>
<td>19.95</td>
<td>15.06</td>
<td>8.08</td>
<td>16.88</td>
</tr>
<tr>
<td>Total</td>
<td>24.74</td>
<td>157.27</td>
<td>33.64</td>
<td>74.78</td>
<td>52.19</td>
</tr>
</tbody>
</table>
For each building category a heat balance was calculated based on the typical standard of each building type for each period. The typical standards of the buildings were deducted from the reported buildings energy performance certifications. The estimated U-values are shown in Table 3 to Table 6.

### Table 3 Estimated U-values for external walls the five building categories for different building periods. (Wittchen 2009; Loga et al. 2010)

<table>
<thead>
<tr>
<th>Ext. walls</th>
<th>Farm houses</th>
<th>Detached houses</th>
<th>Terraced houses</th>
<th>Blocks of flats</th>
<th>Office and trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W/m²K)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1850-1930</td>
<td>0.85</td>
<td>0.86</td>
<td>1.02</td>
<td>1.1</td>
<td>1.04</td>
</tr>
<tr>
<td>1931-1950</td>
<td>0.88</td>
<td>0.85</td>
<td>1</td>
<td>1.16</td>
<td>1.17</td>
</tr>
<tr>
<td>1951-1960</td>
<td>0.86</td>
<td>0.84</td>
<td>0.99</td>
<td>1</td>
<td>1.08</td>
</tr>
<tr>
<td>1961-1972</td>
<td>0.74</td>
<td>0.65</td>
<td>0.65</td>
<td>0.93</td>
<td>0.69</td>
</tr>
<tr>
<td>1973-1978</td>
<td>0.51</td>
<td>0.5</td>
<td>0.54</td>
<td>0.52</td>
<td>0.5</td>
</tr>
<tr>
<td>1979-1998</td>
<td>0.46</td>
<td>0.37</td>
<td>0.34</td>
<td>0.36</td>
<td>0.39</td>
</tr>
<tr>
<td>1999-2003</td>
<td>0.45</td>
<td>0.32</td>
<td>0.32</td>
<td>0.20</td>
<td>0.20</td>
</tr>
</tbody>
</table>

### Table 4 Estimated U-values for roofs the five building categories for different building periods. (Wittchen, 2009; Loga et al. 2010)

<table>
<thead>
<tr>
<th>Roofs</th>
<th>Farm houses</th>
<th>Detached houses</th>
<th>Terraced houses</th>
<th>Blocks of flats</th>
<th>Office and trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W/m²K)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1850-1930</td>
<td>0.34</td>
<td>0.39</td>
<td>0.42</td>
<td>0.45</td>
<td>0.4</td>
</tr>
<tr>
<td>1931-1950</td>
<td>0.42</td>
<td>0.39</td>
<td>0.57</td>
<td>0.54</td>
<td>0.29</td>
</tr>
<tr>
<td>1951-1960</td>
<td>0.32</td>
<td>0.32</td>
<td>0.25</td>
<td>0.37</td>
<td>0.33</td>
</tr>
<tr>
<td>1961-1972</td>
<td>0.36</td>
<td>0.26</td>
<td>0.31</td>
<td>0.44</td>
<td>0.37</td>
</tr>
<tr>
<td>1973-1978</td>
<td>0.26</td>
<td>0.26</td>
<td>0.3</td>
<td>0.3</td>
<td>0.29</td>
</tr>
<tr>
<td>1979-1998</td>
<td>0.26</td>
<td>0.2</td>
<td>0.2</td>
<td>0.18</td>
<td>0.25</td>
</tr>
<tr>
<td>1999-2003</td>
<td>0.18</td>
<td>0.16</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

### Table 5 Estimated U-values for floors the five building categories for different building periods. (Wittchen, 2009; Loga et al. 2010)

<table>
<thead>
<tr>
<th>Floors</th>
<th>Farm houses</th>
<th>Detached houses</th>
<th>Terraced houses</th>
<th>Blocks of flats</th>
<th>Office and trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W/m²K)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1850-1930</td>
<td>0.41</td>
<td>0.37</td>
<td>0.42</td>
<td>0.45</td>
<td>0.56</td>
</tr>
<tr>
<td>1931-1950</td>
<td>0.34</td>
<td>0.38</td>
<td>0.45</td>
<td>0.48</td>
<td>0.49</td>
</tr>
<tr>
<td>1951-1960</td>
<td>0.37</td>
<td>0.36</td>
<td>0.37</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>1961-1972</td>
<td>0.35</td>
<td>0.3</td>
<td>0.3</td>
<td>0.39</td>
<td>0.42</td>
</tr>
<tr>
<td>1973-1978</td>
<td>0.27</td>
<td>0.28</td>
<td>0.25</td>
<td>0.27</td>
<td>0.55</td>
</tr>
<tr>
<td>1979-1998</td>
<td>0.33</td>
<td>0.24</td>
<td>0.24</td>
<td>0.24</td>
<td>0.55</td>
</tr>
<tr>
<td>1999-2003</td>
<td>0.25</td>
<td>0.21</td>
<td>0.22</td>
<td>0.20</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Table 6 Estimated U-values for windows the five building categories for different building periods. (Wittchen, 2009; Loga et. al, 2010)

<table>
<thead>
<tr>
<th>Windows U-value (W/m²K)</th>
<th>Farm houses</th>
<th>Detached houses</th>
<th>Terraced houses</th>
<th>Blocks of flats</th>
<th>Office and trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850-1930</td>
<td>2.59</td>
<td>2.56</td>
<td>2.58</td>
<td>2.72</td>
<td>2.6</td>
</tr>
<tr>
<td>1931-1950</td>
<td>2.61</td>
<td>2.5</td>
<td>2.46</td>
<td>2.68</td>
<td>2.62</td>
</tr>
<tr>
<td>1951-1960</td>
<td>2.52</td>
<td>2.5</td>
<td>2.49</td>
<td>2.69</td>
<td>2.51</td>
</tr>
<tr>
<td>1961-1972</td>
<td>2.7</td>
<td>2.52</td>
<td>2.47</td>
<td>2.48</td>
<td>2.62</td>
</tr>
<tr>
<td>1973-1978</td>
<td>2.47</td>
<td>2.48</td>
<td>2.46</td>
<td>2.58</td>
<td>2.46</td>
</tr>
<tr>
<td>1979-1998</td>
<td>2.43</td>
<td>2.40</td>
<td>2.50</td>
<td>2.41</td>
<td>2.54</td>
</tr>
<tr>
<td>1999-2003</td>
<td>1.57</td>
<td>1.68</td>
<td>2.08</td>
<td>1.80</td>
<td>1.80</td>
</tr>
</tbody>
</table>

Based on the heat balances found from the built area of each building type for each building period the greatest total heat demand was found for detached houses built between 1961 and 1972. This group of buildings also has the highest amount of area and combined with the energy performance the energy demand for heating was approximately 22.5 TJ. The result for all building types is shown in Table 7.

Table 7 Largest energy demand found for heating for each building type. (Wittchen, 2009)

<table>
<thead>
<tr>
<th>Energy demand for heating (TJ)</th>
<th>Period with highest energy demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm houses 8.1</td>
<td>1850-1930</td>
</tr>
<tr>
<td>Detached houses 22.5</td>
<td>1961-1972</td>
</tr>
<tr>
<td>Terraced houses 2.1</td>
<td>1979-1998</td>
</tr>
<tr>
<td>Block of flats 8.4</td>
<td>1850-1930</td>
</tr>
<tr>
<td>Office and trade 4.2</td>
<td>1979-1998</td>
</tr>
</tbody>
</table>

Based on the results in Table 7 the detached houses are selected as a specific target group for the Danish work in REFURB. An analysis of the users of this building typology is made in the following section.
3 Housing market segmentation: dweller typology

The amount of energy renovations and the initiation of renovation projects are dependent upon both economic and technical barriers, but the everyday practice of the occupants living in the houses and their stage in life will also influence their willingness of carrying out energy renovations (Gram-Hanssen et al., 2015). This section will look at the Danish potentials for energy renovation based on both the energy saving potential and the socio-economic conditions. Besides this a description of dweller typologies are included.

3.1 ANALYSIS OF DANISH NATIONAL POTENTIALS FOR ENERGY RENOVATION BASED ON RENOVATION POTENTIALS AND SOCIO-ECONOMY

In order to find the greatest potential for energy renovation, Gram-Hanssen et al. (2015) combine the present age of the house, income of the residents, age and family type. Hereby the combined potential based on energy renovation potentials and socio-economy is revealed. All analyses are made based on Danish statistical data from Statistics Denmark and The Building and Housing register (BBR). The following sections are based on Gram-Hanssen et al., 2015.

3.1.1 Number of single-family houses in local Danish parishes

The first analysis is made in order to find the distribution of Danish single-family houses around Denmark and thereby potential areas for energy renovation. In order to keep the homeowners anonymous, all parishes with less than 100 single-family houses are left out of the analysis.

Figure 2 shows that the largest concentration of single-family homes are located partly in North Zealand and around Copenhagen, in North Jutland around Aalborg, in large parts of eastern Jutland and in large parts of southern Jutland. Especially large parts of North/Western Jutland and the southern islands have low concentration of single-family homes.
3.1.2 Renovation potential

To estimate the potential amount of energy renovations, the single-family houses are now divided into age categories. The time periods for this division are:

- Buildings built before 1962
- Buildings built between 1962-1979
- Buildings built between 1980-1999
- Buildings built after 1999

Unfortunately, it is not possible to find information on the current energy standard of the houses, since renovation initiatives are not registered. For this, the general analysis made in section 2 is used.
In Figure 3 it can be seen that the vast majority of parishes are dominated by single-family houses built before 1979. Also the single-family houses built before 1961 represent a large number. It was concluded in chapter 2, that the greatest energy renovation potential was found in detached houses built between 1961-1972 which corresponds very well to the large amount of these houses in Denmark. The next analyses will combine this knowledge with information regarding stage of life and economic possibilities in order to evaluate on the potential amount of energy renovations divided into the parishes.
### 3.1.3 Types of homeowners

Owners of single-family houses were divided by Gram-Hanssen et al. (2015) into four groups depending on where they are in the stage of their lives. The analyses are made based on age, household size/type and income. Other suggestions for dweller typologies are suggested in section 3.2.

Gram-Hanssen et al. suggest four different groups for the typology analysis regarding stage of life. The groups are:

- Older (households where the youngest person in the household is over 80 years)
- Younger (oldest person under 45 years) without children under 18
- Families (households with children at home)
- Empty nesters (households without children under 18 years, where the adult(s) is(are) aged 45-79 years)

The typical “first-time-buyers” are families with small children, and the typical time for larger renovations is when the house is bought. The other typical type of renovation is the step-by-step renovation which goes on during a longer period. It is only for the older group of people that the age is expected to minimize the initiation of renovation projects (Gram-Hanssen et al., 2015).

In Figure 4 it can be seen that the areas dominated by families with children living in single-family houses are concentrated mainly around the larger cities of Copenhagen and Aarhus. In the rest of the parishes, the empty nesters are dominating. The groups with older and younger are not dominating anywhere. When the distribution of older people in single-family houses is investigated, the results in Figure 5 are found.
Figure 4. Dominating family type in Danish parishes with more than 100 single-family houses. Gram-Hanssen et al., 2015.

Figure 5 shows that the vast majority of areas with single-family houses only have 1-5% of people above 80 years old. Some have between 5-10% but only a very few areas have more than 10%. The tendency is almost evenly distributed across the country but with a small overrepresentation of the 5-10%-group in the Western part of Jutland.
Another important parameter regarding willingness and ability to renovate for energy reasons is the number of adults in the home (singles or couples). Here the couples show the largest surplus and motivation for energy renovation. This analysis is made in Figure 6.

Figure 6 shows that single people represent a significant proportion of all homeowners, and the smallest amount is found to be 10% per cent. In almost half of all parishes, the singles are represented with 30% to 50%. The geographical distribution is here quite evident as it specifically in residential areas outside Copenhagen, Aalborg and the Mid/Eastern part of Jutland including Aarhus that the singles are dominating.
Figure 6. Percentage of single-family homeowners, who are singles (for all ages and with/without children at home) in Danish parishes with more than 100 single-family houses. Gram-Hanssen et al., 2015.

The last analysis made by Gram-Hanssen et al. is the dominating income level in the Danish parishes. This analysis is seen in Figure 7.
The income level is expected to reflect the ability and interest to renovate in the families. The income level is calculated as the total income with subtraction of tax and interest expenses. Figure 7 shows a very clear geographical distribution, where especially the areas around Aarhus and Copenhagen have significantly higher available income on average compared to the rest of the country.
3.1.4 Finding the potential dwellers for deep renovation projects

The analysis made by Gram-Hanssen et al. 2015 reveals the first and easiest steps towards deep renovations by pointing out geographical areas with houses with a certain age and thereby an energy-saving potential, high concentration of families with children which are typical first-time buyers (that most often carry out the deep renovations), and finally the analysis also shows where the income can promote the choice.

By combining the analyses it is found that the socio-economic values are pointing towards the greatest possibilities to renovate in the urban areas around the larger Danish cities. The rural areas also have the energy saving potential but the other parameters do not indicate potential for energy renovation. The analysis also shows that other strategies in rural areas might be necessary to promote energy efficiency and renovation of the Danish single-family houses.

A geographical mapping of energy consumption could help to determine whether the renovation needs are evenly distributed geographically, but unfortunately data for this mapping is not currently valid enough to be involved in this kind of analysis.

3.2 Dweller Typologies

The analysis in section 3.1 reveals the Danish areas with great potential for a high rate of deep energy renovations. However, the approach for convincing the dwellers to start a project will be different depending on the dweller typology. This section will look at different ways to define dweller typologies found from both national and international projects.

A Danish national study based on 4,000 questionnaires sent out to four urban areas in four different Danish regions concludes that the deep energy renovations are most likely to happen (Mortensen et al., 2015):

- Before the homeowners have lived for one year in their house, since the investment limit is lowered as time goes on, and these homeowners were proven to be willing to pay more than average for the same benefits and savings.
- As long as children under the age of 18 years are living in the house, because the homeowners have a higher-than-average interest in conducting similar projects, hence a higher investment limit.
- When the homeowners are young as this is where the interesting investment is largest.
- In households with a high yearly income. Both the interest in similar projects and the acceptance of the prices thereof show that these homeowners will invest in extensive projects.

The same study also concludes that the age of the homeowners is an important parameter for the decisions of energy renovation. The older the homeowner gets, the lower his or her interest in renovation. This fact is illustrated in Figure 8.
Another important finding from the work of Mortensen (2015), is the fact that the majority (87%) of the homeowners is willing to pay extra per month for improvements in comfort and indoor environment whereas 78% is willing to pay extra for improved architectural appearance. These results are shown in Figure 9.
3.2.1 Generic dweller typologies

In order to target the information and thereby increase the level of new deep renovation projects, it is necessary to consider the different dweller typologies. The following section will describe some of the results found in recent European research projects.

One approach is to divide the homeowners into three segments/typologies as suggested by Aune (2007). She describes the three typologies as “Home as haven”, “home as project” and “home as arena for activities” and also suggests how the approach for energy savings in the three groups should be handled. As seen in Table 8 the communication will highly depend on the typologies.

Table 8. Description of the three dweller typologies as suggested by Aune (2007).

<table>
<thead>
<tr>
<th>Typology</th>
<th>Description of the typology</th>
<th>Communication regarding energy savings for this typology</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Home as haven”</td>
<td>Prefers the home as a cosy and comfortable home. Examples are the right lightning, a comfortable indoor temperature or an open fireplace. The use of hot water are also mentioned but not seen as an energy consumption or possibility for saving but instead seen as rest and meditation. This typology prefers a personal and private home.</td>
<td>The important parameters for this typology are privacy, cosiness and stability. The communication need to take this into consideration in order to change their energy consumption. Aune suggests: “High energy costs, new energy-efficient technologies, information champagnes and other instruments implemented to reduce private energy consumption should probably not challenge “the home as haven” mentality, but rather try to address it.” (Aune 2007)</td>
</tr>
<tr>
<td>“Home as project”</td>
<td>“The home as project” is a typology where the dwellers like retrofitting and designing the home, which they see as a material and symbolic expression of themselves. They are motivated by improved comfort rather than energy saving, but still, aiming for improved energy-saving measures in this type of home can be the highly effective because the house constantly is being rebuilt.</td>
<td>For this group the design, functionality, availability and usability are important factors for energy saving products and this is the parameters that should be enhanced in the communication for this group. They value products in the market that fulfil both the demand for low energy and high aesthetic value and Aune suggests that “It is possible to influence the domestication of this home in a more sustainable direction by specifically developing and marketing energy-saving technologies towards this group.” (Aune 2007)</td>
</tr>
<tr>
<td>“Home as arena for activities”</td>
<td>This typology finds the feeling of home from the unity of people and activities going on in the home. They do not see style or materials as important in order to create a home.</td>
<td>As the span in this group is large, the communication also needs to be varied. A “green message” will interest some. A message of responsibility and common interest will catch the interest of others. For this typology economy is a very important parameter, and besides the economic savings caused by energy savings they will also feel a moral obligation for saving energy. When promoting new technology to this group, it is important to point out both the practical and the financial factors.</td>
</tr>
</tbody>
</table>
As Aune writes: “No big rebuilding activities are performed unless they are necessary. The artefacts in these homes, whether it is a couch, a television or a refrigerator, are worn out before they are replaced.” (Aune 2007)

The dilemma for this typology is the fact that even though they seem to live at simple life, old technologies are more energy demanding and old houses often requires more energy for heating. They thereby can end up with a large consumption.

The importance of targeting the information at specific dweller typologies is also stressed by Haines & Mitchell (2014), who have developed personas for this specific aim. The personas are developed based on a qualitative study with interviews of 33 owner-occupier households in the East Midlands region of the UK. All households are living in solid-wall-houses, which hold a great potential for energy renovation.

The overall difference between segments and personas is the amount of data behind the development where segments are derived based on large data samples which result in a general description of each segment (as done in section 3.1) and personas are based on small and very target-specific data samples. The advantage of the personas is the more personal description which makes it easier for the designer or developer to target a specific design or offer towards the persona.

The personas developed by Haines and Mitchell are described in Table 9 together with the opportunities to get them to renovate their building.

Table 9. Description of the personas developed by Haines and Mitchell for building renovations in solid-wall-houses. Table is cited from (Haines & Mitchell 2014).

<table>
<thead>
<tr>
<th>Persona (including subtype)</th>
<th>Key features</th>
<th>Opportunities for retrofit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Idealist Restorer: The property is a project</strong></td>
<td>Motivated to live in an older property because of the character and the opportunity it provides for restoration and improvement. Values the aesthetic period features and space afforded by older homes. Wants to restore as many original features within the home as possible but not at the expense of aesthetics, comfort and convenience. Although they wish to keep the sash windows, they have replaced the quarry tile floor in the hallway with laminate flooring</td>
<td>Very open to retrofitting energy efficiency measures and in an optimal order if the aesthetics of the home are respected. Interested in “clever” energy saving technologies but only if the character of the home can be maintained.</td>
</tr>
<tr>
<td><strong>The Affluent Service Seeker: The property is a pleasure</strong></td>
<td>Motivated to live in an older property because of the character, idyllic rural location large garden and useful outbuildings. Accepts that older properties are expensive to maintain and views spending on the property as a way to preserve and add value to the investment in the property.</td>
<td>Open to incentive schemes and polices that generate income for the homeowner or add value to the property.</td>
</tr>
<tr>
<td><strong>The Property Ladder</strong></td>
<td><strong>Climber: The property is a step up</strong></td>
<td><strong>The Pragmatist:</strong></td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Seeks luxury and quality but also value for money. Known to be financially savvy. Values comfort over financial saving.</td>
<td>Motivated to live in an older property by the potential it offers to add value to its resale value through renovation.</td>
<td>Motivated to live in an older property because of the layout and room size that accommodates a full and active family life.</td>
</tr>
<tr>
<td>Carries out very little DIY through choice but likely to be less physically able than when they were younger.</td>
<td>Happy to borrow money in the short-term to finance home improvements, paying these back when the property is sold.</td>
<td>Home improvements are seen as a hassle rather than a hobby; they take time away from more important things - hobbies and family time.</td>
</tr>
<tr>
<td>Energy efficiency is perceived as difficult to achieve in a large old property but this persona is keen to take advantage of any grants or incentive schemes available.</td>
<td>Enjoys developing their DIY skills as the projects get bigger with each property they buy.</td>
<td>Not particularly interested in keeping older features of the property, but places greater value on convenience.</td>
</tr>
<tr>
<td>Will choose to use specialist professionals to ensure a quality job</td>
<td>Open to consequential improvements as they are thinking at a whole-house level but these improvements must lead to financial gain at the point of resale.</td>
<td>Concerned about the environment and climate change, as a result of their family values.</td>
</tr>
<tr>
<td></td>
<td>Energy saving beyond current building regulations is not a priority.</td>
<td>Motivated to live in an older property because of the character and space it offers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enjoy having a project on the go but improving or updating the decor, furniture and appliances within the home will be of higher priority than repurposing of space or non-essential maintenance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Likely to cover up some issues like damp through frequent redecoration rather than fix the underlying cause.</td>
</tr>
</tbody>
</table>
| **The Stalled: Subtype**  
| **- Lack of Finance,**  
| **The property is a shelter** | Values ‘on the shelf’ solutions, preferring to finance these from savings or windfalls rather than loans. Want a neat and tidy job to be done, with a good-quality finish. |
| Wants a warm, comfortable home, but is not extravagant in their requirements. | Wants to feel safe and secure in their home and be assured that any work undertaken by tradespeople is not exploiting them financially or putting them in danger. |
| Frugal and interested in saving energy primarily to save money. They are positive towards opportunities to improve the warmth and security of their home. | Limited to when grants are available. |
| Leaves parts of the property unheated through the winter, but uses draught proofing to increase comfort. | Will undertake consequential improvements if dictated by grant scheme. |

| **The Stalled: Subtype**  
| **- Pressures of Life,**  
| **The property is a necessity** | Does not have the time, emotional energy or financial resource to undertake home improvements at present. |
| Will use a trusted, known professional to help with any essential jobs around the property but won’t undertake any major projects. | Almost none at present |
| May consider taking a loan to fund essential maintenance but they prefer to wait and use savings when they can afford. |
4 References


Gram-Hanssen, K. et al., 2015. Renovering af danske parcelhuse – eksisterende viden og nye erfaringer,


04.08.2015 - http://boligforskning.dk/sites/default/files/Housing_130907.pdf
04.08.2015 - http://www.ens.dk/node/2040
### Annex 1

<table>
<thead>
<tr>
<th>Name of the project</th>
<th>Advice and coaching at home (ZEROhome)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale/Societal or territorial scope</td>
<td>City/region</td>
</tr>
</tbody>
</table>
| References | ProjectZero  
| Description of the project | From 2010 – 2013 ProjectZero was leading the ZEROhome project. ZEROhome was a unique programme that differs from other offers for energy renovation in Denmark by taking the citizens by the hand the whole way thus eliminating possible barriers. The experiences and measurements show that it has a great effect and contributes to positive initiation of energy renovations at the home owners. Half of the visited home owners initiate energy renovations after a visit by a ZEROhome energy consultant. The energy consultant gave the house owners security, and they felt save when taking the decision to invest in energy renovation. |
| Target group | Housing type: Single-family houses  
Age of the households: Houses from 1952-1997  
Sex  
Household type: Private owned houses (primarily families and older couples)  
Income class  
Other characteristics of target group  
Potential members of target groups  
Reached number of households: 1,300  
Drop-outs: quantity + reasons |
| Stakeholders | Name responsible  
Type of the responsible stakeholder: Public private partnership (ProjectZero)  
Partners and their role |
| Data | Mapping of the initial situation: How was it done? Which data has been collected?  
Data has been collected through the “Building stock register” (BBR)  
Mapping the end situation: How was it done? Which data has been collected?  
Regularly evaluation and follow-up was made based on a questionnaire.  
Evaluation based on the collected data |
| Budget | Cost on investment in total / average for case-by-case: With financial support from the project partners totaling kr. 7.2 million (960.000 EUR)  
Investment of household (average): 150.000 danish kr. (20.000 EUR)  
Investment of the public sector (in total/case-by-case)  
Repayment period for household: 1-15 years  
Time spent per actor for an average case |
<p>| Evaluation | Key success factors |</p>
<table>
<thead>
<tr>
<th>Points for improvement</th>
<th>Opportunities for rolling out on a bigger scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open questions</td>
<td></td>
</tr>
<tr>
<td>Roadmap</td>
<td>Give an insight of the different steps of an example case</td>
</tr>
<tr>
<td></td>
<td>- Homeowner hear about the opportunity</td>
</tr>
<tr>
<td></td>
<td>- Homeowner fills out formula and sends it to ProjectZero</td>
</tr>
<tr>
<td></td>
<td>- ProjectZero records the data in a database and find a date for the visit</td>
</tr>
<tr>
<td></td>
<td>- The energy consultant visits the homeowner in the house</td>
</tr>
<tr>
<td></td>
<td>- The energy consultant goes through the house and write notes</td>
</tr>
<tr>
<td></td>
<td>- Shortly after, the homeowner receives a report with recommendations from the energy consultant</td>
</tr>
<tr>
<td></td>
<td>- Now the homeowner just have to decide to renovate or not to renovate</td>
</tr>
<tr>
<td></td>
<td>- Follow-up is done by ProjectZero</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process time of an example case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottlenecks in the process or timing</td>
</tr>
<tr>
<td>Time spent per actor for each step</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Homepage, PR, ads in local newspapers, facebook, spread the words – friends to friends or neighbours to neighbour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
<th>Cost for each communication tool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range, effect and efficiency of each tool</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
<th>Use of data in communications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Types of arguments used in the communication for each target group/segment</td>
</tr>
<tr>
<td></td>
<td>- Save money</td>
</tr>
<tr>
<td></td>
<td>- Have better comfort</td>
</tr>
<tr>
<td></td>
<td>- Have a better home</td>
</tr>
<tr>
<td></td>
<td>- Be ZERO-friendly</td>
</tr>
<tr>
<td></td>
<td>- Show your neighbours you care</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of the project</th>
<th>EnergiParcel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale/Societal or territorial scope</td>
<td>National – concepts for renovation of single family homes</td>
</tr>
<tr>
<td>References</td>
<td><a href="http://www.energiparcel.dk">www.energiparcel.dk</a></td>
</tr>
<tr>
<td>Description of the project</td>
<td>Package solutions for renovation of single-family homes was the idea behind the Energy Parcel project, which Realdania Byg launched in 2007. The goal was to achieve lower energy costs, better health through improved indoor climate and higher quality of life. The project included four single-family homes, all of which were renovated in different levels ranging from 200,000 to 2,000,000 DKK (app. 26,700 euro to 267,000 euro). The most extensive renovation achieved a measured energy saving of 68% and a significantly improved indoor climate. At the same time, the general perception of the architecture also significantly improved. Aalborg University</td>
</tr>
</tbody>
</table>
was responsible for the documentation of indoor climate and energy use in the project both before and after the renovation of the houses.

<table>
<thead>
<tr>
<th>Target group</th>
<th>Housing type</th>
<th>Single family homes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of the households</td>
<td>Built between 1973 and 1975</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male, female</td>
<td></td>
</tr>
<tr>
<td>Household type</td>
<td>Family</td>
<td></td>
</tr>
<tr>
<td>Income class</td>
<td>Middle to top</td>
<td></td>
</tr>
<tr>
<td>Other characteristics of target group</td>
<td>Senior house, family house</td>
<td></td>
</tr>
<tr>
<td>Potential members of target groups</td>
<td>Senior couple and families with children</td>
<td></td>
</tr>
</tbody>
</table>

Realdania Byg estimates that more than 500.000 know about the project from showings in the houses, at lectures or teaching, through articles and the films on the Realdania Byg website.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Name responsible</th>
<th>Realdania Byg was the main investor in the project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of the responsible stakeholder</td>
<td>Investor</td>
<td></td>
</tr>
<tr>
<td>Partners and their role</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data

<table>
<thead>
<tr>
<th>Mapping of the initial situation: How was it done? Which data has been collected?</th>
<th>Collection of indoor environment (temperature, RF, CO₂, sound), energy consumption (electricity, heat, hot water) and air tightness (blowerdoor) and thermography was made prior to the renovation by Aalborg University. Data was sampled every 5 minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapping the end situation: How was it done? Which data has been collected?</td>
<td>Same as before. Beside this energy consumption and airflow in the new mechanical ventilation system was registered.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaluation based on the collected data</th>
<th>THE PROTOTYPE HOUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget: DKK 2,000,000 incl. VAT</td>
<td></td>
</tr>
<tr>
<td>Floor area: 176 square metres</td>
<td></td>
</tr>
<tr>
<td>Calculated energy requirement BEFORE: 197.2 kWh/square metre per year</td>
<td></td>
</tr>
<tr>
<td>Calculated energy requirement AFTER: 40.9 kWh/square metre per year</td>
<td></td>
</tr>
<tr>
<td>Measured savings in the family's consumption: 78 per cent</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAMILY HOUSE - ACTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget: DKK 400,000 incl. VAT</td>
</tr>
<tr>
<td>Floor area: 138 square metres</td>
</tr>
<tr>
<td>Calculated energy requirement BEFORE: 222.9 kWh/square metre per year</td>
</tr>
<tr>
<td>Calculated energy requirement AFTER: 105.8 kWh/square metre per year</td>
</tr>
<tr>
<td>Measured savings in the family's consumption: 52 per cent</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td><strong>Budget</strong></td>
</tr>
<tr>
<td><strong>Floor area</strong></td>
</tr>
<tr>
<td><strong>Calculated energy requirement BEFORE</strong></td>
</tr>
<tr>
<td><strong>Calculated energy requirement AFTER</strong></td>
</tr>
<tr>
<td><strong>Measured savings in the family’s consumption:</strong></td>
</tr>
</tbody>
</table>

| **Budget Cost on investment**  | See above                                                                               | See above                                                                     |
| **Investment of household (average)** | See above                                                                               | None                                                                           |
| **Investment of the public sector (in total/case-by-case)** | None                                                                                   | None                                                                           |
| **Repayment period for household** |                                                                                      | None                                                                           |
| **Time spent per actor for an average case** |                                                                                      |                                                                                |

<table>
<thead>
<tr>
<th><strong>Evaluation</strong></th>
<th><strong>Key success factors</strong></th>
<th><strong>Opportunities for rolling out on a bigger scale</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obtaining the target for energy savings</td>
<td>Realdania Byg know for certain that there are people who - with reference to the Energy Parcel - have established groups approaching the idea of ‘one-stop shop’ so that one company takes responsibility for the entire case, instead of the private homeowner</td>
</tr>
<tr>
<td></td>
<td>Improving the indoor environment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Providing a convincing and well-documented case that will stop speculating and start demonstrating.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Work with test families in order to ensure identification in the target group – this worked; Realdania Byg had four very well-communicating and likeable families that helped spread the results in a familiar and comprehensible way to the target group.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Points for improvement</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Open questions</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opportunities for rolling out on a bigger scale</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Realdania Byg know for certain that there are people who - with reference to the Energy Parcel - have established groups approaching the idea of ‘one-stop shop’ so that one company takes responsibility for the entire case, instead of the private homeowner</td>
<td></td>
</tr>
</tbody>
</table>
being the project leader. It is possible to roll out on a larger scale - found in Denmark almost 500,000 houses by a narrow 20-year period, which is very similar and that everyone can use the ideas and examples presented in the Energy Parcel.

<table>
<thead>
<tr>
<th>Roadmap</th>
<th>Give an insight of the different steps of an example case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Measurements before renovation (optimum is one year to have all seasons – less optimum spring or autumn can be left out)</td>
</tr>
<tr>
<td></td>
<td>- Renovation period</td>
</tr>
<tr>
<td></td>
<td>- Measurements after renovation (optimum is one year to have all seasons – less optimum spring or autumn can be left out)</td>
</tr>
<tr>
<td></td>
<td>- Dissemination of results</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process time of an example case</th>
<th>App. 3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottlenecks in the process or timing</td>
<td>Measurements before renovation</td>
</tr>
<tr>
<td>Time spent per actor for each step</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>www, public access to the houses during the renovation process. Publishing of books. Lectures and teaching at academies with building technician programs, Engineering Colleges / Universities (engineering), numerous courses for contractors / builders / executing, public lectures, articles in newspapers and journals etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost for each communication tool</th>
<th>Publishing / layout / printing of books: DKK 25,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Establishing online articles / books on Realdania Byg: Investing in terms of layout of books; DKK 5,000</td>
</tr>
<tr>
<td></td>
<td>Hours incurred by Realdania Byg for communication activities (production of books, network activities, contact with journalists, lectures / teaching, and more, is an integrated part of Realdania Byg’s activities and are not priced.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range, effect and efficiency of each tool</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of data in communications</td>
<td>It was important to validate the project through measurements. These results were used in communication regarding the project.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of arguments used in the communication for each target group/segment</th>
<th>- Homeowners: Economic savings, green conscience (community) and non-energy benefits, such as greater comfort, more usable space even in winter, better possibilities of furnishing etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Craftsmen: As above, suitable to pass on to the above target - the possibility of additional sales and better relationship with the customer (to help them get a better house)</td>
</tr>
</tbody>
</table>
| | - Researchers / teachers: Measurement data show that the thermal upgrading pays off - up to a certain point. Casestory to use for teaching.
- Politicians: Energy renovation pay off - up to a certain point. Further renovation requires incentives from the government. |
Deliverable D2.1
Annex 3 Regional Housing Market
Estonia – Region Tartu

GA N° 649865

Project acronym: REFURB
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E-mail: dieter.cuypers@vito.be
Country lead: Kalle Virkus
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Contributors: Kalle Virkus (TREA)

October 2015
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  1.3 REFURBISHMENT ACTIVITY ............................................................................................... 4

2 HOUSING MARKET SEGMENTATION: DWELLING TYPOLOGY ........................................... 6

3 HOUSING MARKET SEGMENTATION: DWELLER TYPOLOGY ............................................ 7

4 REFERENCES ............................................................................................................................ 8

Version Date Author Description
1.0 30-10-2015 Kalle Virkus First draft
1.1 4-11-2015 Kalle Virkus Comments by Dominiek Vandewiele
2.0 30-11-2015 Kalle Virkus Edits by Dieter Cuypers, Final version
1 Description of country context

1.1 ESTONIAN HOUSING STOCK

As a result of the Ownership Reform Act of 1991 of which the aim was to induce overall turnover most of the housing stock was privatized. Formerly state-owned apartments were privatized to the tenants. Since then neither central nor local government bodies have built any residential housing which leaves over 90% of the housing stock privately owned. Every former tenant now owns his or her own apartment but in order to manage a multi-apartment building an association of homeowners as a legal person is formed.

The Estonian housing stock is relatively old as compared to the rest of the EU. Most of the buildings were built between 1960 and 1990. After 1990 the annual replacement rate of residential buildings has been below 1% which means that the housing stock is ageing rather rapidly and will be in need of deep renovation in coming decades.

The predominant housing type is an apartment block built of reinforced concrete elements. The technology was imported to the Soviet Union from France in the beginning of the 1960’s and remained virtually unchanged up to 1991 until the demise of the Soviet Union. Differently from Western European countries where first and second oil crises induced significant changes in building standards especially concerning thermal properties of the building envelope, the methods and standards in Estonia and a large part of the rest of Eastern Europe remained unchanged. Most of these buildings were produced by a couple of large house manufacturing contractors which seized to exist shortly after 1991.

These concrete block houses were predominantly erected in bigger cities in neighbourhoods of tens of thousands of inhabitants. All the cities and rural areas were rather strictly planned. From mid 90’s onward with perceived unlimited freedom urban sprawl really picked up momentum and as spatial planning was neglected the results were severe and in some places acquired even comical conflicts.

As private home ownership was mildly discouraged for a long time up to 1990’s the majority of private houses were built DIY with varying quality. As a result the single house stock in Estonia is dispersed in time, size, quality and technical equipment.

As most of the housing stock was built in the second half of last century and consist largely of the same type of buildings the quality of these homes tends to be rather homogenous. The structural components of the homes can be considered good quality but other components are quality wise rather poor.

The energy performance of concrete block buildings remained stable all through the years being around 230 to 280 kWh/m²/year.

Active incentives for renovation appeared in 2010. Since then annual the renovation rate has been around 1,5%. The rate is likely to decline as conditions to qualify for subsidies have become stricter involving rigorous requirements for indoor climate.
1.2 ENERGY PERFORMANCE

Energy labels for dwellings have been in use in Estonia since 2009. The labels are divided by functionality and level of refurbishment of houses. Residential buildings have two subdivisions: single family houses, multi-apartment buildings.

The labels run from A to F and correlate with minimum levels of refurbishment. Level “A” corresponds with NZEB, level “B” – low energy buildings, level “C” – new buildings, level “D” deep renovated buildings.

Relevant for the current project are labels for single family homes and apartment buildings (Table 1).

<table>
<thead>
<tr>
<th>kWh/m²a</th>
<th>A (NZEB)</th>
<th>B (low energy)</th>
<th>C (new build)</th>
<th>D (renovated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single family</td>
<td>50</td>
<td>120</td>
<td>160</td>
<td>210</td>
</tr>
<tr>
<td>Multi-apartment</td>
<td>100</td>
<td>120</td>
<td>150</td>
<td>180</td>
</tr>
</tbody>
</table>

Energy labelling is compulsory for new and renovated buildings. These labels are calculated by the designers and the calculation is required in order to be able to apply for a building permit. All buildings sold or let must require an energy label.

The issuers are responsible for correctness of the energy labels awarded. In the case of new and renovated buildings the label is issued by the designer (civil engineer or HVAC engineer). In case of existing buildings the label is issued by an energy auditor who is a certified professional.

Up to now there is no legal option to hold anyone responsible for incorrect labelling. This is considered one of the shortcomings of the Estonian energy labelling of buildings scheme. The other major flaw is considered a period of validity of labels especially those for new and renovated buildings. The period of validity is 10 years for all types of labels. While it is acceptable for existing buildings it is too long for new buildings as the actual energy performance of a building can only be really assessed from the second and third year of use. Ideally the label would then be revised.

1.3 REFURBISHMENT ACTIVITY

The actual need for energy refurbishment has been acknowledged after Estonia joined the EU in 2005 and EPBD directive and other directives started being applied. Energy labelling was introduced in 2009 and first pilot renovation projects of multi-apartment buildings started in 2008.

First subsidies and soft loans for renovation and refurbishment of multi-apartment buildings became available in 2009. During the three years of this first program period about 500 buildings (on average 60 dwellings) were renovated. This translates into a renovation rate of about 1% a year. Only buildings applying for deep renovations were eligible for subsidies.

Applications for subsidies and soft loans are presented to authorized banks. The technical documentation has to be verified in advance by the KredEx Fund which is responsible for adequacy of renovation activities. Usually all the technical documentation is inspected by authorized professionals who are co-opted by KredEx.
Renovation in Estonia is targeted mainly and almost only at multi-apartment buildings. The main reason for this is the structure of the housing stock (Table 2).

Table 2 Structure of the Estonian housing stock (amount of buildings per type and building period)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin &amp; Terrace</td>
<td>1.547</td>
<td>3.493</td>
<td>2.439</td>
<td>6.260</td>
<td>1.935</td>
<td>1.433</td>
<td>2.826</td>
</tr>
</tbody>
</table>

There has been a pilot project where single family house owners could apply for 40% subsidy to refurbish their building envelope and/or install renewable energy devices – wind generators or solar photovoltaics (PV banks) but the pilot was rather limited in time and money (€ 1M) and has not been continued by any larger scale measure.

There is no generally accepted target for renovation although the Energy Development Plan for 2030 and beyond to 2050 foresees that 50% of apartment buildings are deeply renovated by 2030.

The average budget needed for deep renovation is € 125 to 200/m². A subsidy for renovation is 25% to 50% of the overall budget including design, building supervision and consulting during the renovation process. The percentage is dependent on the depth of the renovation and geographical location of the building.
2 Housing market segmentation: dwelling typology

As the TABULA/EPISCOPE typology has not been tested yet in Estonia or other Baltic states and the structure of the housing market in other countries has followed incomparably different patterns the following typology is based on available information.

As mentioned above the predominant dwelling type in Estonia is the multi-apartment building built between 1960 and 1990 (Table 2, Table 3 and Figure 1).

Table 3 Dwelling types in Estonia in % per type and building period

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-apartment</td>
<td>2.70%</td>
<td>4.16%</td>
<td>5.30%</td>
<td><strong>52.11%</strong></td>
<td>2.20%</td>
<td>1.75%</td>
<td>3.17%</td>
<td><strong>71.39%</strong></td>
</tr>
<tr>
<td>Single family</td>
<td>3.47%</td>
<td>6.69%</td>
<td>3.54%</td>
<td>7.15%</td>
<td>1.65%</td>
<td>1.27%</td>
<td>1.61%</td>
<td><strong>25.38%</strong></td>
</tr>
<tr>
<td>Twin &amp; Terrace</td>
<td>0.25%</td>
<td>0.57%</td>
<td>0.40%</td>
<td>1.02%</td>
<td>0.31%</td>
<td>0.23%</td>
<td>0.46%</td>
<td><strong>3.23%</strong></td>
</tr>
</tbody>
</table>

Figure 1 dwelling types in Estonia in % per type and building period
3 Housing market segmentation: dweller typology

As the one most important dwelling type comprises 52% of all dwellings and altogether 72% of Estonians live in apartment houses and management of those houses are a responsibility of homeowner associations that comprise all owners of apartments of one particular building it means that predominant dweller type is a legal person belonging to a “home owners association”. There is practically no segregation among dwellers or homeowners of apartment buildings. As this type of living is so widespread there are only little studies and papers produced concerning their behaviour and attitude towards renovation.
4 References


Conditions for applying reconstruction subsidies (http://kredex.ee/korteriuhistu/korteriuhistu-toetused/rekonstruktsioonistutus/)

Dwelling types by location and construction year (http://pub.stat.ee/px-web.2001/1_Databases/Population_census/PHC2011/02Dwellings/02Dwellings.asp)

Energy efficiency in buildings (http://www.energiatalgud.ee/index.php?title=Hoonete_energiat%C3%B5husus)
Deliverable D2.1
Annex 4 – Regional housing market -
Germany – Region of Halle

GA N° 649865

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October 2015
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www.go-refurb.eu

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<th>Author</th>
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<td>Mario Kremling</td>
<td>First draft</td>
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<tr>
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<td>30-11-2015</td>
<td>Mario Kremling</td>
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1 Description of country context

1.1 HOUSING STOCK

1.1.1 Proportion of public/private ownership/tenancy

The housing stock in Germany contains approx. 41 M dwellings in 18 M residential buildings. Most of the residential buildings (85%) and also most of the dwellings (58%) are in the ownership of private individuals. A second amount are the residential buildings resp. dwellings that are property of community associations, which means a group of private individuals, mostly managed by property professionals. The 3 types of housing companies (private, municipal, cooperative) have almost the same share in residential buildings (appr. 1.7%) and dwellings (5-6%).

Owner and tenant rates show a characteristic share in Germany (appr. 45%/55%). These rates differ between East and West Germany and between urban and rural areas. In Saxony-Anhalt the share is 42%/58% (Table 1).

Table 1: Residential buildings and dwellings in Germany (census data per 9th May 2011)

<table>
<thead>
<tr>
<th>OWNER TYPES</th>
<th>share of residential buildings</th>
<th>share of dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>private individuals</td>
<td>84,6%</td>
<td>58,4%</td>
</tr>
<tr>
<td>condominium owners associations</td>
<td>9,5%</td>
<td>22,4%</td>
</tr>
<tr>
<td>private housing companies</td>
<td>1,7%</td>
<td>5,5%</td>
</tr>
<tr>
<td>municipal property</td>
<td>1,7%</td>
<td>5,8%</td>
</tr>
<tr>
<td>housing cooperatives</td>
<td>1,6%</td>
<td>5,4%</td>
</tr>
<tr>
<td>others</td>
<td>1,0%</td>
<td>2,6%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Rates of owners and tenants in Germany and Sachsen-Anhalt (census data per 9th May 2011)

<table>
<thead>
<tr>
<th>Owner rate</th>
<th>Tenant rate</th>
<th>Germany</th>
<th>Saxony-Anhalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner rate</td>
<td>45,8%</td>
<td>42,0%</td>
<td></td>
</tr>
<tr>
<td>Tenant rate</td>
<td>54,2%</td>
<td>58,0%</td>
<td></td>
</tr>
<tr>
<td>Source: DESTATIS 2014a</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

1.1.2 Age of the housing stock

Almost ¾ of the residential buildings and of the dwellings as well were built after 1950, predominantly during the 1960s and the 1970s in both parts of Germany.

Considering the age of the building stock, there is a significant gradient between East and West Germany. The share of the dwellings in older buildings (built before 1949, so called “Altbauten”) in East Germany incl. Berlin is about 40%, in West Germany 20%. Most dwellings that were built between 1950 and 1990 in West Germany are single-family houses, while in East Germany larger multi-family houses became dominant. After 1990, the differences between East and West disappeared. The share of the dwellings built after 1990 is appr. 17% (East) and 20% (West) (Table 2).
Table 2: Age of the housing stock, share of different age classes in the no. of dwellings. Source: own calculations, based on DESTATIS 2014b

<table>
<thead>
<tr>
<th>year of construction</th>
<th>Germany</th>
<th>West Germany</th>
<th>East Germany incl. Berlin</th>
</tr>
</thead>
<tbody>
<tr>
<td>before 1919</td>
<td>14%</td>
<td>11%</td>
<td>24%</td>
</tr>
<tr>
<td>1919 - 1948</td>
<td>11%</td>
<td>9%</td>
<td>17%</td>
</tr>
<tr>
<td>1949 - 1978</td>
<td>43%</td>
<td>48%</td>
<td>28%</td>
</tr>
<tr>
<td>1979 - 1986</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>1987 - 1990</td>
<td>4%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>1991 - 1995</td>
<td>6%</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>1996 - 2000</td>
<td>7%</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>2001 - 2004</td>
<td>3%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>2005 - 2008</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>2009 ff.</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

1.1.3 Predominant housing type: apartment/housing/collective housing

It depends on the point of view, which housing type is predominant:

- Considering the number of buildings, single- and double-family houses dominate the housing stock (83%), the remaining 17% are dominated by residential buildings with 3 dwellings and more (Figure 1).
- Considering the number of dwellings, only a share of 47% is located in the single- or double-family houses, almost 52% are in multi-family houses. There is obviously a distinct difference between East and West Germany. In East Germany 2/3 of the dwellings are located in multi-family houses, 1/3 in single- and double-family houses (Sachsen-Anhalt 43%/56%).

Figure 1: Housing Stock Germany (by no. of dwellings) Source: own calculations, based on DESTATIS 2014b
1.1.4 Urban environment: urban/suburban/rural

The difference between rural and urban areas is clearly recognizable by the share of housing types in Saxony-Anhalt. In the urban areas (cities of Halle, Magdeburg, Dessau) only 17% of the dwellings are located in single- or double-family houses, the big majority are located in multi-family houses (82%). In rural areas (11 rural districts) there is an opposite situation: approx. 52% of the dwellings is located in smaller houses, a little less (47%) in bigger houses (Figure 2). In principle, one can find the same share between urban and rural areas in other parts of Germany. The share of housing types in suburban areas is similar to the rural areas, but it is hard to find accurate data.

Figure 2 Source: own calculations, based on DESTATIS 2014b

1.1.5 Quality of the housing stock

For the assessment of the quality of the housing stock, the existing heating system is an important criterion. The predominant share of the dwellings is heated by central heating systems (70%), widespread all over urban and rural areas in Germany. So called „Einzel- oder Mehrraumöfen“, enclosing electric storage heating systems (Nachtspeicherheizungen) are mainly located in southwestern Germany. Self-contained central heatings (Etagenheizungen) are mainly located in urban areas in West Germany. District heating systems are mainly located in East Germany.
1.2 ENERGY PERFORMANCE

In Germany, the so called ‘Energiestandard’ describes the degree of energy performance. It determines the maximum energy consumption per m² reference surface per year in a building. In general, this value can be reached by structural measures and housing technologies. User behaviour has not been included. The legal context of the Energiestandard is given by EnEV¹ (Energieeinsparverordnung = energy saving regulation) that defines the basic standards. The EnEV applies for almost all buildings with heating or cooling systems.

EnEv primarily refers to new buildings and should help to reduce the energy demand. Two parameters are central: 1) the primary energy demand and 2) the heating demand. The regulations are referring to heating appliances and insulation standards as well. Using renewables gains leverage in balancing compared with fossil fuels. Determining the energy footprint considers room heating, cooling, water heating, ventilation systems, auxiliary power for pumping etc. The EnEV is updated from time to time. The latest update applies to dwellings up to 2016. The primary energy demand for new buildings has to be decreased from 62 to 45 kWh/m²/year; the current insulation standard referring to the transmission heat loss is increased by 20%.

EnEv secondly refers to energetic standards of the existing building stock. On the one hand, standard heating appliances installed before 1978 have to be replaced, steam and hot water pipes in unheated rooms need to be insulated, and the top floor resp. the upper floor ceilings or the roof have to be insulated by deadline the end of 2015 (‘replacement and retrofit obligations’). These necessary steps will be examined by the chimney sweep. In case of default, the municipal public order office will take measures. On the other hand, there are minimum standards for the replacement of single or a few parts of the building (‘renewal and refurbishment requirements’). If one wants to insulate the facade or to replace the windows, one has to respect certain U-value limits, regulated by EnEV. In these cases, the compliance with the EnEV regulations has to be confirmed by the contractor of the construction project. If one wants to perform a wholesale refurbishment (similar to new built), energy balancing has to be carried out. The primary energy demand of the refurbished building is limited up to 40% above the new building standard, up to 66% from 2016 (because the new building standards increase).

Basically, the energetic requirements and regulations of EnEV are associated with public subsidies and loans, provided by KfW-Bank that developed specific standards (‘KfW-Effizienzhaus’). The basic principle is to undercut the baseline of primary energy demand (Qₚ) and transmission heat loss (H’ₜ) of a reference building in a couple of stages. E.g., ‘KfW-Effizienzhaus 55’ means that Qₚ amounts to maximum 55% and the H’ₜ amounts to maximum 70% of the reference building (EnEV2009); ‘KfW-Effizienzhaus 70’ Qₚ<70%, H’ₜ<85%. There are higher levels possible for refurbishment of existing buildings (KfW 85, KfW 115). In very tight connection, KfW developed a system of loans or subsidies that can be received either for the achievement of a certain KfW level (new buildings, refurbishment) or single appliances/measures (refurbishment only).

Since 1st July 2009, an energy pass is officially required for all heated or cooled buildings that are assigned for rent or for sale. The energy pass has to be presented to the prospective tenant or buyer no later than he inspects the dwelling. (Current tenants don’t have the right to access to the energy pass!). Energy passes are scaled similar to efficiency classification of household appliances (from A+ to H) and contain specific energetic values (Qₚ and H’ₜ).

¹ http://www.vz-nrw.de/enev
1.3 REFURBISHMENT ACTIVITY

1.3.1 Existing energy performance of the housing stock

The energy consumption of the housing stock has been decreasing for a couple of years. For room heating in private households, 147 kWh/m²/year are required (2012). The energy performance of the various building parts is quite different. A little more than 40% of the outside walls are insulated. The insulation rate of the top floor resp. the upper floor ceilings is about 76%, the insulation of the basement floor ceilings is only about 37%. All these insulation rates also depend upon the year of construction (older buildings with lower rates).

Most residential buildings are equipped with at least double glazing windows (94%), ca. 3% even with triple glazing. Only a small number of buildings has only single glazing windows (2.5%).

Ventilation systems are not very widespread in the housing stock. Only 1.5% of all residential buildings are equipped with these systems, ca. 50% of them with heat recovery. Ca. 9% of buildings constructed after 2005 are equipped with a ventilation system, most of them with heat recovery.

The main energy sources of room and water heating are natural gas (50%/43%), heating oil (29%/24%), district heating (13%/11%), electricity (6%/22%) and wood (16%/3%). Only a small share is solar powered (2%/4%) or geothermal/environmental energy (1%/1%).

1.3.2 Existing renovation rate

The estimated annual renovation rates range between 1% and 2%, with reference to the insulation of the outer walls, roofs/top floors and basement floor ceilings. The annual replacement ratio of the heating supplies in residential buildings is about 3%. The average annual renovation rate for residential buildings in Germany, is about 1%. Power generation equipment that uses renewable energy sources are not widespread yet. Only 6% of residential buildings are powered exclusively by renewables, furthermore 13% are partially provided with renewables.
2 Housing market segmentation: dwelling typology

2.1 THE TABULA-TYPOLOGY

A first version of the national residential building typology was already developed in 1990 by the IWU (Institut Wohnen und Umwelt). The German building typology has since been regularly updated according to new developments (e.g. new energy saving ordinances). The current version consists of 36 generic residential building types and eight special cases classified by construction year groups and building size groups (Figure 3). The construction year is an important characteristic, because every epoch has its typical ways of construction and typical sizes of building components (e.g. window sizes), which influence the need for heating. The construction year groups are defined by historic events and by the dates of statistical analyses and of the release of energy saving ordinances. The building size on the other hand influences the surface of the building envelope and its subdivision for the different building components.

An additional document\(^2\), published by the IWU in 2015 in the context of the TABULA and the EPISCOPE projects, provides additional information on the different building types. It contains a datasheet for every building type up to the construction year group 1984-1994. Each sheet includes a description of the building type and details regarding the construction and the heating system. In addition, it contains the description of two modernisation packages (‘conventional’ and ‘forward-looking’) and a comparison of the energy use in the as-is state and after the two modernisation alternatives.

**Figure 1:** Classification scheme of the German Building Typology [IWU 2003]

<table>
<thead>
<tr>
<th>Baualtersklasse</th>
<th>EFH</th>
<th>RH</th>
<th>MFH</th>
<th>GMH</th>
<th>HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vor 1918</td>
<td>Fachwerk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| B                |     |    |     |     |    |
| vor 1918        |     |    |     |     |    |

| C                |     |    |     |     |    |
| 1919-1948        |     |    |     |     |    |

| D                |     |    |     |     |    |
| 1949-1957        |     |    |     |     |    |

| E                |     |    |     |     |    |
| 1958-1968        |     |    |     |     |    |

| F                |     |    |     |     |    |
| 1969-1978        |     |    |     |     |    |

| G                |     |    |     |     |    |
| 1979-1983        |     |    |     |     |    |

| H                |     |    |     |     |    |
| 1984-1994        |     |    |     |     |    |

| I                |     |    |     |     |    |
| 1995-2001        |     |    |     |     |    |

| J                |     |    |     |     |    |
| nach 2002       |     |    |     |     |    |

| F/F              |     |    |     |     |    |
| 1969-1978        | Fertighaus |    |     |     |    |

| NBL_D            |     |    |     |     |    |
| 1946-1960        |     |    |     |     |    |

| NBL_E            |     |    |     |     |    |
| 1951-1959        |     |    |     |     |    |

| NBL_F            |     |    |     |     |    |
| 1970-1980        |     |    |     |     |    |

| NBL_G            |     |    |     |     |    |
| 1981-1985        |     |    |     |     |    |

| NBL_H            |     |    |     |     |    |
| 1986-1990        |     |    |     |     |    |

**Explanations**
- in columns: different building size classes: EFH = single family houses, RH = terraced houses, MFH = multi-family houses, GMH = apartment blocks, HH = tower buildings
- in rows: different construction year classes and special cases (prefabricated single family houses from Western Germany / panel buildings ("Plattenbau") from Eastern Germany)
### Classification scheme of the German Building Typology [IWU 2003]

<table>
<thead>
<tr>
<th>Bauartsklasse</th>
<th>EFH</th>
<th>RH</th>
<th>MFH</th>
<th>GMH</th>
<th>HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>vor 1918 Fachwerk</td>
<td>Single type</td>
<td>Single type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>vor 1918</td>
<td>Single type</td>
<td>Wilhelminian style</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1919-1948</td>
<td>Single type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1949-1957</td>
<td>Single type</td>
<td>Industrial house building (GDR), multi-family houses since 1919</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>1958-1968</td>
<td>Single type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1959-1978</td>
<td>Single-family houses without steep roof</td>
<td>Tower buildings from the 40s and 50s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>1979-1983</td>
<td>Single-family houses with steep roof</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1994-1994</td>
<td>Single-family houses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>1995-2001</td>
<td>Built after 1994</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>nach 2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### F/F
- 1969-1976 Ferlhau

#### Sonderfälle
- **NBL_D**: 1946-1960
- **NBL_E**: 1951-1969
- **NBL_F**: 1970-1980
- **NBL_G**: 1981-1985
- **NBL_H**: 1990-1995

#### Explanations
- in columns: different building size classes: EFH = single family houses, RH = terraced houses, MFH = multi-family houses, GMH = apartment blocks, HH = tower buildings
- in rows: different construction year classes and special cases (prefabricated single family houses from Western Germany / panel buildings (“Plattenbau”) from Eastern Germany)

---

*Figure 4 tabula typology for Germany*
2.2 ASSESSMENT OF THE TABULA TYPOLOGY

The typology provided in TABULA is very useful in the context of the REFURB project. Since the table (Figure 3) itself does not contain background information on the different building types, it is necessary to consult the additional documents provided by IWU, in order to gain more information. The most up-to-date data are included in the above-mentioned datasheets, which contain information on the construction of the building, the heating system used and on two modernization variations and the subsequent energy use for each building type until 1994. For each building component, heating system and modernization variation the specific U-value is provided in the datasheet. This ensures comparability not only between the two modernization scenarios for one type, but also between the different building types. All in all, the typology contains very useful information for the REFURB project. Nevertheless, some details could be added in order to improve the informational value of the typology.

By now, the TABULA typology does not include information on financial issues, such as cost for renovation or payback period, which could be a useful addition to the datasheet and might be deduced from the data on energy-use in the as-is-state and the two modernization variations, which are already included in the datasheet.

The proposal for the ambitious “forward-looking” modernization package only includes solar heating as a possible source of renewable energy. Other technologies are not considered, which could be due to the different conditions required for every technology, which are not easily transferred into a superordinate typology. Still, considering the use of other technologies and their energy saving potential could be useful for the users of the typology.
3 Housing market segmentation: dweller typology

3.1 THE FEDERAL STATISTICAL OFFICE TYPOLOGY

The most basic dweller typology can be taken from the publications of the Federal Statistical Office. In 2011 there was a population census, which included a complete inventory count of buildings and dwellings. One aspect of this census was the type of ownership of buildings and dwellings. There are eight different categories:

- Community of owners of dwellings
- Private persons
- Housing co-operatives
- Municipality or municipal housing enterprise
- Private sector housing enterprise
- Other private-sector company
- Federation or Land
- Non-profit-making organization

This basic typology will probably be more or less the same throughout Europe, while the share of each category might vary a lot from country to country.

In addition to this rather technical typology, there is a number of scientific studies, which deal with different owner types and their motivations for housing renovation. Often their data are the result of extensive qualitative research and they give a deep insight into the drivers and barriers for refurbishment.

For the purpose of the REFURB project, the formal statistical ownership typology was combined with findings from different research projects, in order to create a typology that describes the situation in Germany as accurately as possible.

The typology of the Federal Statistical Office is a complete representation of all the types of ownership of buildings and dwellings. Of course it does not give an insight into the motivations and barriers of the different owner types with regard to renovation. These factors have to be added by combining the basic statistical typology with additional research findings. Nevertheless, the basic differentiation between owner types is very relevant for the REFURB project, since it can be expected that the barriers and motives of some owner types are quite different from each other.

The basis for the final REFURB-dwelling-typology for Germany is the statistical typology described above. In order to reduce complexity, some categories can be merged without losing valuable information. The most important categories are the communities of owners of dwellings and the private persons. They will not be merged with other categories, because it is to be expected that their motives and barriers differ significantly. In addition, each of these categories holds a significant share of the residential buildings and the dwellings in Germany (see Figure 3), and must therefore be analysed separately. The different types of housing enterprises (private, municipal, co-operatives) each hold comparable shares of the residential buildings and dwellings in Germany. Irrespective of their legal status, they are all subject to similar
conditions and share the same objectives. That is why we they were merged with the category housing enterprises. The other owner types, combined in the category ‘others’, hold a very small share of the German housing market and are therefore not further considered in this typology.

Table 3 Share of residential buildings or dwellings for different dweller types in Germany.

<table>
<thead>
<tr>
<th>Dweller Type</th>
<th>Share of Residential Buildings</th>
<th>Share of Dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private persons</td>
<td>84.6%</td>
<td>58.4%</td>
</tr>
<tr>
<td>Community of owners of dwellings</td>
<td>9.5%</td>
<td>22.4%</td>
</tr>
<tr>
<td>Private sector housing enterprise</td>
<td>1.7%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Municipality or municipal housing enterprise</td>
<td>1.7%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Housing co-operatives</td>
<td>1.6%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Others</td>
<td>1.0%</td>
<td>2.6%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

3.2 A REFURB DWELLER TYPOLOGY

Since the private persons own almost 60% of the dwellings in Germany, this groups needs to be further distinguished into sub-types. In a project called ENEF Haus³ (energy efficient renovation of owner-occupied dwellings), which was finished in 2010, extensive qualitative research was done in order to identify types of homeowners and their specific motivations for or against energy efficient renovation. Five types were identified, of which three are considered high-potential target groups for inducing behavioural changes with regard to energy efficient renovation of their homes.

The three types are called as follows:

- Convinced energy-savers,
- Open-minded skeptics and
- Improvident upkeepers.

In the REFURB dweller typology they are considered sub-types of the private owners.

The second largest group are communities of owners of dwellings, which form the second dweller type. When multi-family-houses are not owned by housing enterprises of any kind, the single apartments of a building are often owned by different private owners, who share the ownership of the commonly used areas of the house. Therefore they have to come to a collective decision on matters of refurbishment of for example the roof or the façade. This accounts for complex problems in the organization of renovation processes, which will be illustrated in task 2.2 in detail, since they necessitate specific solutions for this target group in the context of the REFURB project.

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A total of 5% of the German dwelling stock is owned by housing enterprises of different legal forms, who form the third category in the dweller typology. Just as the other two types, they are subject to specific problems and requirements, which need to be analysed separately in the context of the REFURB project.

To sum this up, the REFURB-dwelling-typology consists of three basic dweller (or owner) types:

1. private persons (with three subtypes),
2. communities of owners of dwellings, and
3. housing enterprises.


4 Combining dwelling & dweller typology, definition of focus groups

The following matrix (Table 1) combines the dwelling typology described in chapter 2 and the dweller typology from the previous chapter. The subtypes of the private homeowners are not included in the matrix, since they cannot be linked to specific dwelling types in the logic of the tabula typology.

Table 4 Matrix combining dwelling and dweller type

<table>
<thead>
<tr>
<th>code/marking in TABULA</th>
<th>EFH_A single type</th>
<th>RH_B single type</th>
<th>EFH_D single type</th>
<th>(green) 7 types</th>
<th>(orange) 5 types</th>
<th>MFA_A single type</th>
<th>(violet) 2 types</th>
<th>MFH_C single type</th>
<th>(yellow) 15 types</th>
<th>(red) 3 types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single family house before 1918 (half-timber)</td>
<td>Single family house before 1918</td>
<td>Terraced house before 1918</td>
<td>Single family houses 1949-1957</td>
<td>Single family houses with steep roof (since before 1918)</td>
<td>Single family houses without steep roof (1919-1978)</td>
<td>Multi-family house before 1918 (half-timber)</td>
<td>Wilhelminian style</td>
<td>Multi-family house 1919-1948</td>
<td>Industrial house building (GDR), multi-family houses since 1919</td>
<td>Tower buildings from the 60s and 70s</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

There are potential focus groups for the REFURB project to be identified with the help of the matrix. While the housing typology is rather complex, because it is based on refurbishment options and not on visible or tangible building characteristics and because each category consists of a different number of types, the dweller typology in the matrix can quite easily be related with the different housing categories. The matrix is based on the assumption that private persons mostly live in single-family houses or terraced houses of the different categories. In multi-family houses people usually own one apartment (which they rent to someone or occupy themselves), which makes them part of a community of owners of dwellings. Housing companies of various legal forms also mostly own multi-family houses of different categories. Some

building types are more typical for housing enterprises, while others are mostly owned by communities of owners of dwellings (marked with bold print in the matrix). Since there are no statistical data available, which combine the indicators ownership, year of construction and number of dwellings in a building, there is no way to verify these assumptions, which are based on experience, so a risk of misjudgement remains.

There are some categories, which are not especially interesting in the context of the REFURB project: this would for example be both categories of half-timbered houses (single- and multi-family house before 1918). Many half-timbered buildings are listed, which makes it very difficult to implement ambitious renovation measures. In addition, the number of buildings in these categories is rather small. The same holds true for the category terraced houses before 1918. As they are often listed or architecturally valuable, energy efficient renovation measures are not always easily implemented. The same applies to Wilhelminian style houses, which are often listed and have richly decorated façades, which makes insulation difficult. Although there are more than 2.7 million dwellings in that category, it should not be a focus group in the REFURB project.

The datasheets from the TABULA typology show, that all building types are suitable for energy efficient renovation measures. Those building types where difficulties due to preservation regulations are to be expected, will not be included in the focus groups.

The remaining six single- and multi-family house categories can be seen as equally interesting for the REFURB project. In many cases there are no major building-related barriers to be expected with regard to energy efficient renovation. Of course, specific conditions can only be assessed individually.

High potential target groups

Three main focus groups for the REFURB project can be identified from the matrix. They are congruent with the dweller typology established in section 3:

- Private persons who own single family houses,
- Communities of owners of dwellings and
- Housing enterprises of various legal forms.

In addition there are three relevant sub-types of private persons who own single family houses which are also focus groups for the REFURB project. They have been identified as promising target groups for energy efficient renovation measures in the course of the ‘ENEF Haus’-research project. They are called as follows:

- Convinced energy-savers,
- Open-minded skeptics and
- Improvident upkeepers.

Their motivations and barriers with regard to energy efficient renovation measures will be described and analysed in detail in task 2.2, along with those for the other two basic focus groups.
5 Conclusions

5.1 CONCLUSIONS ON THE METHOD TO DEFINE HOUSING MARKET SEGMENTS & FOCUS GROUPS

The method of combining a dwelling typology with a dweller typology in order to identify relevant target groups for energy efficient renovation measures has proven useful, although there are some remarks to be added. The dwelling typology based on the German TABULA typology is very specific for the German building stock and not transferrable to other EU countries. For other countries the country-specific tabula typologies, if available, can be used.

The tabula data are of high quality and the additional datasheets for each building type already include information on energy efficient renovation measures appropriate for this building type. So the information density on the building types is very high to begin with, which makes it comparatively difficult to relate specific types of dwellers to the housing categories. In the case of the matrix developed in section 5 this means, that the focus groups are congruent with the dweller typology. Nevertheless, for less sophisticated housing typologies, the method is very useful.

5.2 CONCLUSIONS ON THE FOCUS GROUPS TO DEVELOP RENOVATION PACKAGES FOR

Private persons who own single family houses and the three sub-types (Convinced energy-savers, Open-minded skeptics and Improvident upkeepers) have been identified as promising focus groups in the REFURB context. Not only because they have a huge share in the German housing stock, but also because they are independent in their decision-making process regarding their own house and therefore their decision-making process is relatively easy.

Communities of owners of dwellings (also called condominium owners associations) are an important part of the German housing stock. There are nearly 9 million condominium apartments in Germany, representing 22% of the housing stock. Therefore this owner group is very important from a quantitative point of view and will become even more important in the future because of the trend of turning tenant buildings into condominium apartments. Furthermore, this trend is continuing because new-built multi-family houses are mostly ‘condos’.

Housing enterprises of various legal forms are the third basic focus group. Depending on their building stock they can make a big contribution to energy saving and CO₂-reduction by renovating energy efficiently. Due to the bigger size of the renovation projects in housing enterprises compared to single-family houses, they are a promising target group.

But in the end, only a combination of renovation measures in all focus groups can contribute significantly to climate protection. The motives and barriers regarding energy-efficient renovation measures of each focus group are described in task 2.2.
References

Census 2011 online database: https://ergebnisse.zensus2011.de/?locale=en#Home:


Verbraucherzentrale NRW: http://www.vz-nrw.de/en/ev


Ergebnisse einer standardisierten Befragung von Eigenheimsanierern. Frankfurt am Main

