# Deliverable D5.1
# Report: Quality assurance approach

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# Contents

# Summary

Deep renovations of the residential sectors buildings towards Nearly Zero Energy Buildings (nZEB) is lagging behind the European political ambitions for energy renovation. The overall REFURB project focuses on bringing forward solutions to solve the complex interplay between the supply side (= the building sector) and the demand side of an NZEB renovation and bring forward ”an offer you can’t refuse” solutions targeting the residential sector.

REFURB uses the point of view of the customer as a starting point. Work Package 5 aimed to ensure high quality and delivery standards. This report is the outcome of Task 5.1 ‘Define approach for quality and performance assurance’. In this task, an approach to assess the performance of the supply side has been developed, to ensure that they do deliver what is promised. While the initial scope of this task focussed on the quality and delivery of the technical solutions (i.e. the product), it has become evident that it is necessary to ensure the quality of the entire renovation process – the customer journey – to increase the probability of keeping the customers within the journey and actually in the end carry out a renovation successfully (i.e. the service).

In a first step, background information on the legal framework for quality assurance of energy renovations, both on European level as on national/regional level in investigated. In order to further stimulate an increased number of energy efficient buildings, the Energy Performance of Buildings Directive (EPBD, 2010/31/EC**)** introduced the definition of nZEB as a building with very high-energy performance where the nearly zero or very low amount of energy required should be extensively covered by renewable sources produced on-site or nearby. The EPBD foresees that after 31 December 2020, all new buildings will be nZEBs, while for public buildings the deadline is set for 31 December 2018.

National laws and action plans form the foundations of the performance of the nZEB renovation since every step in the energy renovation process is embedded in the regulatory context. Therefore, an overview of national laws and action plans is provided as well.

When it comes to energy performance of a building or its components, it can be evaluated by a number of options. With its components, reference is made to the components that have the greatest impact on the energy performance – the building envelope, the technical systems and renewable energy technologies. Quality control of solutions for individual building components might be necessary in addition to a performance check on building level. Out of the information presented in Chapter 2, the large diversity of methods for quality assurance can be observed. Each country designed its own approach. Regardless of the number of tools available for the homeowner on the topic of quality assurance, the majority of countries linked the quality assurance with loans or grants.

Furthermore, there are various quality assurance schemes and incentive structures for energy saving and cost reduction for the homeowner. These schemes and structures include building energy performance certificates (and energy labels for components) performance requirements linked to grants or subsidies, tax reductions, energy portals, and energy performance contracts. In addition to these instruments, individual advice needs to show building owners what they can save and what is cost-effective.

Although there are clearly limitations of the EPCs as a tool to guarantee energy savings, they still provide an initial basis for quality control. Energy performance assessments prior and after the renovation are an accepted means to verify the performance of the deep renovation and can provide a first indication of expected energy savings although known issues arise hampering the guarantee. This can be caused by the calculation model assumption, the quality of works or the user behaviour. Especially if the conditions have

changed before and after renovation, it might be a challenge for the supply side to guarantee a specific performance as these often are solely under the control of the user/customer.

EPCs typically include recommended energy performance improvement measures for the homeowner. However, in many cases they are generated by simple computer algorithms, which depend on input data provided by the assessor. In this case, it is recommended to complement it with a tailored advice, taking into account the specific characteristics of the property. In the case of step-by-step deep renovations, there is a particular challenge to ensure that the renovation measures will not block NZEB-performance levels (so-called lock-in situations). It can be stated that step-by-step renovation plans are per se a support tool to assure the quality of energy renovation because this instrument ideally anticipates all different stages and linked measures. Several step-by-step renovation plans are described where energy agencies turned out to be key players for step-by-step renovation plans.

In case energy savings are verified using actual (metered) data by comparing the metered energy consumption before and after renovation, monitoring data has to be available. In particular in the case of transactions of property, this could not always be the case. Boundary conditions are identified and listed in Section 2.3.4. How to maximize energy saving potential with the smart meters is also elaborated.

From the perspective of homeowners and tenants, information on potential energy savings on an EPC may be important but there are other elements that might be equally or even more important for homeowners when renovating their homes. This is documented in various REFURB WP2 deliverables.

In order to achieve the ultimate goal to reduce energy consumption, the main challenge is to create customer confidence[1], getting homeowners on board of a customer journey towards nZEB and keeping them until completion. Chapter 3 focuses on customer confidence and trust, key in the customer journey. Theoretical models are studied and recommendations are elaborated on how quality of the service offered by one stop shops can be guaranteed, by making the link with the Customer Journey towards nZEB renovation. Customer-confidence can be improved by providing guidance along the customer journey, building customer confidence by using a toolbox of quality assurance measures and illustrating the potential added value of a Single Point of Contact as a facilitator for NZEB renovations.

In addition, having a guarantee on energy savings per se does not create any appealing window of opportunity; a leaky roof or the need for more space does. Again, the homeowner has to already have some kind of intrinsic motivation to want to safe energy (step 1 and 2 of the CJ). Only those who enter the CJ will have energy savings in the end. That is why, especially in the initial phase, it is important to speak the customer´s language and address the aspects that actually motivate the customer at the right moment.

It has been observed that most of the homeowners decide to go for a step-by-step renovation. In that case, they should re-enter in the CJ loop after Step 11 - wanting more into step 4 – considering the offer, to make sure they reach the nZEB level. The following actions are proposed to keep homeowners in the renovation process:

- Offering a roadmap to nZEB based on the modules;
- Addressing ‘co-benefits’ energy savings combined with related pros such as good indoor climate, comfort, health, and well-being as well as impact on market value;
- Sending follow-up offers based on their roadmap (use of CRM/database);

[1] See COHERENO (Collaboration for housing nearly zero-energy renovation) report on creating customer confidence through quality assurance - http://www.cohereno.eu/fileadmin/media/Dateien/Cohereno-report-customer-confidence.pdf.

- Community gatherings in a fun setting, where people who have taken the first steps receive a thank you and can share experiences;
- Offering continuing insight in the amount of money and energy saved (cumulative effect) through smart meter data;
- Have local consortia of energy related companies join forces to offer one complete nZEB renovation package; this local consortia guarantees the energy performance, it is their shared responsibility (for instance used in the Netherlands, guarantee is a so called ‘no energy bill’ being reached;
- Involve the local government: public-private-partnership to get consumers to step into the CJ (for instance, via the Slim Wonen website) and to create trust from the start;
- Dedicate efforts on CRM (Customer Relationship Management); keep track of (local) customers in SalesForce (see D5.3) and organize come together meetings for homeowners to stimulate them to take the next step for their dwellings;
- Consortia of local contractors could also reward their faithful customers with incentives (a discount, some type of present);
- Offer a certain subsidy as a ‘reward’ if a customer is willing to go to nZEB in one go.

# Introduction

Deep renovations of the residential sectors buildings towards Nearly Zero Energy Buildings (nZEB) is lagging behind the European political ambitions for energy renovation. The overall REFURB project focuses on bringing forward solutions to solve the complex interplay between the supply side (= the building sector) and the demand side of an NZEB renovation and bring forward ”an offer you can’t refuse” solutions targeting the residential sector. However, the building sector is faced with a perception of distrust with regards to delivery of NZEB renovations. The building sector needs to significantly upgrade its working practices by raising quality and compliance. This lack of trust is an important barrier for homeowners to start the renovation process in the first place[2]. Quality assurance and delivery standards of technical solutions then contribute to strong customer confidence.

Work Package 5 aimed to ensure high quality and delivery standards. REFURB uses the point of view of the customer as a starting point. This means that – for example – if a supplier promises to a house-owner a specific energy saving or a return on investment of a specific number of years, based on the tools developed in REFURB, the customers should get a guarantee that this is indeed feasible. This guarantee is essential in trust-building at the demand side towards the supply side.

This report is the outcome of Task 5.1 ‘Define approach for quality and performance assurance’. In this task, an approach to assess the performance of the supply side has been developed, to ensure that they do deliver what is promised. A particular issue in this regards is that the demand of homeowners usually requires a system of technologies, e.g. a combination of insulation and climate control can increase comfort for the user. However, suppliers often supply a part of the system (e.g. only the insulation). So to whom does the homeowner turn when the demanded level of comfort is not realised? On the other hand, how can a supplier guarantee the benefits of a system for which he is only partially responsible? These types of questions will be answered in this report.

In addition, while the initial scope of this task focussed on the quality and delivery of the technical solutions (i.e. the product), it has become evident that it is necessary to ensure the quality of the entire renovation process – the customer journey – to increase the probability of keeping the customers within the journey and actually in the end carry out a renovation successfully (i.e. the service). In order to not only improve the quality of the building products or technical solutions used but also the quality of the “compelling offers” and thus the service as a whole, the scope of this task has been expanded to also make the link to the customer journey of the renovation process.

This report is therefore structured as follows:

Chapter 1 provides background information on the legal framework for quality assurance of energy renovations, both on European level as on national/regional level.

Chapter 2 discusses methods for performance evaluation. Fail and success factors are identified, based on a literature study and good examples from practice. First, energy performance assessment methods are analysed from the REFURB countries and regions. Second, tools and practices to ensure quality of technical solutions are screened, with a particular focus on preventing lock-in situations in case of staged deep renovations. Third, means of measuring and monitoring of the energy consumption are mapped.

Chapter 3 discusses how quality of the service offered by one stop shops can be guaranteed, by making the link with the Customer Journey towards nZEB renovation. The same method as the preceding chapter is

[2] REFURB Deliverable D2.2 Mapping the demand drivers

used: fail and success factors are identified, based on literature study and best practices identified by the REFURB partners in their countries or regions.

Based on the findings of the two preceding chapters, Chapter 4 proposes a quality assurance approach for one stop shops. This includes both a technical/product-oriented approach for performance evaluation and a service-oriented approach which uses the customer journey as a framework.

Conclusions and recommendations are formulated in the final chapter, making the link to other work packages and tasks in REFURB.

# 1. Background: legal framework for quality and performance

## 1.1. EUROPEAN FRAMEWORK – EPBD

Ambitious requirements for energy performance in buildings are an effective way to foster innovation and achieve a significant reduction of GHG emissions and energy use, contributing to the energy independence of the EU.

In order to further stimulate an increased number of energy efficient buildings, the **Energy Performance of Buildings Directive (EPBD, 2010/31/EC)** introduced the definition of nZEB as a building with very high-energy performance where the nearly zero or very low amount of energy required should be extensively covered by renewable sources produced on-site or nearby. The EPBD foresees that after 31 December 2020, all new buildings will be nZEBs, while for public buildings the deadline is set for 31 December 2018.

Article 9 of the EPBD requires Member States (MS) not only to set a national nZEB definition, but also to actively promote higher market uptake of such buildings. MS shall prepare and submit to the European Commission the national plans with clear definitions and measures (e.g. policies and financial incentives) for the promotion of nZEBs. These national plans shall include, inter alia, intermediate targets to improve the energy performance of new buildings by 2015 and have to be updated every 3 years.

The European Parliament adopted the Energy Performance of Buildings Directive, EPBD Recast, on May 18th, 2010. Since July 8th, 2010, the amended directive is effective. By means of the EPBD Recast, an important contribution towards reaching the climate protection goals of the EU shall be made.

These are the most important amendments of the EPBD Recast[3]:

1. **Making the energy performance certificate public:** The Directive will be requiring that the performance indicator set on the certificate is indicated in housing advertisements.

   MS shall require that, when buildings or building units are constructed, sold or rented out, the energy performance certificate or a copy thereof is shown to the prospective new tenant or buyer and handed over to the buyer or new tenant.

   **Measures:** The recommendations included in the energy performance certificate shall cover measures carried out in connection with a major renovation of the building envelope as well as measures for individual building elements independent of a major renovation. The recommendations included shall be technically feasible and may provide an estimate for the range of payback periods over its economic lifecycle.

3. **Independent control systems for energy performance certificates:** MS shall lay down the necessary measures to establish a system of certification of the energy performance of buildings. The energy performance certificate shall include the energy performance of a building and reference values such as minimum energy performance requirements in order to make it possible for owners or tenants of the building or building unit to compare and assess its energy performance.

[3] See http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=DE; German summary: https://www.zukunft-haus.info/gesetze-studien-verordnungen/gesetze-verordnungen/epbd.html.

4. **Experts for energy performance certificates:** MS shall ensure that energy performance certifications are carried out by qualified and/or accredited experts, whose independence is to be guaranteed based on objective criteria; and that regularly updated lists of qualified and/or accredited experts are made available to the public.

5. **Displaying:** The dissemination to the public of information on energy performance should be enhanced by clearly displaying these energy performance certificates, in particular for buildings with a total useful floor area[4] over 250 $m^2$ which are occupied by public authorities or which are frequently visited by the public.

6. **Increasing the number of nearly zero-energy buildings:** MS shall ensure that by 2021, all new buildings are nearly zero-energy buildings. Nearly zero-energy building[5] means a building that has a very high-energy performance. By 2019, new buildings occupied and owned by public authorities are nearly zero-energy buildings. Member States may decide not to apply the requirements in cases where the cost-benefit analysis over the economic lifecycle of the building in question is negative.

7. **1000 $m^2$ limit at renovations falls:** All buildings or building elements that are subject to major renovation[6] (before that only buildings with a total useful floor area of more than 1000 $m^2$), should meet minimum energy performance requirements. These energy-saving minimum requirements are adapted to the local climate by each MS.[7]

Few MS declared objectives that go beyond nZEB requirements, including zero energy buildings in the Netherlands, positive energy buildings in Denmark, and climate neutral new buildings in Germany.[8]

The EPBD neither prescribes a common approach to implement nearly Zero-Energy Buildings nor describes the assessment categories in detail. Thus, MS have established different parameters, both in terms of quantity and quality, in their nZEB definitions. This intentional ambiguity helps accommodate the differences in building styles, resources and climate in the EU.

**Energy performance indicators**

In most countries, the nZEB definitions refer to maximum primary energy as one of the main indicators. In a few cases (e.g. the Netherlands and the Belgian Region of Flanders), the primary energy use of the building is assessed through a non-dimensional coefficient, comparing the buildings' primary energy use with a "reference" building with similar characteristics (e.g. building geometry).

For residential buildings, most jurisdictions aim to have a primary energy use not higher than 50 kWh/$m^2$/y.

Concerning the methodology to calculate the energy performance of buildings, the EPBD (Annex I) lists the main end-uses that should be included such as heating, domestic hot water, cooling, ventilation and (mainly in non-residential sector) lighting.

[4] Total useful floor area TUFA: The area of a building can be measured in a number of different ways, and it is very important to be clear about which measure is being used, for example in property sales, planning applications, building regulations applications, lease negotiations, rating valuations and so on. The term 'total useful floor area' (TUFA), or 'total usable floor area' is described in the building regulations of each country.
[5] Definition according to the European Commission: http://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/nearly-zero-energy-buildings.
[6] The major renovation definition was covered in previous deliverables; a definition in monetary terms in the framework of the EPBD recast can be found here: http://www.ecofys.com/files/files/ecofys_2009_major_renovation_definition_in_monetary_terms.pdf.
[7] In Germany, this requirement is already met according to the EnEV.
[8] http://bpie.eu/wp-content/uploads/2015/09/BPIE_factsheet_nZEB_definitions_across_Europe.pdf., p. 3.

Apart from the requirement for primary energy consumption, most countries also set separate requirements on final energy use, as suggested by the European Committee for Standardisation.

**Renewable Energy Sources (RES)**

Eleven MS plus Brussels Capital Region and Flanders set a definition that comprises both a numerical target for primary energy use (or final energy) and considers the share of renewables in a quantitative or qualitative way. In 8 of these jurisdictions (Cyprus, Lithuania, Latvia, Romania, Slovakia, Ireland, France, Region of Flanders), the share of primary energy consumption which has to be covered by renewable energy sources is explicitly stated, while in other jurisdictions (e.g. Czech Republic, Denmark, Estonia and Brussels Capital Region) renewable sources are considered indirectly.

In Denmark, while a minimum share of renewable sources has not been established, a gradual evolution of primary energy factors has been planned and an increase in the share of renewable energy above 50% is expected in 2020.

**nZEB Definitions for existing buildings**

According to the EPBD (Article 9), MS should also develop policies in order to encourage the renovation of buildings to nZEB levels. So far, the nZEB requirements established by the European Commission only address directly new buildings to be constructed from 2020 onwards. No mandatory requirements have been introduced for nZEB renovations. However, with energy efficiency of the overwhelming majority of existing buildings being unsatisfactory, their renovation is even more crucial.

Criteria for nZEB renovation of buildings have been identified in 13 jurisdictions, but definitions have so far only been set in eight (Austria, Cyprus, the Czech Republic, Denmark, France, Latvia, Lithuania, Brussels Capital Region). Of these, Austria, France, and Brussels Capital Region have set primary energy use requirements for renovation at a less strict limit compared to new buildings. Germany, Ireland and Slovenia envisage doing likewise, though the renovation definitions for these countries have not yet been set. Denmark and Lithuania have the same nZEB definition for new and existing buildings, as do Bulgaria, Cyprus, Italy and Latvia, where the nZEB definition for new buildings is also applied for deep renovations.

Table 1 presents a cross-country overview of the main aspects related to national nZEB definitions in REFURB partner countries.

**Uptake of nZEB renovation**

As for the uptake of nZEB renovation, evaluating the progress in renovations of existing buildings is complicated by the fact that not much data are available; for instance, Eurostat does not measure such progress. However, the nZEB renovation rates are considered very low in relation to the great potential for reducing energy consumption in existing buildings.

During the Commission's public consultation on the EPBD in 2015, stakeholders pointed out many possible reasons for a slow uptake of renovations, a major one being the complex nature of deciding whether to renovate. [9] To make this decision, owners need to understand the precise costs and returns, as well as consider relevant legal, technological, organisational and financial issues. Another obstacle seems to be the non-existence of a minimum renovation target, accompanied by appropriate financial mechanisms. There, owners often are still not convinced that they should venture into a costly and risky renovation,

[9] A paper by Entranze Project provides an overview of factors influencing acceptance and adoption of deep renovation: http://www.entranze.eu/files/downloads/ENTRANZE_D2_6_Final_version.pdf.

because they are not sure whether the requirement for renovation will ultimately extend to all buildings or not and may not be fully convinced that a renovation will bring the promised savings.[10]

A further major complicating factor seems to be the ownership structure of EU buildings: residential buildings account for 75% of buildings in the EU, and the large majority of them are privately owned. Decisions are even more complex in multi-family buildings, which account for 47% of all buildings in the EU, and in some countries (for instance, Italy or Estonia) for over 70%.[11]

With around 30% of residential buildings in the EU being rented, slit incentives between property owners and tenants of buildings present another serious obstacle for renovations.[12] Split incentives occur when those responsible for paying energy bills (the tenant) are not the same entity as those making the capital investment decisions (property owner). The property owner may not be inclined to undertake energy renovation measures when the benefits associated with the resulting energy savings accrue to the tenant.

An Aachen University study shows that slow renovation can also be the result of overambitious legislation. The study uses the example of Germany to argue that prescribing very deep levels of renovation can be too expensive and overwhelming for home owners.[13]

[10] European Parliament, Briefing, May 2016, Energy efficiency of buildings, A nearly zero-energy future?, http://www.europarl.europa.eu/Reg-Data/etudes/BRIE/2016/582022/EPRS_BRI(2016)582022_EN.pdf, p. 6.
[11] Ibid, p. 7.
[12] Ibid, p. 6.
[13] Galvin, R. (2014), Why German homeowners are reluctant to retrofit, Building Research & Information; http://www.tandfonline.com/doi/pdf/10.1080/09613218.2014.882738.

| | | | | | nZEB definition for new buildings | | | | | | nZEB definition for existing buildings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Status of the definition | Main reference(s) | Year of enforcement | | EPBD scope of nZEB definition [1] | Numerical indicator | Maximum primary energy [kWh/m²y] | | Share of renewable energy | Other indicators | Status of the definition | Maximum primary energy [kWh/m²y] | |
| | | | Public | Non-public | | | Residential buildings | Non-residential buildings | | | | Residential buildings | Non-residential buildings |
| Belgium - Brussels | ✓ | Amended Decree of 21/12/2007 | 1/01/2015 | 1/01/2015 | ✓ | ✓ | 45 | ~90 [2] | ✓ Qualitative | EP, OH | ✓ | 54 | ~ 108 [2] |
| Belgium - Flanders | ✓ | Regulation of 29/11/2013 | 1/01/2019 | 1/01/2021 | ✓ | ✓ | 30% PE [5] | 40% PE [5] | ✓ Quantitative [4] | EP, OH | Under development | | |
| Belgium - Wallonia | Under development | Consolidated report to EC | 1/01/2019 | 1/01/2019 | ✓ | Under develop-ment | | | Quantitative | EP | Under development | | |
| Denmark | ✓ | Building Regulations 2010 | 1/01/2019 | 1/01/2021 | ✓ | ✓ | 20 | 25 | ✓ Qualitative | EP, OH, TS | ✓ As for new buildings | 20 | 25 |
| Estonia | ✓ | Regulation 68:2012 | 1/01/2019 | 1/01/2021 | ✓ [7] | ✓ | 50-100 [2] | 90-270 [2] | ✓ Qualitative | | ✗ | | |
| Germany | Under development | KfW Efficiency House, National nZEB plan | 1/01/2019 | 1/01/2021 | ✓ | Under develop-ment | 40% PE [5] | | Minimum share in current requirements for all buildings | EP | Under development | 55% PE [5] | |
| Nether - lands | ✓ | National nZEB Plan | 1/01/2019 | 1/01/2021 | ✓ | ✓ | Included in the calculation; building needs to comply with energy performance coefficient = 0 | | ✗ | EP | ND | | |
| Slovenia | Still to be approved | Official Journal 17/14, National nZEB Plan | 1/01/2019 | 1/01/2021 | ✓ | Still to be approved | 45-50 [2] | 70 | Under development | EP | Still to be approved | 70-90 [2] | 100 |

[14] http://bpie.eu/uploads/lib/document/attachment/128/BPIE_factsheet_nZEB_definitions_across_Europe.pdf. The original table covers EU28 (and Norway).

**LEGEND OF TABLE 1**

✓ definition included in an official document ✗ no definition available **ND** - no data

**Other indicators:** - Carbon emissions, **EP** - Envelope performance, **OH** - Overheating indicator, **TS** – Performance of technical systems

[1] For residential buildings, the EPBD takes into account the following energy services: heating, cooling, domestic hot water, air conditioning, and, for non-residential buildings, ligh
[2] Depending on the reference building
[3] Depending on the location
[4] Requirement depending on the RES measures adopted
[5] Maximum primary energy consumption defined as a percentage of the primary energy consumption (PE) of a reference building. In the Czech Republic, the non-renewable prim primary energy
[6] No cooling for residential buildings
[7] Energy consumption of appliances is included in addition in the definition (both for residential and non-residential buildings)
[8] In the National nZEB Plan, BBC /"Bâtiments Basse Consommation"(buildings which comply with the Thermal Regulation 2012) are defined as buildings with an energy consumpt buildings will be positive energy buildings from 2020
[9] Apart from England, the targets for the other UK countries are different and expected to be reviewed. Northern Ireland is trying to promote the UK government's goal that all standard by 2016.

## 1.2. NATIONAL FRAMEWORK

This Chapter provides an overview of national laws and action plans in the REFURB countries covering energy renovation.[15] This compilation gives an insight into strategic policies and the implementation of European guidelines at national and regional level. National laws and action plans form the foundations of the performance of the nZEB renovation since every step in the energy renovation process is embedded in the regulatory context.

### 1.2.1. Germany[16]

Germany matters in meeting the EU climate goals, both politically and economically. In Germany, the building sector accounts for 40% of final energy use and for about one third of the GHG-emissions. However, while Germany is considered a frontrunner for some building policies and instruments, the national renovation rate is just at the level of the European average (around 1%/y). Out of every three building upgrades undertaken in Germany, only one implements energy-saving measures.[17]

Quite a number of strategic documents have been adopted in Germany in the past legislation, showing the important role of the building sector in achieving energy transition and climate protection targets: the climate action plan 2050, the energy efficiency strategy for buildings, or the national action plan on energy efficiency.

After the election to the German Bundestag in September 2017, implementation will be the next challenge. This will include stepping up existing instruments and adopting new measures.

**Energy Saving Act (EnEG)**

The Energy Saving Act ("Energieeinsparungsgesetz" - EnEG) was implemented in 1976 to improve the balance of trade, more precisely to reduce the dependency of the Federal Republic of Germany on

[15] There is no claim for completeness. Estonia is not included.
[16] A good starting point for strategic approaches and relevant legislation in terms of energy efficiency in buildings in Germany is provided by the Federal Ministry of Economic Affairs and Energy: http://www.bmwi.de/Redaktion/EN/Dossier/enhancing-energy-efficiency-in-buildings.html.
[17] http://bpie.eu/national-initiatives/germany/.

imported energy carriers. The act does not contain any regulations directly affecting the citizen but empowers the Federal Government to legislate ordinances. Thereby, the approval of the "Bundesrat" (Parliament representing the German Federal States) is necessary. Since then ordinances that pose energy requirements on buildings and their appliances can be legislated based on the EnEG.

**Energy Saving Ordinance (EnEV)**

The Energy Saving Ordinance ("Energieeinspaarverordnung (EnEV)") is an important part of the energy- and climate policy of the German Government. Merging the Thermal Insulation Ordinance and the Heating Appliances Ordinance valid up to then, the Energy Saving Ordinance was released for the first time in 2002 and amended for the first time in 2004. In order to implement the first European Directive on Energy Performance of Buildings (2002/91/EC), the EnEV was reissued in 2007 and was once more amended in 2009 following the government's decision "Integriertes Energie- und Klimaprogramm (IEKP)".

On 1st May 2014, a new version of the ordinance came in to force as a consequence of the "Second Ordinance amending the Energy Saving Ordinance of 18th November 2013" (EnEV 2013). The amendment partly serves for the implementation of the recast of European Directive on Energy Performance of Buildings (2010/31/EU). In pursuit of the German Federal Government's decision about the "Energiekonzept" and the "Energiewende", the level of requirements was re-adjusted effective from 1st January 2016 in course of this amendment.

**Gebäudeenergiegesetz (GEG) – 'BuildingEnergyLaw'**

Like all the other EU member states, Germany has to introduce nZEB standard into building and energy performance regulations according to the EPBD (Energy Performance Building Directive). Therefore, a new law was supposed to be introduced: the 'Law for energy saving and use of renewable energy for heat and cold production in buildings' – in short BuildingEnergyLaw (GebäudeEnergieGesetz – GEG). Due to doubts about the economic viability of the proposed nZEB standard and other political reasons, some members of the conservative party (CDU/CSU) in the Bundestag blocked the legislative process, in order to prevent the draft bill to be presented again in this legislative period. This delay results in a violation of EPBD.

The GEG was supposed to be introducing nZEB standard for new buildings from 2019 (public) or 2021 (private) and, at the same time, harmonise and simplify the existing regulations EnEV (Energieeinsparverordnung/Energy Saving Ordinance), EnEG (Energieeinsparungsgesetz/Energy Saving Act) and EEWärmeG (Erneuerbare Energien-Wärmegesetz/Renewable Energy-Heat-Act). The draft of GEG included regulations for existing buildings as well, and would therefore have been relevant for energy renovations: for the most part, the energy requirements for existing buildings would have stayed the same as before, but combined in one law and thus easier to apply for homeowners, energy consultants and contractors.

Next to regulations on the energy performance of new and existing buildings, the draft of GEG also included revised rules on Energy Performance Certificates (EPC, 'Energieausweis'): due diligence was increased for issuers of EPC regarding the quality of data provided by houseowners. Violations could have been fined. The GEG also included the duty of the EPC issuer to use suitable photographies or on-site inspections for their evaluation of a building. The GEG draft also included, that EPC need to include specifications on $CO_2$ emissions, based on primary energy demand or usage, not on final energy demand or usage.

After the election in the autumn of 2017, the new government will have to put the topic back on the agenda in order to comply with EPBD, to continue working on the reduction of emissions in the building sector and to simplify the regulations for the homeowners.

**Climate action plan 2050**

The Climate Action Plan provides guidance to all areas of action in the process to achieve Germany's domestic climate targets in line with the Paris Agreement. These areas of action are energy, buildings, transport, trade and industry, agriculture and forestry.

Key elements are:

- Long-term target: based on the guiding principle of extensive greenhouse gas neutrality in Germany by the middle of the century.
- Guiding principles und transformative pathways as a basis for all areas of action by 2050.
- Milestones and targets as a framework for all sectors up to 2030.
- Strategic measures for every area of action.
- Establishment of a learning process, which enables the progressive raising of ambition, envisaged in the Paris Agreement.[18]

**Energy Efficiency Strategy for Buildings**

The Energy Efficiency Strategy for Buildings explores ways of achieving the goals of energy and climate policy in the building sector and covers both existing and new buildings in Germany. The Energy Efficiency Strategy for Buildings is thereby an important contribution to the development of approaches towards a climate-neutral building stock by 2050. By the year 2050, primary energy demand of buildings will have to be reduced by 80 percent against the 2008 level, through a combination of energy savings and the use of renewable energies. The building strategy maps the current state of knowledge and therefore cannot finally forecast developments by 2050.

The Energy Efficiency Strategy for Buildings will be updated and developed further as an element of the Climate Action Plan 2050.[19]

**National action plan on energy efficiency (NAPE)**

The National Action Plan on Energy Efficiency (NAPE) sets out the Energy Efficiency Strategy of the German Federal Government for the 18th legislative term. NAPE aims to convince all stakeholders of the need to raise energy efficiency and involve them in these efforts. It seeks to show them the scope and opportunities and provide evidence confirming the benefits of a commitment to energy efficiency. With an intelligent mix of consulting, communication and information about lucrative efficiency measures, funding facilities and standards for new installations, NAPE contains a set of instruments to motivate companies and consumers to raise energy efficiency and take an initial step towards harnessing the enormous potential.

The central short-term measures of NAPE include:

- Introducing new competitive tendering for energy efficiency;
- Raising funding for building renovation ($CO_2$ Building Renovation Programme) and introducing tax incentives for efficiency measures in the building sector, supported by the Federal Government and state governments;
- Setting up energy efficiency networks together with business and industry.[20]

### 1.2.2. Denmark

[18] http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimaschutzplan_2050_kurzf_en_bf.pdf.
[19] https://www.bmwi.de/Redaktion/EN/Downloads/energy-efficiency-strategy-buildings-short-version.pdf?__blob=publicationFile&v=2.
[20] https://www.bmwi.de/Redaktion/EN/Publikationen/nape-national-action-plan-on-energy-efficiency.pdf?__blob=publicationFile&v=1.

**National plan for increasing the number of nearly zero energy buildings in Denmark - 2013**[21]

The "National plan for increasing the number of nearly zero energy buildings in Denmark" was published in March 2013. It covers policies and measures regarding both public and private new building to be nZEB by 31 of December 2020. Besides new buildings, the plan also focus on polices and measures for promotion of major renovations for existing buildings. Some of the key points within the national plan in regards to building renovation are as follows:

- Direct and indirect actions promoting energy efficiency of existing buildings. Energy classes for renovated buildings (voluntary).
- Building class 2020 (currently voluntary) has been prepared to meet the building's directive for nZEB
- Implementation of 'Strategy for energy renovation of buildings' in 2014 (see below)
- A mandatory energy audit conducted during the energy performance certificate is made for each house when change of ownership occurs. Besides the audit, each home undergoes professional evaluation, which points out and classifies issues related with the condition of the building. This evaluation allows the buyer to be familiar with current problems of the house and helps in pointing new owners to the 'right' first steps when renovation is undertaken.

**Building Regulations 2010 / Building Regulation 2015**[22]

Present regulations define energy performance requirements but only with respect to the new constructed buildings. nZEB definition is reflected in energy frame 2020 for new constructed buildings that will be mandatory first in 2020 for new residential buildings.

In the Danish building regulations 2015, conversions and alterations to existing building stock must comply with specific requirements for U-values and linear losses for separate construction elements. Those are specified in section 3.2 of this report. As alternative to satisfying requirements for U-values and line losses, conversion requirements can be met through compliance of energy frames for existing buildings.

There is no clear definition of nZEB target for renovated buildings. Currently, there are two energy frames for renovated buildings (class 1 and 2), however they are only voluntary. To achieve a renovation class, the requirement for supplied energy must be improved by at least 30 kWh/m$^2$ per year. Renovation class 1 is achieved when the energy demand for heating, cooling, ventilation and domestic hot water does not exceed 52,5 kWh/m$^2$ per year plus 1650 kWh divided by the heated floor area. Renovation class 2 is achieved when the energy demand for heating, cooling, ventilation and domestic hot water does not exceed 110 kWh/m$^2$ per year plus 3200 kWh divided by the heated floor area.

In order to ensure uptake of renewable sources in renovated buildings, the building regulations specify that part of the energy supply must be from renewable sources when major renovation is done. Major renovations are defined as renovations involving large share of the building envelope and change of boiler or burner is done simultaneously.

**Strategy for energy renovation of buildings 2014**[23] – action plan developed by the Danish ministry of energy, climate and buildings outlining incentives and programs supporting renovation of buildings. The strategy is aimed at different types of buildings, highlights for private homes are:

[21] http://www.buildup.eu/en/practices/publications/national-plan-increasing-number-nearly-zero-energy-buildings-required-18.
[22] http://bygningsreglementet.dk/

- Promote renovation of single-family houses via 'Bedre Bolig' scheme – approval scheme where certified specialist are authorized to advise home-owners on ways of carrying out and manage energy renovation. The accreditation course for the professionals allows them to evaluate existing condition and advice on choice of solutions, suppliers, documentation, quotes etc.
- Promote alternatives to oil and gas-fired boilers based on renewable energy – Since 2013 no oil and gas-fired boilers can be installed in new buildings; since 2016, it is not possible to install oil-fired systems in existing buildings in areas where natural gas or district heating is a possibility.
- Programmes supporting new business models, where energy company owns and operates heat pumps for building owner, while they pay fixed amount for heating, similarly to district heating.

### 1.2.3. Slovenia

The new Energy Act (EZ-1, adopted in February 2014) has transposed the requirement of the Recast EPBD Directive on nearly zero-energy buildings into national legislation. Article 330 of the Act lies down that all new buildings must be nearly zero-energy, with due regard to the deadlines laid down in the Directive. Under the EZ-1, a nearly zero-energy building means a building with very high energy-efficiency or very low quantities of energy needed for buildings operation, where the energy needed is produced to a large degree from renewable energy sources at the actual location or nearby.

In June 2010, pursuant to the recast EPBD, Slovenia adopted the rules on Efficient Use of Energy in Buildings (PURES, Off. Gazette of RS, 52/10, adopted 2. July 2010), which introduce the methodology for calculation of energy efficiency indicators in buildings in accordance with the CEN EPBD standards or the SIST EN ISO 13790 standard and lay down the minimum energy-efficiency requirements for new buildings and the major renovation of existing buildings, it also prescribes the minimum requirements relating to maintenance and technical improvements.

PURES 2010 sets strict minimum requirements for thermal insulation of the envelope and for the maximum permissible heat for the heating of a building, which together prescribed 25% of renewable sources in overall end-use energy for operation of the system in the building and the technical requirements for the system (gas condensing boilers, the required COP for heat pumps, the required efficiency of ventilation recovery systems, the compulsory preparation of sanitary hot water using renewable source systems), constitutes a key part of the minimum requirements for energy-efficient buildings, while the primary energy for heating and cooling is defined somewhat loosely.

### 1.2.4. The Netherlands

**Energie Akkoord 2013 – national agreement**

In 2013, the Netherlands reached a national agreement to reduce the use of fossil fuels and to stimulate the production of sustainable energy. This action plan is called the 'Energie akkoord'. This national action is supported by many key stakeholders, as mentioned earlier in deliverable 'D3.2, Country context'.

The 'Energie Akkoord (2013) sets a few clear and ambitious energy targets (agreements) for residential buildings:

- The built environment as a whole needs to be energy neutral by 2050;

[23] https://ec.europa.eu/energy/sites/ener/files/documents/2014_article4_en_denmark.pdf

- (residential) new built has to be nZEB by 2020 (EPC = 0);
- Rental homes owned by corporations: Need to meet (on average) energy label B by 2020;
- 80% of rental homes owned privately need to meet energy label C by 2020.

The Trias Energya (see Figure 2) is the leading principle in the Energie Akkoord. Energy saving comes before production of renewable energy and thirdly, if needed fossil fuels are used but only in the most efficient and clean way possible.

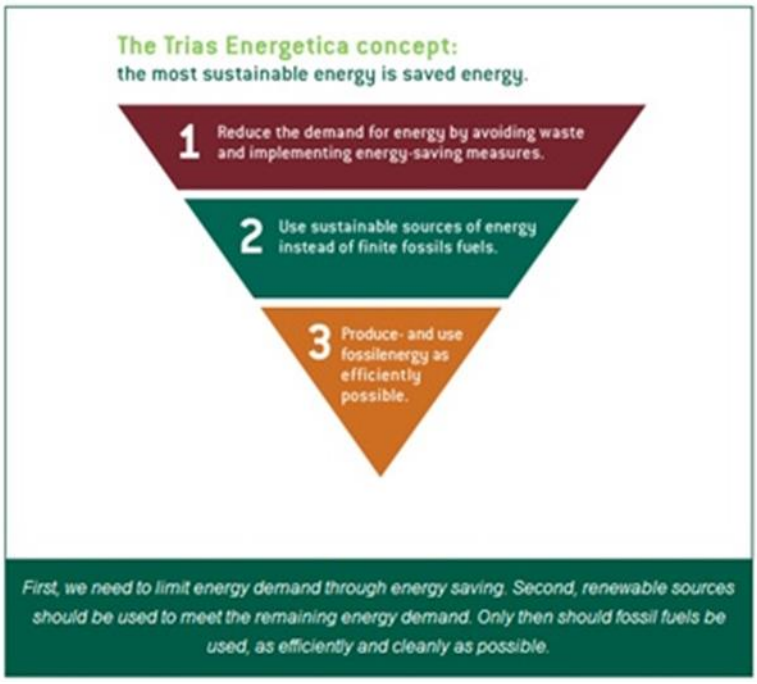



*Figure 1 - Trias Energya (model developed by Delft University, 1979)*

In the Netherlands, the integral energy performance of a dwelling is defined by a non-dimensional coefficient, the EPC. The EPC is formalised in national legislation: It is included in the 'Bouwbesluit', with reference to the NEN 7120 norm as the standard method for deriving the EPC. In the Netherlands nZEB dwellings are known as ´Bijna Energie Neutrale Woningen´ and these are required to reach an EPC equal to zero (EPC = 0)[24] .

Besides renovating to nZEB, the overall national target set for the built environment (= energy neutral by 2050) also gives rise to an even higher ambition level concerning the energy performance of existing dwellings: Transforming/ renovating to a zero-on-the-meter dwelling (NOM, nul-op-de-meter woning; zero-energy building). A zero-energy dwelling needs to meet an EPC equal to -0,42 (EPC= -0,42). A zero - energy dwelling should produce (a little) more renewable energy than it requires accounting for seasonal fluctuations.

**Energie agenda – national agenda to reduce $C0_2$ emission**

The 'Energie agenda' (2016) is a national plan to reduce $C0_2$ emissions by 80-95% by 2050. The agenda was drawn up in line with the Paris agreements. The 'Energie agenda' describes the transition paths towards a $C0_2$-poor society in 2050. The energy transition will also require drastic changes for the built environment. Currently, the built environment in the Netherlands accounts for 30% of the

[24] Definitions and matching EPC values can be found here: http://www.kuub.info/files/2015/02/Energiedefinities-woningen_2015.pdf.

total use of fossil energy. This is the reason why the national government thoroughly stimulates energy saving and the production of sustainable energy. For instance, via subsidies, energy saving loans and Green Deals. Becoming independent of fossil fuels is a key aspect of the 'Energie agenda'. The use of natural gas within residential homes is to be phased out completely by 2050. Minister Kamp of Economic Affairs has recently sent a letter to the Dutch Parliament in which he proposes to (quickly) remove the grid operator's duty to connect newly built houses to the natural gas grid. The 'duty to connect' is to be replaced by a 'right for heat'. This 'heat' could be geothermal heat, heat from biomass, residual industrial heat from nearby and heat generated within an all-electric concept.

**Leeuwarder Energieagenda – municipal plan sustainable energy**

The municipality of Leeuwarden has an overall sustainable energy plan for the short- term (till 2020) called 'De Leeuwarder Energieagenda (LEA for short; 24 February 2016). There are two energy targets for all types of dwellings in the LEA:

1. Achieve an energy saving of 20%, as compared to the energy use of 2010, in 2020;
2. Produce at least 1,41 PJ of sustainable energy in 2020. This is equal to 16% of the total energy use in Leeuwarden in 2013.

Energy saving (target 1) can be achieved in numerous ways, such as Slim Wonen in Leeuwarden, agreements with housing corporations, the use of residual industrial heat and via smart solutions at home (smart meters, changed behaviour, etc.). The production of sustainable energy (target 2) will likely be reached via an 'energy mix', consisting of solar energy, using residual industrial heat and geothermal energy, wind energy (existing windmills) and energy from biomass.

**10 PJ energy convenant - Roll- out of smart meters**

In the 10PJ energy convenant (23-05-2017), the national government and the cluster organisation for grid operators agreed on the nation-wide rollout of smart meters for all types of dwellings by 2020. Every household in the Netherlands will be offered a smart meter by their regional grid operator before 2020. Grid operators have also agreed to inform the customer about the possibilities of connecting the smart meter to a monitor or display of any kind. Homeowners who can follow their energy use 'live' and who can benchmark it, haven proven to save much more energy than those who do not have these insights.

### 1.2.5. Belgium - Flanders

The relevant national and regional regulations concerning energy performance of buildings and nZEB renovations were already briefly discussed in a previous REFURB deliverable[25]. However, since its time of writing, this regulatory context has evolved. One of the main drivers behind these changes is the Renovation Pact, an initiative of the Flemish Government in collaboration with stakeholders to improve the energy performance of the existing building stock in Flanders. This section highlights the most important changes and its impact about quality assurance of nZEB renovations.

**Long-term ambition (2050) for the energy performance of existing buildings**

The Flemish Energy Agency (VEA) defined the long-term ambition for the energy performance of existing buildings in May 2016. This long-term ambition can be interpreted as the nZEB definition for renovated buildings in Flanders.

There are two options in order to comply with the long-term ambition:

[25] Deliverable D3.2 Energy efficiency solutions per housing type: Annex 1: Belgium – Flanders.

- Option 1: Set of measures related to the building envelope and the technical installations. Requirements for the building envelope consist of maximum U-values for the building components, which are similar to the existing nZEB thresholds for new residential buildings. The requirements for the technical installations relate to specifications of the heating system, which should be a condensing boiler, (micro-) Combined Heat and Power (CHP), heating system on renewable energy sources (such as a heat pump), decentralized heating with nominal performance limited to 15W/m² or a connection to an efficient District Heating network.
- Option 2: Target for Energy Performance Indicator. Depending on the calculation method, an E-level of E60 or an EPC energy score around 100 kWh/m² per year is required[26].

Goal of this long-term objective: An average reduction of EPC energy score between 65 or 85%, depending on housing typology.

| Category | $U_{max}$ requirements (W/m²K) |
|---|---|
| Roof | 0.24 |
| Wall | 0.24 |
| Floor | 0.24 |
| Window (profile and glazing) | 1.5 |
| Glazing | 1.1 |
| Doors | 2.0 |

*Table 2 – Required thermal insulation values for NZEB legal requirements for new residential buildings in the Flemish Region (Belgium)*

**Increased quality control requirements**

Recently, there is an increase of policy measures related to the quality control of building components with high impact on the energy performance of a building. These measures range from certification requirements for construction companies, to quality labels or a quality control framework for certain building components. Some of these measures are mandatory; others are voluntary but might be required in order to qualify for grants or other financial support.

**Rollout of smart meters**

The use of digital meters is still in its early stages in Belgium. Although Flanders is lagging behind about the deployment of smart meters, the public announcement of the smart meter rollout in 2019 by the Flemish Government is a sign of a shift in a new direction. The Flemish Ministry of Energy has publicly announced a plan to have a smart meter installed in every Flemish house by 2019 to stimulate market uptake of smart meters[27]. Initially smart meters will be mandatory for new buildings and buildings that undergo major renovation for instance when installing a decentralized production system (below 10 kVA) or when replacing old meters.

[26] The E-level is calculated using the energy performance calculation for new residential buildings in Flanders (EPW-method), while the EPC-score is calculated using the energy performance calculation for existing residential buildings in Flanders (EPC-method).
[27] Flemish Government (2017) *Conceptnota "Digitale meters: uitrol in Vlaanderen".*

# 2. Methods for performance evaluation

There are a number of options to evaluate the energy performance of a building or its components. With its components, reference is made to the components that have the greatest impact on the energy performance – the building envelope, the technical systems and renewable energy technologies.

In terms of quality assurance, the leading questions are: How to guarantee energy savings for the owner? Will renovation measures deliver the benefits that they promise? Therefore, this Chapter covers specific regulations, energy performance certificates for buildings, energy contracting models, obligations from grants as well as other financial schemes for energy performance improvement of residential buildings. In this chapter, three categories are distinguished with regards to methods for performance evaluation:

1. Assessment of the energy performance of the building, which may include energy performance requirements of certain building components;
2. Methods that emphasise on how to improve (rather than assess) the performance on one hand and that support quality and compliance checking during construction on the other hand; and
3. Measuring and monitoring of energy consumption post-construction.

Each category is discussed below. The final section identifies success and fail factors, which will form the basis of the quality assurance approach in Chapter 4.

## 2.1. ENERGY PERFORMANCE ASSESSMENT AND ENERGY PERFORMANCE REQUIREMENTS

This Chapter refers to existing approaches - national or regional, public and private - for energy performance assessment and energy performance requirements for the customer (private homeowner).

### 2.1.1. Germany

**Energy performance certificates for buildings**

The introduction of energy certificates in all member states of the European Union – and as such for Germany – was required in course of the implementation of the first Directive of Energy Performance of Buildings.

When the directive came into effect (2006), energy demand certificates for new buildings were already introduced in Germany through earlier ordinances since 1995. Furthermore, regional and national pilot projects on voluntary basis for the issuance of energy certificates were widely introduced. Additionally there was a long tradition of "heating cost accounting" which could serve as a suitable basis for the issuance of energy consumption certificates.

Based on this, with the issuance of the Energy Saving Ordinance 2007 (EnEV 2007) the government opted for a so-called "dual system" which foresees coexisting certificates based either on demand- or on consumption. This compromise was on the one hand supposed to provide the desired best possible description of the energy performance of the building, as well as on the other hand to limit financial administrative burdens to an affordable level.

With the EnEV 2013 getting into force by 1st May 2014, the energy certificates are changed significantly. This was due to the transposition of European as well as some national issues. Significant changes are – among others – the establishment of an independent control system[28] as well as the introduction of energy classes for residential buildings.

Regulations concerning the issuance of Energy Certificates

The legal basis for energy certificates is given in Chapter 5 of the Energy Saving Ordinance ("Energieausweise und Empfehlungen für die Verbesserung der Energieeffizienz"). The regulations concern i. a. the different occasions when energy certificates become compulsory, the use and principles of energy certificates, the layout and structure of forms, the requirements for the recommendations to be included in the certificates and the skills needed to be an issuer for existing buildings.

According to § 16 EnEV, energy certificates are necessary:

- After the completion of a new building,
- If - in correspondence with refurbishment measures or a larger extension - an energy balance for the entire building is calculated,
- With sale or renting of buildings or parts of buildings (e.g. apartments),
- For display on certain buildings of public service frequently visited by the public.

In general, energy certificates are issued for an entire building. Energy certificates for single apartments or other units within buildings are not foreseen in Germany. According to § 20 EnEV, every energy certificate has also to include recommendations for improvements to the building.

With the EnEV 2013, new regulations were added concerning an independent control system for energy certificates and the introduction of compulsory energy performance indicators for property advertisements.

Since the first introduction of energy certificates for existing buildings, official bulletins are published with reference to the regulations of the Energy Saving Ordinance. These bulletins contain methods and simplifications applicable in course of the issuance of energy certificates and other calculations for existing buildings. Concerning the climate correction of consumption indicators in consumption-based certificates, these bulletins refer to correction factors provided by Deutscher Wetterdienst (DWD; Gemany's National Meteorological Service).

**Obligations from grants**

In Germany, there are several financial drivers for private owners of single-family houses to start renovating their house. Reducing energy costs and running costs are major aspects. Therefore, grants make a substantial contribution to quality assurance. This topic is already mentioned in a detailed manner in WP4.5 "Supportive financial constructions". However, since these instruments refer to certain standards and quality assurance achievements some KfW products[29] should be noted at this point as well:

- loan from the KfW-Bank:

KfW is a government-owned development bank in Germany, which is, amongst others, active in the field of housing and environment and specialises in supporting energy efficient renovation and building. In order to finance measures of energy refurbishment, the bank provides loans at reduced interest rates, as well as grants and subsidies. The loans are associated with the abovementioned

[28] §26d refers to sampling inspection of energy performance certificates and inspection report regarding air-conditioning systems.
[29] https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/.

energy requirements and regulations of EnEV. KfW-Bank 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 certain 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). There are higher levels possible for refurbishment of existing buildings (KfW 85, KfW 115).The standard 'KfW-Effizienzhaus 40 Plus' is the most advanced standard. These houses can produce energy, store it and thus are able to provide the small amount of additional energy they still need for themselves. In connection with these standards, KfW developed a system of loans, that the homeowner can receive either for the achievement of a certain KfW level or for single refurbishment measures.

- 'Kredit 151':

If you renovate your house towards a 'KfW-Effizienzhaus' you can receive this loan. You can get up to 100.000€ per dwelling. The interest rate is 0.75%. The higher the 'Effizienzhaus'-standard is after refurbishment, the higher is the repayment grant you receive, which means you do not have to pay back the full amount of your loan. For a 'KfW-Effizienzhaus 40 Plus' you receive: 15% of the grant amount as a repayment grant (up to €15.000). For a 'KfW-Effizienzhaus 40' you receive 10% of the grant amount as a repayment grant (up to €10.000). For a 'KfW-Effizienzhaus 55' you receive 5% of the grant amount as a repayment grant (up to €5.000).

- 'Kredit 167':

If you install a new heating system based on renewables (solar thermic systems, bio mass, heat pumps, combination of fossil fuels and renewable energy), you can receive this loan. You can get up to €50.000 per dwelling. The interest rate is 1.11%. It can be fixed for up to 10 years.

### 2.1.2. Denmark

**National approach for energy performance**

The current approach to stimulate better energy performance of renovated buildings is setting requirements for maximum transmission and linear losses of different building elements. Those are shown in Table 3.

| Building element | $U_{max}$ requirements (W/m²K) |
|---|---|
| External walls and basement walls in contact with the soil | 0.18 |
| Partition walls and suspended upper floors adjoining rooms/spaces that are unheated or heated to temperature which is 5 C higher or lower than temperature in the room concerned | 0.40 |
| Ground slabs, basement floors in contact with the soil and suspended upper floors above open air or ventilated crawl space | 0.10 |
| Ceiling and roof structures including jambs walls, flat roofs and sloping walls directly adjoining the roof | 0.12 |
| Doors/gates | 1.80 |
| Hatches, new secondary windows and skylight domes | 1.40 |
| Renovated secondary windows | 1.65 |
| Renovated Element | Linear loss (W/mK) |
| Foundations | 0.12 |
| Joints between external walls, windows or | 0.03 |

| | |
|---|---|
| external doors and hatches | |
| Joints between roof structure and rooflights or skylight domes | 0.10 |

*Table 3 – Maximum allowed U-values and linear losses for building elements in the Danish Building Regulations 2015 for conversions and alterations of existing buildings. Extract from Building Regulations 2015 – Chapter 7.4.2.*[30]

**Energy performance "Energy demand of buildings"**

Alternative to the requirements for separate elements, the requirements for conversion can be met by compliance with the energy demand for new buildings. The energy demand is calculated based on a simplified calculation tool, under quasi–stationary conditions (ISO 13 970). The energy need for heating is calculated according to EN 832 and EN ISO 13790, district heating and hot water calculations are made according to EN 14335. Total energy demand is calculated according to EN 14335. It includes energy need for heating, cooling, ventilation and domestic hot water. There is one mandatory and one voluntary energy frame for buildings in the Danish Building Regulation 2015. Those are energy frame BR2015 and Energy frame 2020, respectively. The maximum allowed energy use for building class in BR 2015 is 30 kWh/m$^2$ per year plus 1000 kWh per year divided by the heated floor area. For voluntary building class 2020 the maximum allowed energy use is 20 kWh/m$^2$ per year.

**Financial schemes by the government**

Two schemes support renovation process by financial stimulation. Those can be obtained for a variety of renovated elements and systems.

The first one is a grand obtained for completed works (Energi Tildskuld). The size of the financial compensation is dependent on the initial source of energy that the building is supplied with, type of renovated elements and their before/after conditions. The grant is awarded on the condition of proof before renovation (usually a picture), approval of application and documentation in form of receipts for materials/workers, which answers to the approved application.

The second financial compensation that has mostly to do with stimulation for renovation, rather than quality of the renovated works is tax deductions (Håndværksfradrag). The general idea is that individuals living in a renovated house that are above the age of 18 years can receive tax deduction from their payments, because they have renovated parts of their house. The amount of deduction is depended on number of factors, such as location, type of renovation, amount of renovated elements, etc.

### 2.1.3. Slovenia

**Energy performance certificate (EPC)**

Energy performance certificate (EPC) is a document providing information to energy performance of the building and information towards increasing energy efficiency in buildings. The measure is of informative value to the prospective user – buyer or renter. It should be noted that the energy performance certificate in Slovenia is mandatory for all buildings, in case if building (or apartment) is sold or leased (longer than one year). Additionally, the energy certificates are also required for all new buildings and all public buildings with an area greater than 250 m$^2$.

In years 2013-2016 more than 35.000 EP certificates were issued, 77% of them for residential buildings.[31] The information of energy efficiency provides information on energy costs related to

[30] http://bygningsreglementet.dk/br15_03_id118/0/42
[31] See Register of energy bills as of 20/07/2017 available on Energetika portal http://www.energetika-portal.si/fileadmin/dokumenti/podrocja/energetika/energetske_izkaznice/seznam_izdanih_ei_20-07-2017.pdf.

ensuring thermal comfort indoors. It is to be mentioned that EPC not only indicates the class or provides energy efficiency of building, but also the recommended measures to be implemented in order to increase efficiency. The energy performance certificate is therefore a step further than the energy labels for electrical appliances, informing users about the energy consumption and provides advice towards the most effective measures. These recommendations provide an incentive for the implementation of most important measures and are not general, but pertaining to the building for which an energy performance certificate is made.

Energy improvement is a costly affair and therefore, because of the non-favourable economic situation in Slovenia, the investors decide for the loans and incentives aimed at co-financing energy efficiency measures.

**Financial schemes**

The key measures supporting realisation of the targets set in relation to the renovation of existing single-family houses and multi-apartment buildings are, in particular: financial incentives, the provision of repayable funding for nearly zero-energy renovation (dedicated funds – Eco fund and funding – loans from international financial institutions), the provision of information to building owners and managers (energy advisory services, information campaigns), energy contracting models and in state of development a stimulating tax policy to encourage nearly zero-energy renovation.

Slovenian Eco fund – Slovenian environmental public fund (www.ekosklad.si) was established as a legal public entity under the Environmental protection Act and constituted as the largest public financial institution with a goal to promoting environmental investments in Slovenia. The main activities of Eco-fund are providing favourable soft loans at lower interest rates and provision of subsidies to environmental friendly investments on terms of open Calls. Besides, Eco fund is responsible for providing for actions of ENSVET energy advisory network, promotion and awareness rising.

In latest years, the Eco-fund grants (Open Calls) reflected the mission of European guidelines towards deep building renovation by providing higher grants for such investments. Thus, the investments that are focusing on single investment measure only (thermal insulation of building envelope, insulation to ceiling, regulation of heating) are subsidised with a lower rate (20 % of eligible costs), in comparison to the investment with a focus on comprehensive measures, which receive higher grants (40 % of eligible costs). To guarantee the energy savings the specific condition has to be kept, project supervision in planning and construction in accordance to the legislation on construction. Up to 50% of costs for supervision, service could be covered by the incentive. In addition, it is promoted to use the service of national energy advisory network in the decision-making phase, to receive independent advice and to prepare a tailor-made approach for the investment.

SID and EIB Bank loans: investments into energy efficiency and utilization of RES for specific intents: energy efficiency (building envelope, heating appliances and systems, ventilation and cooling systems), RES (solar thermal systems, photovoltaics, biomass heating, heat pumps). Purpose of the soft loans is to provide loans for investment into energy renovation for private persons (max. €30.000), building managers, flat-sharing communities (up to €150.000), covering up to 100% of project investment, with a loan maturity of max. 15 years. The soft loan may be obtained at Gorenjska bank, Saving bank LON, others. In process of loan, issuing SID bank is verifying the investment and calculates measures/ investment performance. In our opinion, the critical review of investment by the experts safeguards against pitfalls in the process of construction.

In Slovenia, there are few initiatives aimed at energy performance improvement for customer worth mentioning:

- National energy advisory network (network EnSVET) providing over 6000 advices per year in 55 advisory offices across Slovenia (www.ensvet.ekosklad.si). Free-of charge energy advisory service for citizens provides individual, free and independent energy consulting. Additionally, awareness rising activities for promotion of energy efficiency and RES are part of EnSVET action package. The network of ENSVET offices is covered by independent energy advisors, providing energy advices on energy efficiency measures and assisting in selection, planning and implementation of investment measures. The application for advisory service is carried out through e-application, by email or in direct (phone) communication with advisory office. After the preliminary interview with the energy advisor, the first action plan for the action is prepared and necessary information inherent to the works provided. The EnSVET is not providing the services of refurbishment actions supervision.

- Information campaigns, websites with info on subsidies available at Ministry page, Eco fund Slovenia and via many semi commercial websites supporting advanced energy efficient buildings with significant share of RES.

### 2.1.4. The Netherlands

**Energy labels (=certificates)**

Since 2008, energy labels for privately owned dwellings have been issued. The energy label system was simplified over the years. Since 2015, it is obligatory for a homeowner to apply (online) for a definite energy label for their dwelling before any relevant transition, such as selling or renting out. All dwellings without an energy label, received a temporary energy label from the national government in January 2015. This was done in line with the national implementation of the EPBD. A temporary energy label does not have any legal value; it is merely an estimation of the energy performance of the dwelling and is meant to create awareness among homeowners. Homeowners, who carry out a relevant transaction without a definite energy label, run the risk of being fined. A definite energy label is valid for 10 years.

**Energiebespaarlening – national loan for energy saving measures**

A dedicated fund offers private homeowners cheap loans for carrying out energy saving measures. For financing individual measures, homeowners can lend a minimal of €2.500, and a maximum of €25.000. Higher loans are available for a 'zero – energy house' (€50.000) and the 'very energy-conscious package (€40.000), provided that certain preconditions with regard to energy performance are met. The payback time is between 7 and 15 years, with an interest rate of 2,5% (for 10 years).

The Stimuleringsfonds Volkshuisvesting, national government, ASN Bank, and the Rabobank support the fund. It can accessed online: https://www.energiebespaarlening.nl/particulieren/.

The loan can be used to finance individual energy measures too. In any case, the homeowners has to be able to show quotations from certified contractors and builders when applying for the loan. In addition, only a maximum of 75% of the sum can be used for financing solar panels. The other 25% always has to be spend on other energy saving measures.

*Loan for very zero – energy house*

A private homeowner can lend up to €50.000 to finance a renovation towards zero-energy. The loan has to be paid back within 15 years.

These are the preconditions that (also) need to be met to get an 'Energiebespaarlening' for a zero-energy house:

| Measure | | Insulation values |
|---|---|---|
| Roof insulation | | minimum Rc-value 6,5 [m²K/W] |
| Facade insulation | | minimum Rc-value 5,0 [m²K/W] |
| Floor insulation | | minimum Rc-value 4,0 [m²K/W] |

| | | |
|---|---|---|
| **Glass** | | maximum U-value 0,8 [W/m²K] |
| **Insulation window frames** | | maximum U-value 1,5 [W/m²K] |
| **Insulation doors (facade)** | | maximum U-value 1,5 [W/m²K] |

*Loan for very energy- conscious package*

A private homeowner can lend up to €40.000 to finance a renovation towards a 'very energy-conscious package'. The loan has to be paid back within 15 years.

A loan for a 'very energy conscious package' renovation is only possible when these energy measures are included:

- Insulation of the roof, façade, floor, window frames, glass and doors;
- A system for $C0_2$- controlled ventilation or balance ventilation with heat recovery;
- Airtightness.

These are the preconditions that (also) need to be met to be to get an 'Energiebespaarlening' for financing a 'very- energy- conscious package':

| Measure | Values |
|---|---|
| **Airtightness** | (Qv_10) kar [l/sm²] at least 0,4 |
| **Roof insulation** | minimum Rc-value 6,5 [m²K/W] |
| **Facade insulation** | minimum Rc-value 5,0 [m²K/W] |
| **Floor insulation** | minimum Rc-value 4,0 [m²K/W] |
| **Glass** | maximum U-value 0,8 [W/m²K] |
| **Insulation window frames** | maximum U-value 1,5 [W/m²K] |
| **Insulation doors (facade)** | maximum U-value 1,5 [W/m²K] |

### 2.1.5. Belgium - Flanders

**Energy performance assessment**

In Flanders, Belgium, there are two energy performance assessment methods that could be applicable for a renovation project:

- The energy performance assessment method for new buildings or renovations (EPW-method). This method has to be used to assess the energy performance when issuing a building permit for a new building or renovation.
- The energy performance assessment method for existing buildings (EPC-method) to calculate energy performance certificates (EPCs). The EPCs are mandatory when advertising buildings for sale or rent.

Both methods were already covered in Deliverable D3.2 Energy efficiency solutions per housing type: Annex 1: Belgium – Flanders.

**Energy performance requirements**

In Flanders, a distinction is made between major renovations and ”regular” renovations. A major renovation according to the Flemish Energy Performance regulation corresponds with a renovation in which first, the technical building system is replaced and second, 75% of the building envelope is insulated. Energy performance requirements differ for major renovations and regular renovations (see

*Table 4*).

| Category | Requirement for major renovation | Requirement for renovation |
|---|---|---|

| | | |
|---|---|---|
| **Thermal Insulation** | Maximum U-values (for new or newly insulated building parts) | Maximum U-values (for new or newly insulated building parts) |
| **Energy Performance** | Maximum E90 (as calculated according to the EPW-method) | - |
| **Indoor Environment** | Minimum ventilation requirements | Minimum ventilation requirements (for existing rooms when windows are replaced and for new spaces) |
| **Technical Installations** | - | Minimum installation requirements (for new, renewed or replaced systems) |
| **Renewable Energy** | ≥ 10 kWh/m².year | - |

*Table 4 - Energy performance requirements for renovations and major renovations (source: Flemish Energy Agency (VEA))*

The minimum requirements for technical installations apply for new systems such as condensing boilers, heat pumps or ventilation systems with heat recovery[32]. The requirement for renewable energy production was introduced only recently, and entered into force in January 2017.

**Performance requirements associated with grants or subsidies**

In addition to the aforementioned mandatory requirements, there are voluntary performance requirements in order to obtain a grant or subsidy for renovation measures or major renovations. They can relate to the overall performance of the building (e.g. major renovation with energy performance level E60) or building component (e.g. minimum thermal resistance for floor insulation). An overview is provided in Table 5.

| Measure | Description / specification | Requirements |
|---|---|---|
| **Building performance** | Energy performance of the building | E60 |
| **Roof insulation (*)** | | R ≥ 4,5 m².K/W<br>min. 30 m² |
| **Wall insulation** | Cavity wall | min. 30 m² |
| | Exterior insulation | R ≥ 3,0 m².K/W<br>min. 30 m² |
| | Interior insulation | R ≥ 3,0 m².K/W<br>min. 30 m² |
| **Glazing** | High Performance glazing | U ≤ 1,1 W/m².K<br>min. 5 m² |
| **Floor insulation** | | R ≥ 2,0 m².K/W<br>min. 30 m² |
| **Heat pump** | Brine/water<br>Water/water | Energy efficiency label: A++ |
| | Air/water | Energy efficiency label: A+ |
| | Hybrid air/water | Energy efficiency label: A+ |
| | Air/air | Energy efficiency label: A+ |
| **Ventilation** [33] | Type C | Demand control $f_{reduc}$ < 0,9 |

[32] It should be noticed that on a European level, similar requirements are put forward by the European Ecodesign directive for energy related products for heating, domestic hot water production and ventilation.

| | | |
|---|---|---|
| | Type D | Efficiency of heat recovery $r_{preh}$ > 75% |

*Table 5 - Energy performance requirements for renovation measures to apply for grants or subsidies (source: Flemish Government)*

There are several grants at the homeowner disposal depending on the undertaken renovation measure. For example, in the case that cavity or external insulation is not possible, indoor insulation may take place. Then there is a big risk of causing internal condensation, therefore an expert needs to perform a study to determine the optimal insulation material and method to be applied. The works can be performed by a certified contractor or by a non-certified contractor supervised by an architect[34]. More can be read on Section 4.5 of this report.

### 2.1.6. Estonia

In Estonia, the energy performance assessment method for new buildings and major renovations is relatively complex, as it is mainly based on dynamic energy simulations. The energy performance used on EPCs is based on a simplified methodology using measured energy consumption, the Weighted Specific Energy Use (WSEU)[35]:

In order to determine the building's weighted specific energy use, the following parameters are calculated:

1) the average expenditure of heating energy reduced in accordance with the number of degree days per test reference year and multiplied by the energy carrier conversion factors;
2) the average expenditure of energy for the purpose of heating household water, multiplied by the energy carrier conversion factors;
3) the average expenditure of electricity multiplied by the energy carrier conversion factor;
4) the average expenditure of gas which is used for other purposes than the generation of heating energy, multiplied by the energy carrier conversion factor.

The format of the EPC is visualised below.

[33] In Belgium, "Type C" is used for ventilation systems with mechanical exhausts and natural supply; while "Type D" is used for ventilation systems with mechanical exhaust and mechanical l supply.
[34] http://www.energiesparen.be/binnenisolatie/burgers

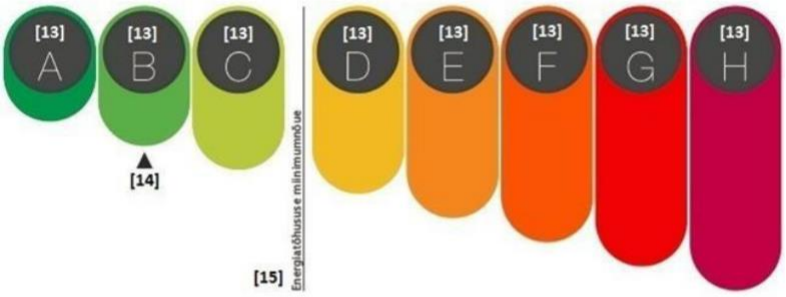
[35] Format and procedure of issuance of energy performance certificates:
https://www.riigiteataja.ee/en/eli/527102014001/consolide
Minimum requirements for energy performance:
https://www.riigiteataja.ee/en/eli/520102014001/

[1]

Energiamärgise nr: [1¹]
Hoone kategooria: [2]
Hoone kasutamise otstarve: [3]
Aadress: [4]
Ehitisregistri kood: [5]
Ehitusaasta: [6]
Köetav pind: [7]
Korterite arv: [8]
Soojusvarustus: [9]
Energiaallikas: [10]

Tellija: [11]

Energiamärgise algandmete allikas: [12]




[16] : [17]
Märgise väljaandmise kuupäev: [18]
Märgis kehtib kuni: [19]

Märgise väljaandja:

Äriühing või FIE: [20]
Registrikood: [21]
Vastutav spetsialist: [22]
[23]

Hoone energiakasutus:

| Energiakandja | TARNITUD ENERGIA | | | EKSPORDITUD ENERGIA, kWh/a | LOKAALSE TAASTUVENERGIA SÜSTEEM | ERIKASUTUS (tarnitud - eksporditud), kWh/(m²·a) |
|---|---|---|---|---|---|---|
| | elekter/kaugküte/ kaugjahutus, kWh/a | OSTETUD KÜTUSED | | | | |
| | | kogus/a | ühik | | | |
| [24] | [25] | [26] | [27] | [28] | [29] | [30] |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | ERIKASUTUS KOKKU, kWh/(m²·a) : | | [31] |

Märkused: [32]

### 2.1.7. Findings

There are various quality assurance schemes and incentive structures for energy saving and cost reduction for the homeowner. These schemes and structures include building energy performance certificates (and energy labels for components) performance requirements linked to grants or subsidies, tax reductions, energy portals, and energy performance contracts. In addition to these instruments, individual advice needs to show building owners what they can save and what is cost-effective.

A recently published report of the EeMAP project[36], reviewed different options for Energy Performance Indicators from the perspective of financial institutes. One of the conclusions was that the Energy Performance Certificate (EPC) is still the most widely available instrument for building energy performance information in Europe, as it provides homeowners and occupiers with objective information to assess, compare and improve the energy performance of their properties. Nevertheless

[36] EeMAP (2017) Technical Report on Building Performance Indicators that Impact Mortgage Credit Risk

the report highlights a number of challenges in using EPCs as a baseline for calculating how much energy would be saved when undertaking an energy-efficient renovation.

Although there are clearly limitations of the EPCs as a tool to guarantee energy savings, the REFURB EPCs still play an important role as a tool to promote energy renovations. They still provide an initial basis for quality control. Energy performance assessments prior and after the renovation are an accepted means to verify the performance of the deep renovation and can provide a first indication of expected energy savings.

*Performance gap and the challenge to assess energy savings*

An energy performance assessment prior and after renovation can provide an indication of expected energy savings. However, despite the various quality assurance schemes and incentive structures for energy saving and cost reduction for the homeowner discussed previously, it should be mentioned that it is challenge to guarantee to achieve the expected benefits, as it does not (necessarily) mean that the predicted energy saving will be achieved in practice. This can be caused by the calculation model assumptions, the quality of works or the user behavior .

The following sample illustrates this matter: In 2015, scientists at the E.ON Energy Research Centre at RWTH Aachen University investigated the causes of the so-called "rebound effect": With the refurbishment of a residential neighbourhood in Karlsruhe, everything was done correctly in theory. Nevertheless, the consumption values measured in three investigated buildings are up to 25 per cent higher than the requirement values calculated prior to the refurbishment.[37]

The fact that the expected energy savings did not materialise is due to both technical and social reasons. Especially when it comes to energy renovation of older buildings (German "Altbau") - the rebound effect particularly occurs with such older buildings: with existing building stock, the disparity between the energy requirement and consumption is greater the older the buildings are. This is because input parameters that are to some extent accepted and specified in the calculation methodology increasingly differ from the values that actually occur in reality. Particularly sensitive input variables have proved to be the indoor temperature, U-values, thermal bridge calculations and the air exchange rate.

Additionally, people adjust their behaviour to the technology and seem to relish using their new devices and comforts, often pushing energy consumption up and undermining the effort to reduce emissions of carbon. The behaviour undermines expected energy savings. Therefore, user behaviour needs to be taken into account with energy refurbishments.

It can be generally ascertained that it is evidently not sufficient to focus purely on energy efficiency measures. According to the research results mentioned above, increasing the energy efficiency in the building sector alone is not necessarily enough to reduce the overall energy consumption and additional measures are required. Planners and architects will need to take into account that the theoretically possible energy savings will be reduced as a result of the performance gap and rebound effect.[38]

Especially if the conditions have changed before and after renovation, it might be a challenge for the supply side to guarantee a specific performance as these often are solely under the control of the user/customer. A commonly applied model to assess the energy performance of residential buildings are simplified quasi-steady state models[39]. The assumptions in this model rely on:

[37] http://www.bine.info/en/publications/projektinfos/publikation/nutzerverhalten-bei-sanierungen-beruecksichtigen/.
[38] Ibid.
[39] The energy performance regulation applied in Belgium serves as reference in this example but similar findings can be made in case of The Netherlands, Denmark, Germany,…

- Reference weather or climate data (e.g. solar radiance, outdoor monthly temperatures),
- Technical characteristics of the building (e.g. inulation levels of the building envelope, performance of the building systems) and
- Standard user behavior (e.g. an average indoor temperature of 18 °C, consumption of domestic hot water based on building volume).

Deviations from these boundary conditions can result in a difference between the predicted and actual energy consumptions and thus between the predicted and actual energy savings. Linking back to the three bullets above, the following situations are not uncommon to occur:

- Other outdoor temperatures or solar radiation as a result of "hot" or "cold" years;
- Quality of works, either with using other building products than specified or building components performing differently in real-life conditions than under test conditions;
- Different user behavior, which can be the result of the consumption pattern but also changed composition of the household or lifestyle change (e.g. a new child or children leaving the house; retirement and thus an increased presence at home during the day).

There are numerous studies and reports on this subject[40].

Furthermore, there is a perception among built environment professionals that EPCs are unreliable as a source of data on building performance. The European project QUALICHeCK addressed this issue, by specifically focusing on improving compliance with EPCs41 and quality of the works42. Frequent deviations between actual versus claimed or expected EPC ratings and quality of building works however could discredit the overall perception of deep renovations in the building sector.

This performance gap undermines the reliability of the EPC for investors or economic decision-making[43]. When the quality and reliability of EPCs is low, it becomes more difficult to rely on them. This is rarely an issue for the customer, it is mainly important for financial institutes to assess the risk of investments based on energy savings.

*Communication of the performance assessment*

From the perspective of homeowners and tenants, information on potential energy savings on an EPC can be important but there are other elements that might be equally or even more important for homeowners when renovating their homes. This is documented in various REFURB WP2 deliverables: Energy savings could be important for customers, but are not necessarily the only reason or the main reason for customers. Comfort, esthetics, and other drivers can be equally or more important.

This was also a topic in the workshop "Scaling up deep energy renovations: Unleashing the potential through innovation and industrialization" organized by BPIE in 2016 and attended by REFURB

[40] A selection of relevant references in Belgium:
- Deurinck, M. (2015) Energy savings in residential buildings
- Delghust, M. (2015) Improving the Predictive Power of Simplified Residential Space Heating Demand Models

[41] QUALICHeCK (2017) Source book for improved compliance of Energy Performance Certificates (EPCs) of buildings

[42] QUALICHeCK (2015) Guidelines for better enforcement of quality of the works in buildings

[43] Geissler S., Braunisch K. (2016) *QUALICHeCK factsheet #36: Investing in building energy efficiency: the role of the EPC in economic decision-making*

partners VITO and ProjectZero[44]. In the following example, energy savings were not mentioned in the top three of main advantages after deep renovations:

*"In the Dutch Energiesprong project, what building occupants liked most about their renovated net zero energy homes, was the deeper windowsills, the new kitchen and the fact that the house no longer looked like public (=social) housing."*

There are indications that improving the 'look and feel' of EPCs, by moving from technical document to a visual attractive and informative medium increase the perception of reliability by homeowners and tenants.

The Flemish Energy Agency conducted a service design process with end-users, to improve the 'look and feel' of energy performance certificates. The current EPCs will be updated and a new format for EPCs (EPC+) will be introduced in 2019. The new update focusses on user-friendliness, communication and information on renovation measures, rather than targeting the energy performance gap. The latter was addressed as well but rather by relatively modest improvements of the calculation methodology. Important features of this new update are the choice to depict an energy efficiency class (A+ to F), a renovation roadmap and indication of investment cost for renovation measures.

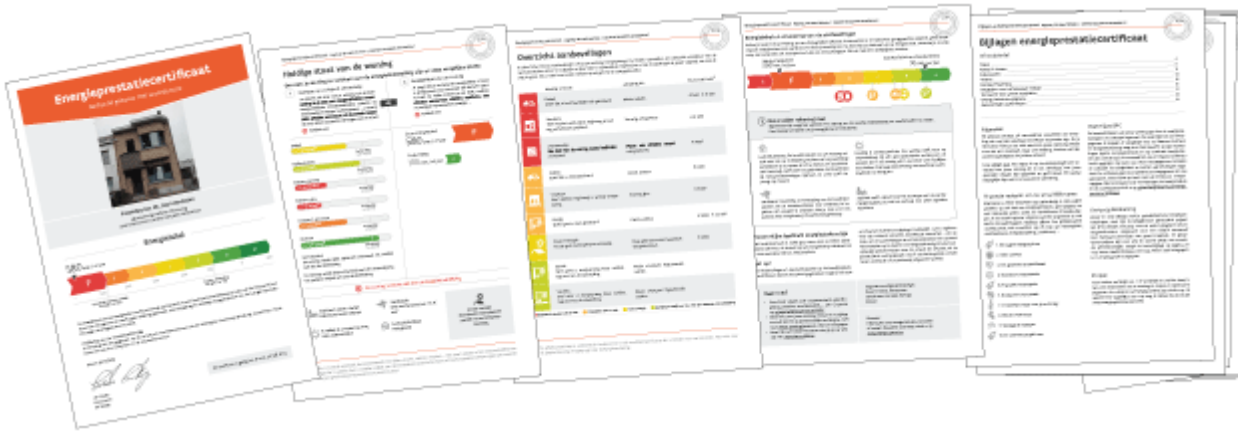




*Figure 1: Snapshot of Mijn Energiekompas (above). The choice was made to use energy labels instead of numerical value to represent the energy performance of the dwelling in an intuitive and easily understandable way. The new format of EPCs in Flanders, which will be launched in 2019 (below) will follow the same logic.*

[44] BPIE, i24C (2016) Scaling up deep energy renovations: Unleashing the potential through innovation and industrialization, available on http://bpie.eu/publication/scaling-up-deep-energy-renovation/

*Source: Leiedal & VEA*

This switch from using a numerical value in kWh/m².year to an energy label followed the trend of preceding tools in Flanders (such as Leiedal's Mijn Energie Kompas which was launched in the beginning of 2017) and other (inter)national examples of EPCs.

## 2.2. TOOLS FOR QUALITY ASSURANCE IN THE RENOVATION PROCESS

Processes for energy renovation are quite similar to new build and involve many of the same actors, although they normally exclude the tasks and actors of property development and sale or letting. Such renovation processes and actor constellations are thus almost as complex as those for new build. In some regions, we have observed that a number of quality standards have emerged or were improved during the course of REFURB. For example, in Belgium a new quality standard for indoor insulation and cavity wall insulation have been introduced along with a certification scheme for installers of renewable energy systems.

For the actual energy renovation process, there are specific instruments and schemes to assure the quality of the implemented measures, such as schemes that support renovation process by financial stimulation, mandatory requirements, quality frameworks, certification requirements for installers, labels, and brands. These instruments and schemes are only working if there is a sufficient number of skilled providers willing and able to perform the energy renovation tasks. Education and training of building professionals (architects, planners, installation contractors, financiers and other relevant market actors) is essential to increase renovation rates and ensure high quality. Easy-to-use tools for energy-efficient building design and for life-cycle cost calculation are important for the training. Certification of successful participation to the training can make it more attractive for both the qualified market actors and their customers.

According to the German network of energy consultants (DEN)[45] there are main influencing parameters of the construction and implementation quality shown in Figure 3:

[45] Deutsches Energieberater-Netzwerk e.V. (http://den-ev.de/). Presentation held on 21/04/2015 in Leipzig (German): http://www.effizienzgebaeude.dena.de/fileadmin/nwg/hotels/bilder/netzwerktreffen/praesentationen/netzwerktreffen-leipzig-dena-modellvorhaben-hotels-herbergen-hinderk-hillebrands-fehler-bei-der-sanierung-vermeiden.pdf.

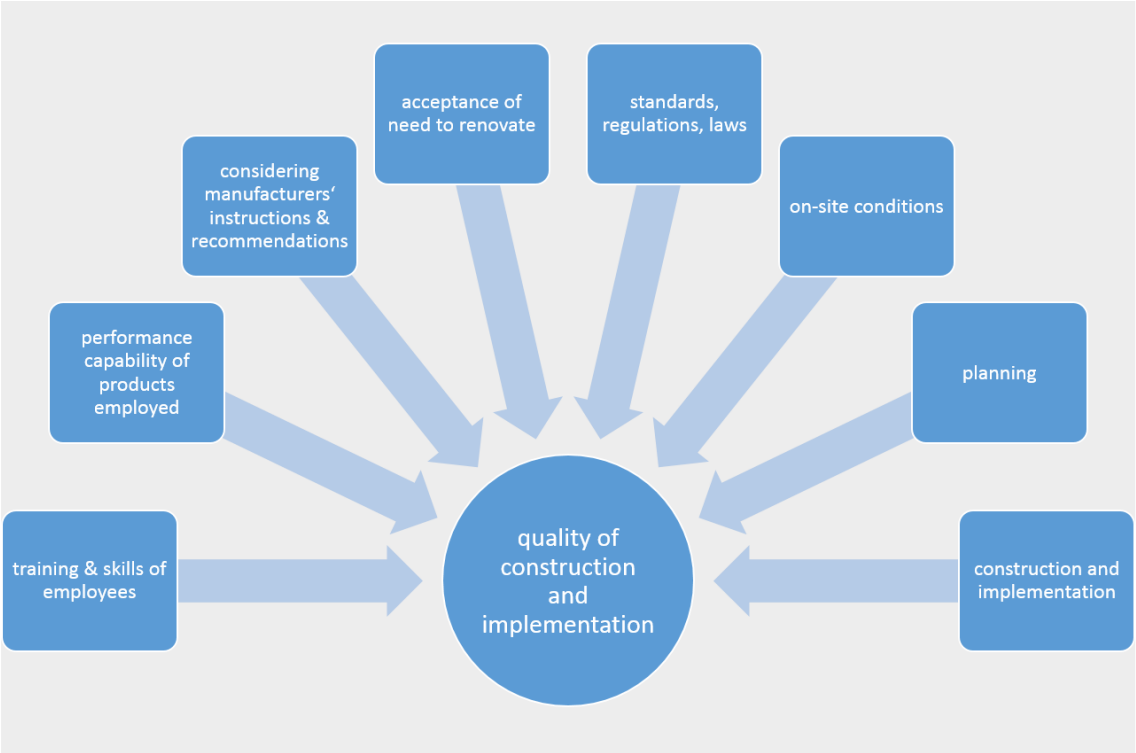



*Figure 2 - Influencing parameters of the construction and implementation quality (own graph according to Deutsches Energieberater-Netzwerk e.V.)*

These parameters again refer to both sides of the renovation process - demand and supply. There are methods and support tools for these influencing parameters; some are mentioned hereafter:

For homeowners (demand side), there are many tools in terms of webpages and web tools[46] providing quality assurance support, available, almost too many, as it becomes difficult for homeowners to decide which source to trust. Many of the tools/webpages are descriptive tools, providing extensive information on energy renovation, renewables, heating technologies, funding options, financing tips, help with finding experts, how to start the renovation process, how to carry out the renovation etc. It sometimes can be hard to find out, if the information provided in the tool/pages is up to date or which motivation the tool/webpage provider has for providing the service (or who the provider even is).

Concerning methods and support tools in the *actual* renovation process (when the supply side becomes active), there are several tests and monitoring tools to ensure the quality of the implemented measures such as

- Infrared thermography,
- Airtightness (blower-door test),
- Acceptance procedures,
- Reverse onus clause / burden of proof shift,
- Documentation.

These methods are comprehensively described in the "Bauherrenmappe" (building owner's folder).[47] Furthermore, the KfW-Bank provides detailed information on quality assurance linked to loans and grants.[48]

[46] This topic in elaborated in detail in WP4.4 "Tools and approaches to secure market uptake" prepared by AAU.
[47] See section 6.1 in this document.
[48] https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/Energieeffizient-Sanieren/Qualit%C3%A4tssicherung/index.html.

For Germany, it seems quite difficult to find reliable information on how these measures are implemented in the renovation process and how efficient they are. However, the KfW-bank provides detailed information on their quality assurance findings regarding loans and grants awarded.[49] Referring to a representative sample of 444 creditors and beneficiaries in 2014[50], the most common sources of error in implementing the "KfW-Effizienzhaus" standards are:

- Not correct recording of the heated building volume,
- Overestimated revenues of solar panels,
- Missing insulation towards adjoining unheated building sections.

When it comes to implementing single measures, most common sources of error are:

- Missing hydraulic balancing,
- Inadequate insulation of pipes.[51]

According to the German network of energy consultants (DEN), frequent errors in the renovation process are:

- Incorrect air-tightness layer,
- Wrong or inadequately installed insulation material.

Practice, however, shows that if there is no tailored renovation roadmap, the planned measures can negatively affect the economic viability of a measure implemented earlier. When renovating existing residential buildings, it may happen that some details can be clarified not before the renovation process already started and that some measures cannot be implemented as planned. Therefore, experts strongly recommend a continuous monitoring of construction to better link theory and practice. Again, human behaviour may have an impact when it comes to quality assurance in the renovation process: e.g., installers need to be well educated particularly for the products employed; homeowners should understand the implemented measures and use them appropriately.

This Chapter refers to existing methods and support tools for quality assurance with specific focus on the actual renovation process (implementation of energy renovation measures). It provides an overview of a broad range of instruments available in the REFURB countries. The tools overview is complemented with the WP4.4 Deliverable "Tools and approaches to secure market uptake". In this deliverable, the accent is put into the quality assurance. Quality assurance tools and instruments affect both, the private homeowners (demand side), and the service providers (supply side). The two recipients need to be approached in a different manner with different kinds of instruments and tools ensuring quality in the renovation process. Therefore, this Chapter reflects on instruments targeting both demand and supply side: instruments linked to funding schemes, tests and monitoring tools, labels and brands, quality frameworks, and requirements for installers. Below an overview per country is presented.

In addition, this Chapter also includes examples of step-by-step renovation plans with specific focus on quality assurance. Within this Chapter, the availability of accepted schemes offering the option of integrating individual measures into an overall concept for the building is explored. Meaning having the long-term goal in mind and plan from there. In this case, future refurbishment work is also taken into account from the beginning, and a systematic step-by-step refurbishment can take place. Ideally, this ensures that a high-quality result is achieved and no lock-in situations occur.

[49] For detailled information about financial products for energy renovation provided by KfW-bank please see section 4.1.

[50] https://www.kfw.de/KfW-Konzern/Newsroom/Pressematerial/Themen-kompakt/EBS/Qualit%C3%A4tssicherung/index.html.

[51] Ibid.

### 2.2.1. Tailored renovation roadmap (”Individueller Sanierungsfahrplan”)(DE)

On 4 May 2017, the German Federal Ministry for Economic Affairs and Energy (BMWi) presented a new energy audit tool at the Berlin Energy Days event.[52] The 'tailored renovation roadmap' is a software-based tool that serves to provide a good overview of the modernisation work a particular building will require in the long-term future. The tool points to untapped possibilities for energy conservation and the use of renewables and gives an estimate of the relevant investment costs and of the savings achieved in terms of heating costs and carbon emissions.

The new tailored renovation roadmap gives property owners a transparent, bespoke and step-by-step overview of the modernisation work their building will require. It is an easy way for them to find out what to expect and when, what the work entails, and how various measures can be designed to add up to a full modernisation plan. For energy advisers, the customised modernisation roadmap is a tool that allows them to communicate the result of their technical work in a way that is easy to understand and comes in the form of a well-structured, standardised report. This allows for the common step-by-step approach to modernisation to be used to create an overall concept tailored to the building in question.

The tailored renovation roadmap is key to the ministry's efforts to implement the government's Energy Efficiency Strategy for Buildings (see Section 3.1).

The tool was developed in close cooperation with the Federal Office for Energy Efficiency within the Federal Office for Economic Affairs and Export Control (BAFA) and an external consortium consisting of the German Energy Agency (dena), the Institute for Energy and Environmental Research (ifeu) and the Passivhaus Institute (PHI). The roadmap now serves as a standardised tool that is ready to be deployed on the ground. It creates a uniform framework and comes with a user-friendly design and a great deal of extra information tailored to the needs of energy advisors and property owners. The renovation roadmap serves as a proof-of-advice within the energy advice-funding programme for residential buildings (BAFA on-site energy audits) and fits in perfectly with the existing financial support programmes.

This instrument can be used for single-family dwellings and duplexes, but also for apartment buildings. For this purpose, existing regional and international approaches for individual refurbishment road maps were first comprehensively analysed. Later on, technical details on how to take into account the individual living situation, expectations with regard to comfort-related aspects, the energy savings assessment of the building, and issues of cost effectiveness were fleshed out, discussed with energy consultants, and incorporated accordingly.

The goal is to develop uniform standards across Germany for the results of an extensive energy consultation with the help of the tailored renovation road map, and to integrate it into real-world consulting practices. Of particular importance in this case is ensuring that widespread, reliable quality standards are established on the market, and significantly increasing both the motivation as well as trust in energy-efficient refurbishment among homeowners.[53]

Since the German federal state Baden-Württemberg was a frontrunner when implementing the tailored renovation roadmap in 2015, the respective model report can serve as a reference to illustrate the instrument described above.[54] Figure 6 gives an impression of the stepwise approach (for the English version please see Annex 1).

[52] http://www.bmwi.de/Redaktion/EN/Pressemitteilungen/2017/20170504-bmwi-stellt-neues-instrument-der-energieberatung-vor.html.

[53] https://www.dena.de/en/topics-projects/projects/buildings/individual-refurbishment-roadmap-for-residential-buildings/.

[54] Document in German language can be found here: https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/5_Energie/Beratung_und_Information/SanierungsfahrplanBW/Muster_Sanierungsfahrplan_BW.pdf, English version (work translation) see Annex 1; https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-

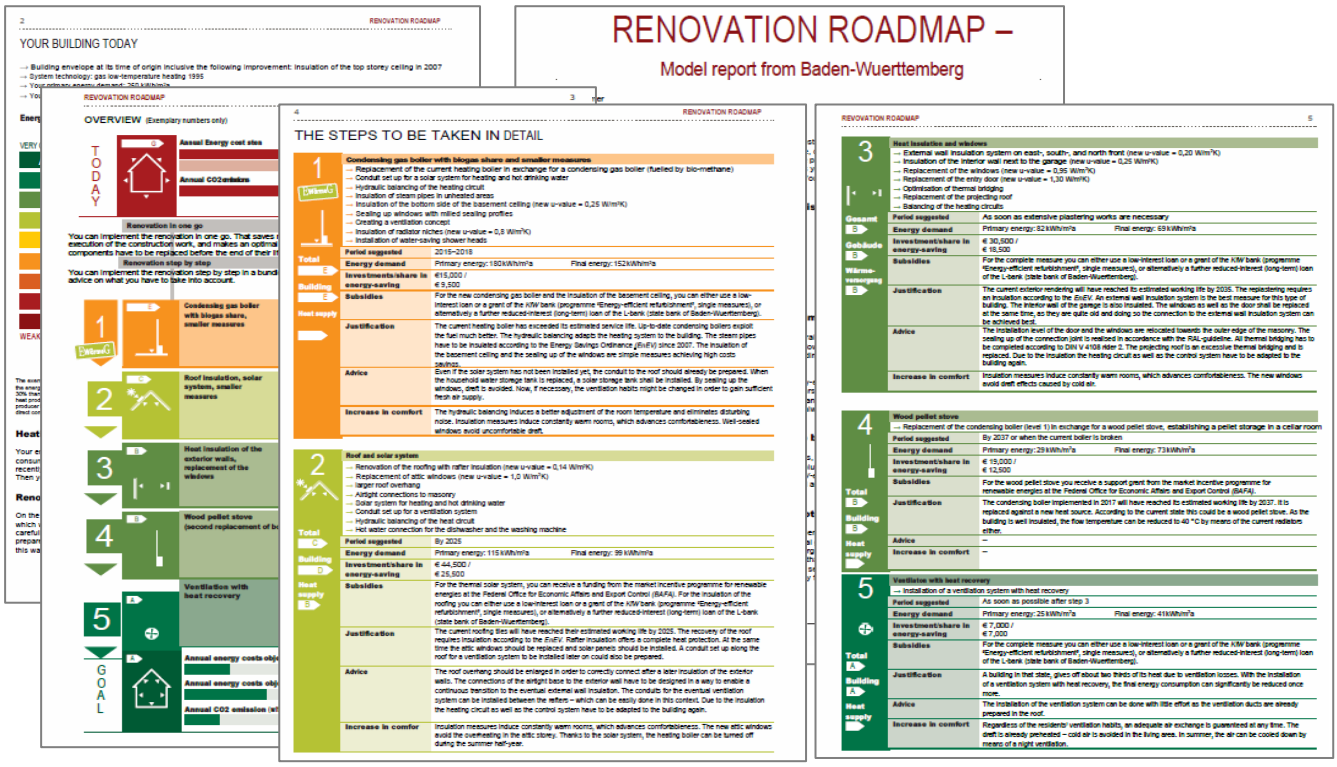



*Figure 2 - Tailored renovation roadmap (model report from Baden-Württemberg)*

As the tailored renovation roadmap is only recently available on national level is difficult to find reliable statements on the actual acceptance and usage. However, there are positive experiences from Baden-Württemberg. Handicraft businesses are allowed to elaborate tailored renovation roadmaps and to perform the proposed measures. This aspect is mentioned to be a major advantage compared to the BAFA guideline of the on-site energy consultation in residential buildings, as handicraft businesses have almost no access to this programme[55]; the BAFA guideline has been conceived as an instrument for energy consultants.[56]

### 2.2.2. Building owner's folder "Bauherrenmappe" (DE)

The Energy Agency Saxony-Anhalt gathered a comprehensive compilation providing relevant information for homeowners planning to renovate their houses called "Bauherrenmappe"[57] (published in November 2015). This folder contains well-prepared information for private homeowners to avoid lock-in situations when implementing a step-by-step renovation, including:

- Legal framework,
- Permits,
- Financing and funding,
- Basics of planning,
- Thermal envelope,
- Installations technology and domestic engineering,
- Quality assurance and documentation,

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um/intern/Dateien/Dokumente/5_Energie/Beratung_und_Information/SanierungsfahrplanBW/Muster_Sanierungsfahrplan_BW.pdf.

[55] http://blowerdoor-test-deutschland.de/erfahrungsbericht-sanierungsfahrplan.htm.

[56] For BAFA guideline see Section 7.1.

[57] Compilation in German langauge: https://lena.sachsen-anhalt.de/fileadmin/Bibliothek/Sonstige_Webprojekte/Lena/Dokumente/Downloads/Bauherrenmappe_Sachsen-Anhalt.pdf.

- Reference examples,
- Glossary,
- Checklists.


*Figure 3 - Overview "Bauherrenmappe" content*

The building owner's folder is available as a "real" folder (can be ordered by postal service) and as an electronic file. Sample copies are available in consumer association offices in Saxony-Anhalt. Currently, the content is regionalised for municipal and district level in Saxony-Anhalt. For City of Halle, the Service Centre Climate Protection is in charge for the regionalised version, which is expected to be finished this year (2017).

### 2.2.3. Market quality label for zero- energy concepts: NOM Keur (NL)

Recently, Stroomversnelling has developed and introduced the NOM Keur 1.0 for net zero energy (in Dutch Nul op de Meter, NOM) concepts. In addition, Stroomversnelling is also the provider of the NOM Keur. This NOM Keur 1.0 is a protected quality label (See Figure 4) developed in close cooperation with the market itself. With the use of this label, the market aims to make the quality of the NOM concepts more predictable. The gap between proposition (theoretical energy performance) and reality (actual energy performance) can be narrowed with the use of the NOM Keur schemes. The quality of a net zero energy concept is determined by means of checking its technical specifications, quality control, communication with residents, results of monitoring as well as experiences from the end users. All the guarantee aspects that need to be met during or after the renovation are listed within the NOM Keur manual/ thematical worksheets.

The NOM Keur is meant for net zero energy concepts (EPC = -0,42) with an insulating shell (modular approach), spacious production of renewable energy and smart installations. There should also be a guarantee that the concept will provide 40 years of actual energy performance, comfort and indoor climate. Version 1.0 of the NOM Keur (since 3 February 2017) applies to low-rise rental homes without district heating but with an established energy provider. In 2017, the NOM Keur will be developed and rolled out further. The focus of the label is on the net zero energy concept itself and not so much on the type of dwelling, although that will of course be of influence.

The entire NOM Keur (see Figure 4) knows three phases as it covers three parts of a net zero energy concept:

1. Proposition (Propositie, red sublabel); is it likely that the theoretical proposition is going to meet the requirements for a 'true' net zero energy dwelling?

2. Application (Toepassing, blue sublabel); on- sight assessment of the net zero energy concept (with a reference home)
3. Lifespan (Levensduur, green sublabel); quality guarantee of the net zero energy concept in time (should be 40 years).

The technical aspects of the proposition include many aspects relating to both energy (production) as well as comfort. An important aspect of comfort is the airtightness (the QV_10) of the dwelling after renovation. If the airtightness of a renovated dwelling is too high, it is not likely to provide the required comfort nor may it genuinely be a net zero energy dwelling. The NOM Keur Proposition requires a QV_10 < 0,4 $dm^3/ s/m^2$.The airtightness is especially important for concepts with joint insulations parts (roof, façade, modular approach). Solid airtightness between the joints is crucial for the overall energy performance of the dwelling.

A housing corporation in the Netherlands receives a national refund based on the actual achieved number of label jumps. To ensure a valid business case, housing corporations therefore need assurance on the quality of the result. If a contractor can show the housing corporation a quality label like NOM Keur, this could make a difference in the decision- making. Of course, in essence, the same applies to a homeowner. Before investing, a homeowner also wants to be assured of having 'no energy bill' (= return on investment) for a certain period before investing in a net zero energy renovation. When applying the NOM Keur quality label, both housing corporation now and homeowner (in the future, after rollout) can be assured of a investing in a quality zero energy product.


*Figure 3 - Nom Keur and its three parts: Proposition, application and lifespan (http://stroomversnelling.nl/over-stroomversnelling/nomkeur/nom-keurhouders/)*

Homeowners also want a guaranteed return on investment. The NOM Keur can provide such a quality assurance.

### 2.2.4. Bedre Bolig (DK)

The scheme 'Bedre Bolig'[58], initiated within the 'Strategy for energy renovation of buildings', offers to homeowners help by certified professional both throughout the process of renovation and after it. The help throughout the process includes 'designing' of the renovation and guidance of how to control the process. The support after the renovation is done can consist of different options such as:

- The consultant can review the project and ensure that work is done properly.
- Owners can choose to document the energy conversion by getting a new energy label, which can be used for sale of the house.
- Follow up check 1 year after completion of the project can also be purchased

There are quality assurance tests in place although not specifically for renovation projects but for building projects (both new build and renovation) in general. A requirement of testing 10% of the buildings, certified as building class 2020, for leaks trough the envelope is in place in the building regulations. The regulations state that maximum air change trough leakage in the building envelope must not exceed 1.0 l/s/m$^2$ of the heated floor area at a pressure of 50 Pa. Performing blower door test (air leaks) and thermographic scanning of building after renovation could be a good way to assure quality of performed works for renovated projects.

There are schemes that support renovation process by financial stimulation[59]. Those can be obtained for a variety of renovated elements and systems. The size of the financial compensation is dependent on the initial source of energy that the building is supplied with, type of renovated elements and their before/after conditions. Financial support is given on the condition of proof of condition before renovation (usually a picture), approval of application and documentation in form of receipts for materials/workers, which answers to the approved application.

### 2.2.5. Compliance and quality of works: practices from Slovenia

**Energy performance certificate for residential buildings**

The energy performance certificate (EPC) implemented before the renovation process should form the basis for decision making process, providing the potential investor with the information of building status (performance) and the associated risks. Additionally, it provides the investor with the first tailored set of measures, to be implemented in order to achieve better living conditions.

After this preliminary process, the investors are advised to seek specific expert advice towards the technical and financial feasibility of deep renovation measurements. Besides, using the free and independent advisory service (EnSVET), which would be a first step, there is a possibility to decide for the company that preforms the technical documentation, provide detailed information to investment measures and prepare step-by step actions for deep renovation. This way the preliminary guidelines and advices by the EPC and EnSVET are verified and provide legitimization for large-scale investment. Thus, the investor is taken off the burden of choosing the direction towards technical measures to be implemented. There would be two alternatives, one to seek and subcontract certified persons/ companies to act as a single-point of contact for all phases of the investment – from planning to the building authorisation, the other would be (at least for higher investments) to explore to the possibility of energy contracting.

After the deep renovation is implemented, it would be necessary to seek the Declaration of performance by a certified person – including report of specific, site-related performance features. It

[58] http://sparenergi.dk/forbruger/vaerktoejer/bedrebolig

[59] This aspect is elaborated further in section 4.2 "Financial schemes by the government".

would be favourable, if such monitoring would be performed by independent persons, whereas predominantly the reporting is implemented by persons involved in the building project, certified and controlled by a third party. The update of the EPC should follow the Declaration of performance – providing additional verification on the quality of implementation.

In the phase of construction, it is of utmost importance to provide for systematic inspection of a building site by an expert supervisor. The strictest form of control would be an inspection (supervision), whereby each building site or random samples is visited by an independent person. The praxis show that the supervision is performed by the (certified) personal of company performing the works. In the area of energy efficiency of buildings, there are several examples of such direct performances (e.g. airtightness testing of building envelope, IR thermography, etc.).

**Infrared thermography**

IR camera can quickly and non-destructively detect areas of damaged insulation, thermal bridges (walls, attics, joinery and outlets). All can increase a building's energy costs by allowing cold air to enter the building and heated air to escape in the winter, but also allow moisture to form at the thermal bridges locations. IR can also identify poorly insulated or uninsulated pipes, but also other sources of costly heat losses. The IR camera thermography is regularly performed in process of measured EPC preparation, but in validation of the energy refurbishment of buildings.

**Airtightness (blower-door test)**

Current legislation, in different ways introduces the principle of air tightness of buildings. Indirectly, through limiting the maximum energy performance for heating and directly via airtightness measurement, where set as an obligation – passive house standard. Passive house standard buildings have to be built air-tight, as otherwise all non-tight locations in the building would cause too high thermal transmissions (parameters - heat demand 15 kWh/$m^2$, airtightness n50 < 0,6 h-1).

Airtightness test is a simple and affordable process in which compliance with the building regulations is verified and is able to demonstrate the locations in building envelope, attic, etc. which are not air-sealed. The test is best carried out during construction, when the windows and doors have been installed and before performing the facade and floor screeds. The airtightness test may be also performed later on for verification of measures efficiency.

**Obligations from grants: Eco fund**

Eco fund request the investor to provide the information to the efficiency of the implemented measures. Eco fund obliges the investors receiving grants for energy refurbishment to guarantee the energy savings and provide for project supervision in planning and construction in accordance to the legislation on construction. Implemented measures subject to grants have to be carried out by a certified contractor with a duly registered business. Additionally, Eco Fund has the right, at any time during the period from the issuance of the decision to grants to up to three years after the signing of the agreement, to make an secondary check of documentation or in any other way verify the targeted use of grants, compliance with planning documentation and investment realization with the provisions of public calls and applicable regulations.

Eco fund obliges investors receiving grants for investments into low energy houses and buildings built in passive standards to perform the airtightness measurement (blower-door test) to test the efficiency of construction and certification in passive house standard. The certificate has to be issued before receiving payment of Eco fund grants.

### 2.2.6. Certification requirements for installers (BE)

The three regions of Belgium have set-up a Renewable Energy Systems Certification framework (RESCERT[60]). Installers are able to acquire a RESCERT-certificate to prove their competence in installing renewable energy systems in residential buildings. The following renewable energy systems for heating and/or domestic hot water production are included:

- Solar photovoltaic system
- Solar thermal system
- Biomass boiler
- Heat pumps
- Shallow geothermal heat pumps

Since 1/7/2017, the RESCERT certification is required when applying for a grant for heat pump or solar thermal collector.

As there is a high risk to have moisture issues as a result of improperly applied interior wall insulation, a similar certification requirement is in place for interior insulation[61]. Again, having a certified contractor or a certified architect supervising the works are needed in order to qualify for the associated grant amount.

### 2.2.7. Construction quality label

Closely related to the RESCERT certificate, the Flemish Government created a voluntary label for installers of renewable energy systems to ensure quality and reliability towards consumers: the "QUEST and Construction quality label[62]. The label can be acquired for solar PV systems, solar thermal systems and heat pumps (see Figure 5):


*Figure 4 - QUEST-label in Flanders for solar PV systems, solar thermal systems and heat pumps*

As part of the process to obtain the QUEST-label, interested construction companies have to organize a third party quality control on one of their installed renewable energy systems to check their compliance.

### 2.2.8. Quality framework for ventilation systems

Since 1/1/2016, there are two mandatory requirements for new ventilation systems in new-build or renovated building projects[63]:

- To compose an draft design of the ventilation system before the start of the construction;
- To validate its performance against the performance criteria of the technical specification document[64].

[60] https://rescert.be.
[61] http://www.energiesparen.be/bouwen-en-verbouwen/isolatie-en-luchtdichtheid/muurisolatie/binnenisolatie-van-massieve-of-volle-muren.
[62] http://www.questforquality.be
[63] http://www.energiesparen.be/epb/prof/kwaliteit-ventilatie
[64] STS P 73-1 Systems for minimum ventilation in residential buildings, available at: http://economie.fgov.be/nl/modules/publications/sts/sts_73_1.jsp

This includes in-situ measurements of flow rates and verification of the ventilation ducts, in- and exhausts, heat recovery but also compliance checking with the initial draft design specifications.
Both tasks have to be conducted by an accredited ventilation expert in collaboration with an architect.

### 2.2.9. Renovation advisory tools (BE)

Under the framework of the Renovation pact, the current EPC-method is currently under revision. This revision will lead into two tools: EPC+ and Renovation advice (RA)[65]. These new tools will support energy experts and renovation advisors to draft a step-by-step renovation plan and indicate households the expected benefits of each step and the renovation as a whole.

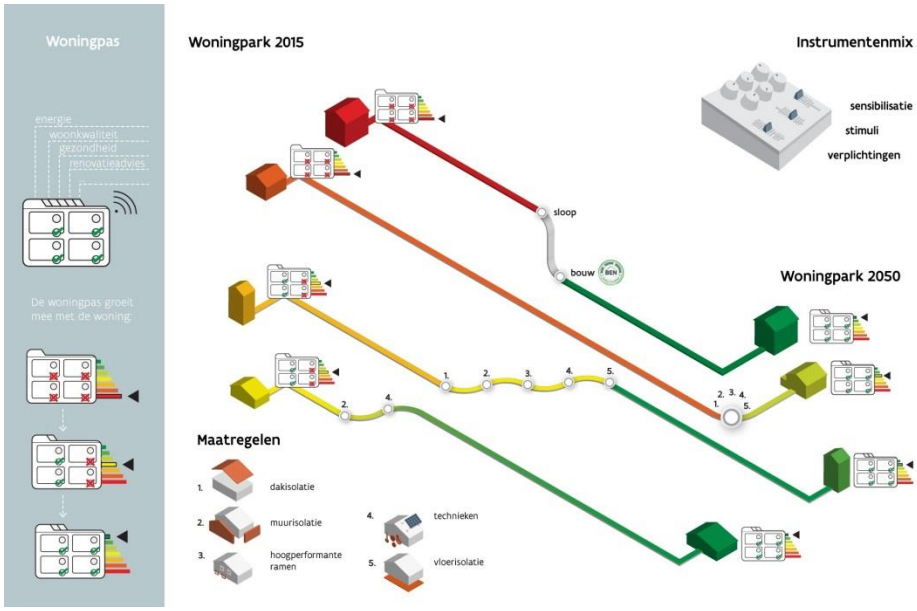



*Figure 5 - The approach of the Renovation pact (Source: VEA)*

The new RA-tool was inspired by best practices across Europe, in particular the "individuelle Sanierungsfahrplan". The tool is currently under development and expected in 2019.

**Other emerging tools in Flanders to support nZEB renovations**

In addition to the RA-tool developed under the framework of the Renovation Pact, there are a number of tools emerging in Flanders, all of them with the goal to support building professionals in composing renovation advice and or roadmaps:

- Cashflow simulator (as part of the research project RENOFASE[66]): An energy calculation tool using the cost-optimal methodology that can compare different renovation options. The RENOFASE project offers a number of additional tools that can support the building professional even more, such as a diagnosis tool etc.
- OptiTool (RenBen VLAIO living lab): a tool similar to the Cashflowsimulator, used in the Flemish pilot project RenBen[67]
- Axii renovation planner[68]: an energy simulation tool that focuses on generating a step-by-step renovation masterplan for both single housing and multi-family housing.

[65] http://www.energiesparen.be/renovatiepact/tweedefase/werf3
[66] http://www.renofase.be/
[67] http://www.warmerwonen.be/renben
[68] https://pixii.be/hulpnodig/axii-renovatieplanner

### 2.2.10. Findings

Quality control of solutions for individual building components might be necessary in addition to a performance check on building level. The factsheets composed under the framework in the QUALICHeCK project discuss various examples of such quality control measures on building component level in different Member States.

Out of the information presented in this Chapter, the large diversity of methods for quality assurance can be observed. Each country designed its own approach. Regardless of the number of tools available for the homeowner on the topic of quality assurance, the majority of countries linked the quality assurance with loans or grants. For example, the German KfW bank provides detailed information on their quality assurance findings regarding loans and grants awarded.

In Denmark, within the Strategy for energy renovation of buildings, homeowners can find certified professionals and support throughout the complete renovation process.

In Slovenia, within the process for the energy performance certificate, the investors are advised to seek specific expert advice. After the deep renovation is implemented, it is necessary to seek the Declaration of performance by a certified person. During the construction phase, systematic inspection by an expert supervisor are of utmost importance. As mentioned before, the Eco fund grant obliges to perform the airtightness measurement before receiving the payment.

The Netherlands has addressed the gap between the theoretical and real energy performance by introducing the NOM Keur 1.0 for zero energy concepts. This quality brand has been developed in close cooperation with the supply side. The NOM Keur can provide the quality assurance that the homeowners and housing corporations need. In this country, the Energy Performance guarantee serves as a national insurance for the homeowner. This insurance can be claimed when two or more energy saving measures are being carried out. The Energy Performance guarantee assures that the promised energy savings are met in reality.

In the three regions in Belgium, a Renewable Energy Systems Certification system for installers has been setup covering PV, solar thermal, biomass, heat pumps and shallow geothermal heat pumps. In Flanders is the sole region where a voluntary label for installers of renewable energy systems to ensure quality is also available.

The mapping of existing practices in the REFURB confirm that there are already a number of different quality requirements on building component level in place in selected regions and Member States. In the set-up of one stop shops and renovation packages, it is recommended not to set up parallel or deviating quality requirements in order to avoid the risks of creating incompatibilities with the national requirements and as a consequence, add extra barriers (e.g. confusion on standards) and the subsequent need for additional control mechanisms.

*Advice on performance improvement measures and renovation plans*

EPCs typically include recommended energy performance improvement measures for the homeowner. However, in many cases they are generated by simple computer algorithms, which depend on input data provided by the assessor. In this case, it is recommended to complement it with a tailored advice, taking into account the specific characteristics of the property.

In the case of step-by-step deep renovations, there is a particular challenge to ensure that the renovation measures will not block NZEB-performance levels (so-called lock-in situations). It can be stated that step-by-step renovation plans are per se a support tool to assure the quality of energy renovation because this instrument ideally anticipates all different stages and linked measures. Although the majority of the countries do not count with such an approach, there are several step-by-

step renovation plans described. Germany may be considered a frontrunner with the tailored renovation roadmap ("Individueller Sanierungsfahrplan"), which started as a regional resp. federal state level instrument in Baden-Württemberg and is about to become the national standard. To avoid lock-in situations and problems of technical incompatibility, all implemented measures have to interlock when it comes to step-by-step renovations. That is why it is deemed positive that handicraft businesses (e.g. installers) are allowed to elaborate tailored renovation roadmaps and to perform the proposed measures. This matter simplifies the process and seems highly beneficial for assuring quality in the renovation process.

Flanders listed further accompanying tools to support building professionals in composing renovation advice or roadmaps. Apparently, there are lots of initiatives and ideas; the challenge seems how to make it work for non-professional and non-expert homeowners on the one hand. On the other hand, the step-by-step renovation plan should serve as an accepted standard and needs to be used by the majority of suppliers.

Energy agencies turned out to be key players for step-by-step renovation plans (or first steps in this direction). For greater effectiveness of their energy efficiency policy, governments are likely to need an energy agency. Tasks of energy agencies typically include the co-ordination of policies and implementing parts of the policy package, such as provision of information and initial advice, initial energy audits, promotional activities, education, training, dissemination, co-ordination of energy efficiency projects and programmes, demonstration activities, network building between market actors, awareness raising, and organising campaigns.

## 2.3. MEASURING AND MONITORING OF ENERGY CONSUMPTION

Measuring and monitoring is a relatively straightforward and accurate way to assess the energy consumption of a building. For a borrower who is purchasing a property, measurement can typically only be used to verify the performance after they have moved in. Exceptions to this include cases where an operational rating EPC has been produced, or where the vendor is able and willing to provide past energy bills.

This chapter discusses three best-practices identified by the REFURB partners:

Energie ID: a voluntary self-reporting monitoring service in Belgium

Buurkrachtbuurten: monitoring used as part of a communication and marketing campaign with the objective to influence user behaviour and incite investments in energy renovation

Stroomversnelling huur/Transition Zero: monitoring as part of energy performance contracting services

### 2.3.1. Energie ID (BE)

Energie ID[69] is an online platform active in Belgium, which allows its users to upload their energy consumption figures and keep track of their consumption data. This can be done either manually or automatically. Manually uploading consumption data requires users to read and insert their metering data on monthly basis. Fault detection of the inserted data is done by computer algorithms. Automatically uploading consumption data can be done by coupling digital meters, dataloggers or other data sources to the Energie ID platform.

Participating to the Energie ID platform is done by users on a voluntary basis (= self-reporting). Nevertheless, the platform includes a functionality to compose groups to steer collective actions or for building stock monitoring.

Energie ID's annual report of 2016[70] includes aggregated data of electricity and gaz consumption from 3.500 residential households. The data was collected on monthly basis and depicts both primary energy consumption and delivered energy consumption. Furthermore, weather correction is applied. The figures below illustrate the challenges in selecting suitable energy indicators for monitoring the energy use on one hand (Figure 6 ) and an indication of the relation (or mismatch) between calculated energy performance and measured energy consumption (Figure 7 and Figure 8). The red bars show consumption figures of households without PV panels while blue bars show households with PV panels.

[69] https://www.energieid.be/
[70] http://about.energieid.be/media/13996/11_jan_pecinovsky.pdf

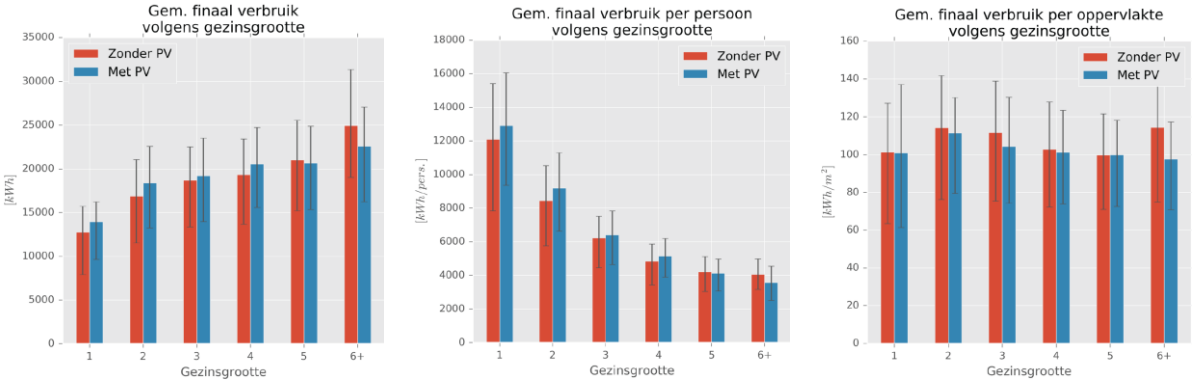



*Figure 6: Comparison of energy indicators (all show delivered energy): absolute (left), kWh per capita (middle) and kWh per m² (right). The horizontal axis shows the household size (1 family member until 6 or more). Energy indicators based on absolute energy consumption or consumption per capita indicate the influence of household size. Source: Energie ID*

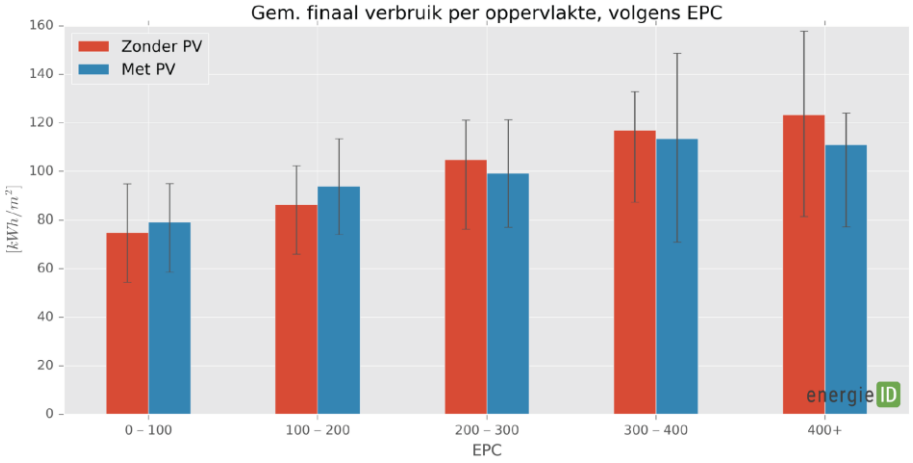



*Figure 7: Delivered energy consumption per floor surface area in function of calculated energy performance (kWh/m² as depicted on EPC for existing residential buildings in Flanders). Source: EnergieID.*

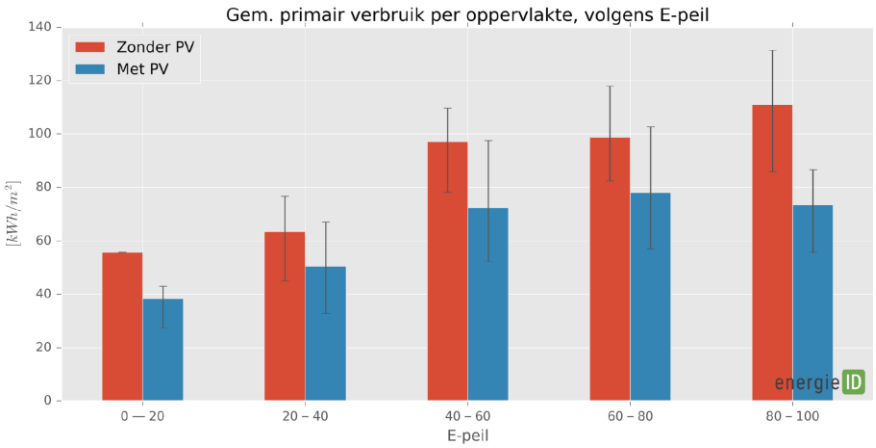



*Figure 8: Primary energy consumption per floor surface area in function of calculated energy performance (E-level as depicted on EPC for new or major renovated residential buildings in Flanders). Source: Energie ID.*

### 2.3.2. Buurkrachtbuurten (NL)

The approach of Buurkracht[71] illustrates how smart meters can be used as a tool to promote energy efficiency and renovation measures. Residents of a neighbourhood who participate in the platform for upgrading their house (solar panels, better insulation etc.), receive a free smart meter. This way they are given insight to their energy consumption by comparing their consumption with their neighbours' as well as their consumption in the past in order to verify their progress and their energy/monetary savings.

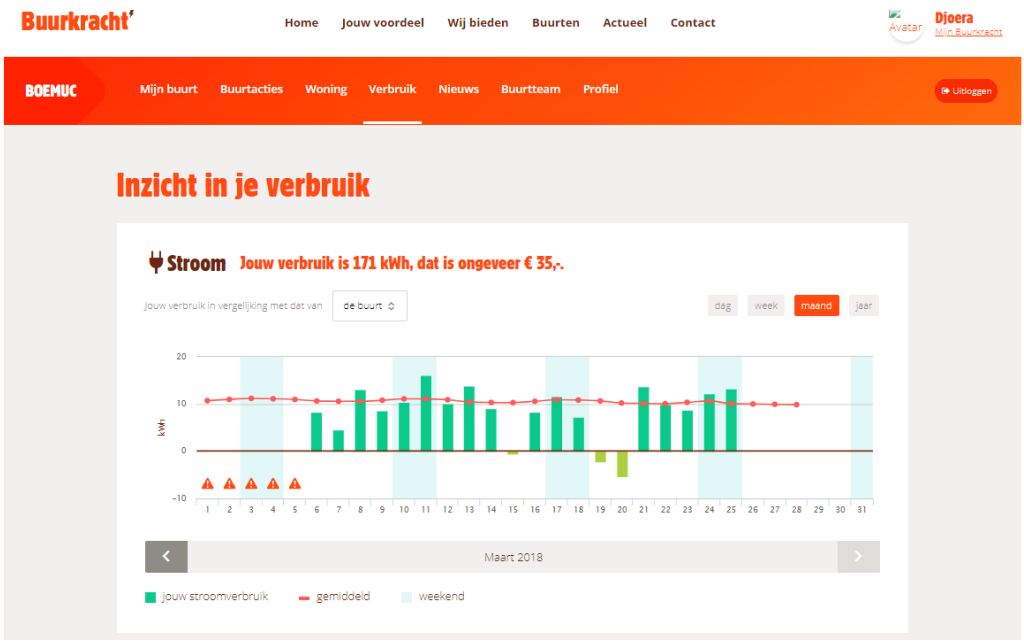



*Figure 9: Buurkracht examples of visualizing user energy consumption (Source: Buurkracht).*

In the Netherlands the roll-out of smart meters in the residential building sector has been assigned by the national government has to the DSOs the task to offer a smart energy meter. This will be done in a 5 year period between 2015 – 2020. The DSOs decide the planning, but household have the opportunity to obtain a smart meter earlier (priority placement), in exchange for a reimbursement.

As Buurkracht is linked to a DSO, it is possible to offer this priority placement possibility. Once a Buurkracht neighbourhood starts, the neighbourhood gets priority for the roll-out of smart meters and every household in the neighbourhood receives a smart meter free of charge. Expenses are paid by Buurkracht[72]. Once the smart meters have been installed, every household in the Buurkracht neighbourhood with a smart meter receives an offer to create a free personal account at their neighbourhood page on the Buurkracht website (see invitation letter in Annex). With this free account comes the possibility to digitally connect your smart meter to your personal account and thus gain insight in your energy consumption. This insight takes the form of two graphs: 1 for the use of electricity, 1 for gas.

[71] https://www.buurkracht.nl/.

[72] Interviews with participants indicated that the communication of the DSO with homeowners about the placement of the meter (the announcement of the installation of the meter) and the placement itself (as people have to be home, open the door for the installer, during which time there is no electic power due to safety reasons) is an important milestone for home owners. Buurkracht used this information to couple the installation of the smart meter to the customer journey (i.e. an additional step) and use the momentum to annouce the activities of the Buurkracht team by sending letters directly after the meter has been installed.

Both graphs have the option to switch between a daily, weekly, monthly or yearly consumption view. In daily view mode it is possible to see hourly consumption and thus identify consumption peaks. Buurkracht offers support to households to consequently try to identify the source of these peak productions, for instance with simple measuring devices as depicted in the figure below. The energy consumption of individual appliances can be monitored (in kWh or costs) to identify the least energy efficient household appliances. This monitoring of individual household appliances thus is part of an awareness raising strategy in energy efficiency.


Several nudging techniques are applied:

- Insight: Not only the energy consumption is indicated (kWh or m³) but also energy cost (EUR). In particular the energy cost is important, as it is easier to interpret for households compared with an abstract figure of energy consumption in kWh (people do not know if 1 kwh is a lot or not).
- Peer pressure: The graphs also offer a comparison of energy use with that of the average use in the neighborhood or optionally a comparison to the average use of comparable households (based on building type, building year and number of inhabitants). These comparisons give both meaning to the data presented (otherwise it is difficult to know whether the daily consumption of 5 kWh/2,50 euro is a lot or not) and it makes use of social comparison/peer pressure: people do not like using more than others…
- Competition: To engage people in using their energy consumption graphs, weekly updates are sent via email. This email offers news from their neighborhood but also provides information of their 'weekly score': this week your consumption was 10% above the average in your neighborhood. (this is also the subject line of the email).

The smart meter and the insight in consumption are not a stand-alone feature. They are part of an overall strategy (i.e. the Buurkracht Customer Journey), in which the Buurkracht team tries to create awareness and activate their neighbours towards saving energy. By door-to-door visits, organization of neighourhood meetings and group purchasing, they mobilize the neighbourhood. In addition the website offers intuitively information on the energy consumption (from graphs to online tools), which measures households can choose to reduce their consumption and possible offers via group purchases.


*Figure 10: Buurkracht examples of visualizing user energy consumption (Source: Buurkracht).*

Succes factors are – as mentioned:

- Offering consumption data in euro's in addition to kwh / m3
- Making use of social comparison
- Using weekly update email to keep households engaged
- Integrating smart meters and insight in consumption in the total customer journey in order to trigger investments in energy saving measures

### 2.3.3. Stroomversnelling huur (NL) / Transition Zero (NL – UK – FR)

Under the framework of the Stroomversnelling Huur programme in The Netherlands, a concept for NoM or 'Nul op de Meter' (EN: Zero Energy Building) has been developed for residential buildings, both new-build and renovations. A NoM residence compensates the energy used for heating, cooling, domestic hot water, ventilation, lighting and household appliances with renewable energy production on an annual basis and under default weather conditions and normal consumption behaviour. 'Stroomversnelling Huur' applies this concept on rental residences, owned by housing corporations and rented by tenants.

Another key feature of 'Stroomversnelling Huur' is the 'Energie Prestatie Vergoeding' or EPV (EN: Energy Performance Refund): Tenants pay a fixed monthly cost, based on a fixed amount of yearly energy consumption. A publication commissioned by Platform 31 / Energiesprong in collaboration with TNO, Van Beek and RIGO describes the terms and conditions of the EPV[73]: If tenants use more energy than this fixed amount, they have to compensate with additional energy costs. If they use less, they get a refund. As the energy use is not only dependent on the building characteristics but also the user behaviour, the conditions for the EPV are stipulated in an Energy Performance Contract. This includes, among others:

- Energy consumption allowed for household appliances
- Duration of showers per person per day

[73] Borsboom W., Leidelmeijer K., Jacobs P., van Vliet M., De Jong P. (2015) *Resultaten uit monitoring: Eerste ervaringen met prestatiegarantiecontracten voor nul op de meter woningen.*

- Thermostat set-point temperatures for heating in winter and minimal set-point temperatures for cooling in summer

Three classes of EPV are defined, to distinguish the level of energy consumption of the user: low, medium and high energy consumption.

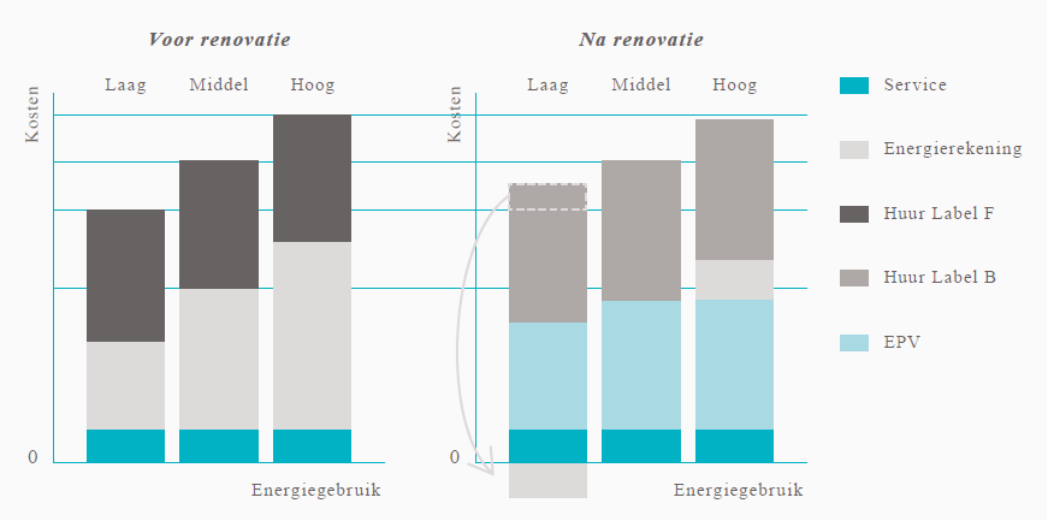



*Figure 11: Illustration of the EPV: Situation before renovation (left) and after renovation (right). The energy cost before renovation (light grey) has been substituted with the EPV after renovation (light blue). The rent after renovation (dark grey) has been increased slightly (medium grey) as a result of a better energy efficiency class (label B after renovation compared to label F before renovation). Source: Energielinq*[74]

Monitoring is pointed out as an important part or even requirement of the service, in order to guarantee the performance of the applied systems. NoM-projects in The Netherlands have applied a range of monitoring systems:

- Monitoring of system performance (e.g. heat pump performance, PV-panels etc.);
- Monitoring of energy use such as gaz or electricity use;
- Monitoring of user behaviour and comfort parameters such as indoor temperature or domestic hot water use. Additional sensors are recommended (e.g. windows or doors) to capture user behaviour even better;
- In addition, household surveys are done to complement the monitoring results.

Furthermore, in general inhabitants respond well to monitoring, even expecting pro-active actions from suppliers in case systems are not working properly etc. Nevertheless inhabitants might object against the use of data for reasons of privacy and cyber security.

Finally, there are indications that user-feedback and the element of competition (trying to stay within the limits of the allowed annual energy consumption) have a positive influence on the user behaviour and resulting energy consumption.

The concept of NoM is very well documented (e.g. knowledge hub online Energielinq[74]). The concept is currently implemented in UK and France as well under the framework of the H2020 project Transition Zero[75].

There are two important boundary conditions, specific to the context in the Netherlands, which have to be kept in mind when applying the NoM-concept in other regions:

[74] https://www.energielinq.nl/
[75] http://transition-zero.eu/

- Market segment: Stroomvernelling Huur and Transition Zero target the rental building sector. A single organisation (i.e. a housing association) owns a building stock of certain volume. The risk for the investor thus is limited. In case of privately owned residences, there needs to be a kind of cooperative structure set-up or another organization that can operate as third party between the ESCO and the households. Furthermore, this intermediate party needs to have the necessary technical, financial and juridical skills. Technical support to set-up energy performance contracts is necessary
- Reimbursement of electricity produced by PV-panels: Article 31c of the Electricity Decree of 1998 in The Netherlands requires electricity providers to reimburse the electricity produced by PV-panels and injected in the electricity grid. In other words, consumers receive the same price for the electricity they inject in the grid, compensating the cost they pay when they use the same amount of electricity on another time[76]. It has to be kept in mind that 'all-electric' concepts without battery storage or demand-response strategies typically use only 10-30% of the produced electricity by themselves.

### 2.3.4. Findings

*Monitoring data is not always available*

In case energy savings are verified using actual (metered) data by comparing the metered energy consumption before and after renovation, monitoring data has to be available. In particular in the case of transactions of property, this could not always be the case. Following boundary conditions have to be taken into account:

- Monitoring data should be comparable: Data needs to be available before renovation and data needs to be available after renovation for at least a period of one year. In addition, monitoring data has to be corrected according to the weather conditions, otherwise it is difficult to judge whether the difference in energy consumption result of the renovation or better climate. Furthermore, disaggregating monitoring data (e.g. extracting data on heating consumption from overall gas consumption figures) in order to compare with for instance calculated energy consumption might be challenging
- The conditions before and after renovation relating to comfort should be similar (e.g. extensions of the building volume; heating of the whole building instead of selected rooms)
- The conditions before and after renovation relating to household composition should be comparable (e.g. a new family member, children leaving the house etc.)
- Monitoring data could be unavailable due to privacy or security reasons (e.g. inhabitants might choose not to release their data)

Leiedal did a testing of several types of digital meters to check on the possibilities to play a role in the quality control. In practice, it was a challenge to perform a proper "before and after" metering campaign. The main reason is that most deep renovations happen 1-3 years after a dwelling is sold. So the household type is different, the usage pattern is different, and the officially metered energy data before renovation is unavailable due to privacy reasons.

*Monitoring systems as communication tools*

The smart meter by itself is nevertheless not enough for users to change their behaviour: a pilot project in a city in Belgium demonstrated that homes with a smart meter had less than 3% reduced electricity consumption while gas consumption was not affected[77] due to the fact that smart meters do not analyse

[76] This is not always the case. For instance, in Belgium-Flanders, a 'prosumer-tariff' is in force: when injecting electricity from PV-production in the grid, a fee has to be paid by the 'prosumer'.

[77] "Van slimme meter naar slimme gebruiker," Smart Grids Flanders, 19 11 2012. [Online]. Available: http://www.smartgridsflanders.be/en/node/735. [Accessed 24 05 2017].

the energy usage or explain in simple terms how to reduce it without compromising user comfort[78]. The information collected by the smart meters needs to be combined with other smart software, hardware or methods in order to make the users understand their energy saving potential better by providing them with meaningful feedback and advice for action[79]

Still visualization and simplified analysis itself are not enough, as the focus should be more on policies, techniques and methods that will target more actively the behavioural change. A report by the European Commission's Joint Research Centre[80] highlights the need to pursue direct communication with the consumers aiming at their actual behaviour and at earning their trust individually in order to have their attention. It is not safe to assume that people care about saving energy and changing their behaviour just by knowing their analytical energy bill from the smart meter. As a result behavioural science techniques are highlighted as complementary to the data content such as comparison with neighbours, loss aversion, reciprocation, use of communications that target short attention span etc.

One of the insights in the project is the fact that user-feedback using actual energy consumption figures can have more impact if used as a communication tool rather than as a technical means to verify performance. As an example, in the Netherlands, Buurkracht uses the roll-out of digital meters as an opportunity to promote energy savings measures. While users are rather sceptical about the digital meter as technical object, they respond rather well to the digital platform coupled to it as they can see their energy savings in relation to the average energy savings in their neighbourhood and the potential reduction by investing in renovation measures. A recent study in the Netherlands [81]shows that with bimonthly indirect feedback on paper, not even 1% of energy saving is achieved. But with direct feedback through a digital platform or in home display 3,5 % can be reached. This will increase when coupled with a customer journey / neighbourhood oriented energy savings approach.

Smart meters are not of actual value by themselves if not combined with other methods or tools for promoting the behavioral change of the people who are engaged in a deep renovation. The use of smart meters needs to be enhanced using elements such as from the ones described in the best practices. This will lead to a well-structured approach that will focus on the energy consumer and his needs or priorities. It will also contribute significantly to the quality assurance of the renovation packages.

How to maximize energy saving potential with the smart meters:

- Visualization & simplified analysis of data with in-home displays.
- Provide feedback from the smart meter data (easy to understand) as well as recommended actions for more energy saving.
- Integrate smart meter data in energy calculation assessments
- Be clear on the expectations of the potential energy saving, how they can be achieved and monitored via the smart meter.
- Show users the historic evolution of their consumption plus their performance in comparison to neighbours or similar users.
- Ensure from the very beginning user data protection and privacy.
- Retrain installers to interact with users & explain the smart meter's function during the installation process to get user's attention and trust.

[78] Fifthplay, "How to make your smart meter really smart," [Online]. Available: http://blog.fifthplay.com/how-to-make-your-smart-meter-reallysmart. [Accessed 19 05 2017].
[79] D. Balmert, D. Grote and K. Petrov, "Development of Best Practice Recommendations for Smart Meters Rollout in the Energy Community," KEMA International BV, 2012.
[80] S. Rivas, B. Cuniberti and P. Bertoldi, "Effective information measures to promote energy use reduction in EU Member States," Joint Research Center, 2016.
[81] http://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2016-de-slimme-meter-uitgelezen-energiek-2122.pdf

- Encourage communication between smart meter installers and users before and after the installation.
- Gamification of reducing energy consumption by providing rewards or tangible motives.
- Include digital meters in the renovation package.

*Monitoring as part of energy performance contracts or services to verify energy performance guarantees*

Nul op de Meter is a very concrete goal and this indirectly suggests a certain energy performance and thus quality level (meaning, no energy bill). As illustrated by Stroomversnelling and Transition Zero, monitoring energy consumption is an important part of ESCO-services using energy performance contracts. However, this is applied in non-residential projects or large-scale residential projects: Projects with sufficient scale in order to minimize the financial risk[82]. This is a very important distinction as this determines the potential business case using performance guarantee approaches. Housing corporations equals 'mass', possibilities for subsidies and thus ways to make a solid business case. The approach is much more rational, while the residential sector runs more on 'emotions' of homeowners. This more soft approach to effectively anticipate homeowners' emotional drivers have been studied within REFURB. Application of Energy Performance Contracts in single family homes are still restricted to innovative pilot projects. In particular in The Netherlands, there is experience with regards to Energy Performance Contracting in residential projects. Within REFURB, partner Fryslan has explored to transfer the Energy Performance Contracting to the market of single family home renovations.

[82] The feasibility of energy performance contracting as a financial construction has been discussed in Deliverable D4.3 Financing constructions. Chapter 2.3 in particular is relevant regarding this topic. In this chapter, reference is made to Stroomversnelling Huur / Energiesprong, which is in fact the predecessor of H2020 Transition Zero. The Stroomversnellings approach aims at NZEB instead of nZEB.

# 3. Quality assurance and customer confidence

The Customer Journey concept[83] was adopted by the REFURB consortia in Work package 2 and its steps were described in detail in D2.5.

A study of Wageningen University (NL) compared a number of customer journey approaches for energy renovation in the Netherlands[84]. For each of these, interviews were done with homeowners (40 in total) experts (13 in total) and participatory observations (46 in total).

The main conclusion was that trust is key in the customer journey. Trust is three fold:

1. Trust in people and institutions (organisation)
2. Trust in their knowledge, experience and competences (expertise)
3. Trust in materials and technologies they deliver (products)

Trust is built through interaction (personal and non-personal) where personal interaction is essential in building trust. From the study, it is remarkable that 80% of the respondents indicated that their trust in the organisation, the expertise or the products, resulted from personal contact with a representative from the intermediary organisation (e.g. Buurkracht or Reimarkt). This compared to only 45% that indicated that their trust in the organisation, the expertise or the products (also) resulted from their perception that a guarantee would be given and / or suppliers had a certification.

The Customer Journey consists of eleven main steps. It starts with raising awareness (step 1), the customer gets interested (step 2) and becomes active (step 3). He considers the options (step 4), looks for financing (step 5). In the next steps he selects a service provider (step 6) he performs the installation and payment (step 7). He experiences the installation (step 8) and he might look for a service agreement (step 9). If he is satisfied, he will share his experience (step 10) and he will want to have more (step 11).

In between each step of the customer journey, one can identify how many customers are lost with every step. Thus, the funnel can be considered as a monitoring system: it indicates in which step(s) most customers are lost. The steps were most customers are lost, the hotspots, are the steps where improvement practices can be applied best. The Customer Journey with its steps and the drop-out moments is graphically illustrated in Figure 12.

[83] Customer Journey related to energy saving -Homeowners, Vereniging Nederlandse Gemeenten (Association of Dutch Municipalities) in association with Price Waterhouse Coopers

[84] https://www.hieropgewekt.nl/kennisdossiers/onderzoeksrapport-samen-op-reis-naar-een-energiezuinige-woning

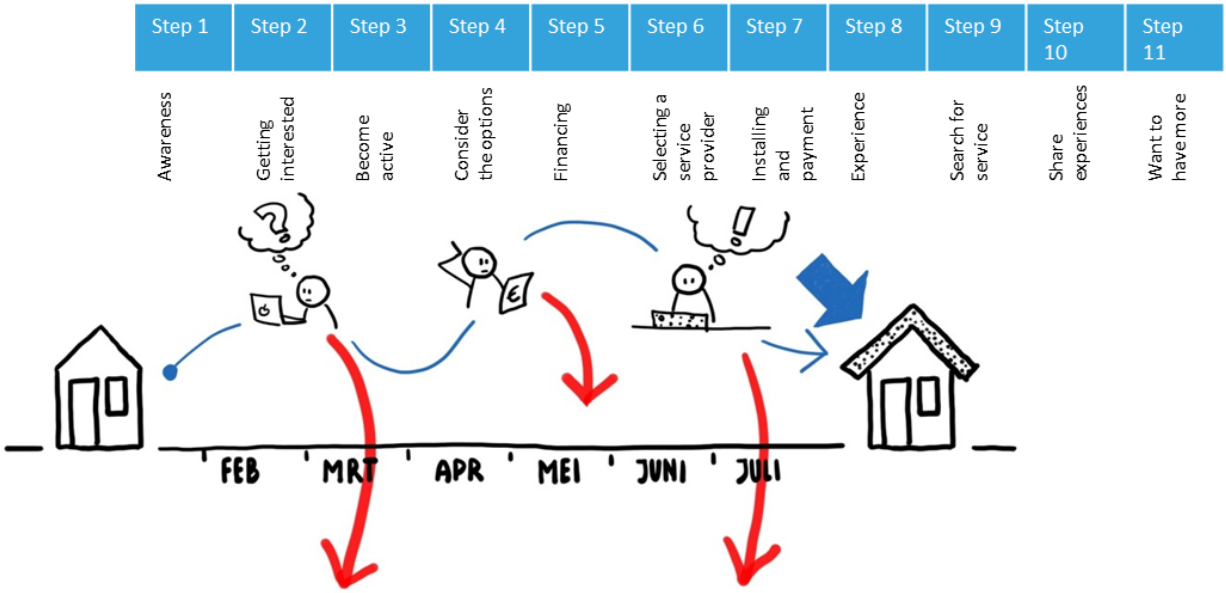



*Figure 12: Illustration of the Customer Journey towards nZEB renovation with drop out moments*

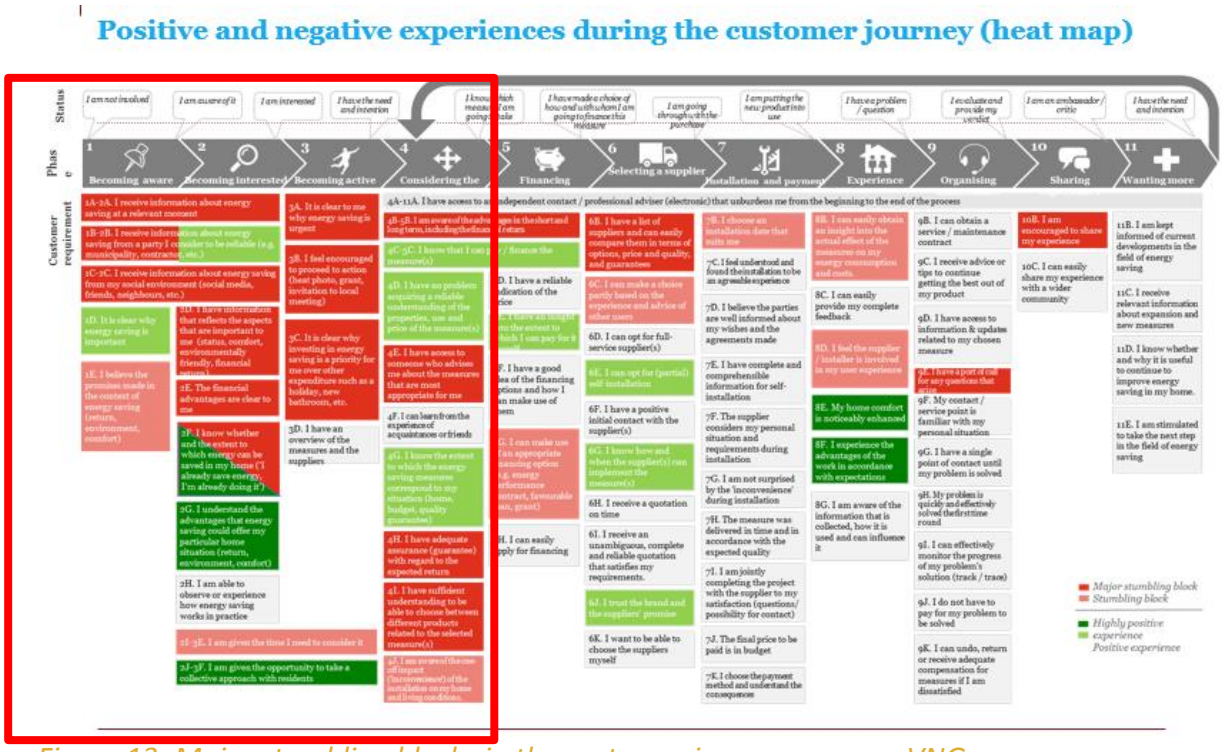



*Figure 13: Major stumbling blocks in the customer journey, source: VNG*

The purpose of continuous improvement of the Customer Journey is to minimize these losses: To get as many homeowners as possible from the starting point to the end point. The goal is to change the funnel into a tunnel, where both ends are equally wide which means no customers are lost along the way. Key in preventing customers from dropping out is introducing certain measures, such as the *right positive triggers* as well as *taking away (the main) barriers at the right moment* within the Journey.

This chapter discusses approaches to continuous improvement of the Customer Journey towards an nZEB renovation as identified by the REFURB partners in their countries.

In the first section (section 3.1), the underlying theoretical models for continuous improvement of the Customer Journey are summarized and described. In the second section (section 3.2), a summary of the currently applied best practices for the improvement of the Customer Journey are presented (in-depth analyses are included in Annex). Finally, some overall conclusions are drawn in the last section of this chapter (section 3.3).

## 3.1. THEORETICAL MODELS FOR CONTINUOUS IMPROVEMENT OF THE CUSTOMER JOURNEY

DMAIC is a model for continuous improvement that aims to get to the root cause of, i.e. main reasons for customers to drop out of the journey towards nZEB. DMAIC[85] (an acronym for Define, Measure, Analyze, Improve and Control) refers to a data-driven improvement cycle used for improving, optimizing and stabilizing business processes and designs. The DMAIC improvement cycle is the core tool used to drive Six Sigma projects. However, DMAIC is not exclusive to Six Sigma and can be used as the framework for other improvement applications. All of the DMAIC process steps are required and always proceed in the given order (See Figure 13).


*Figure 13: Representation of the DMAIC model*

The different steps are described here below:

**Define**

The purpose of this step is to clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline. Crucial in the problem articulation is the Voice of the customer: what are customers saying about your business? What makes them unhappy and dissatisfied?

**Measure**

[85] DMAIC was develop as a method in Six Sigma. Six Sigma is a set of techniques and tools for process improvement. It was introduced by engineers Bill Smith & Mikel J Harry while working at Motorola in 1986. Jack Welch made it central to his business strategy at General Electric in 1995. Description in – among many, many others - *Tennant, Geoff (2001).* SIX SIGMA: SPC and TQM in Manufacturing and Services

The purpose of this step is to objectively establish current baselines as the basis for improvement. This is a data collection step, the purpose of which is to establish process performance baselines. The performance metric baseline(s) from the Measure phase will be compared to the performance metric at the conclusion of the project to determine objectively whether significant improvement has been made.

**Analyze**

The purpose of this step is to identify, validate and select root cause for elimination.

**Improve**

The purpose of this step is to identify, test and implement a solution to the problem; in part or in whole. This depends on the situation. Identify creative solutions to eliminate the key root causes in order to fix and prevent process problems.

**Control**

The purpose of this step is to sustain the gains. Monitor the improvements to ensure continued and sustainable success.

## 3.2. BEST PRACTICES TO MEASURE CONTINUOUS IMPROVEMENT WITHIN THE CJ

Partners have been asked to describe and analyse 1-2 (or more) best-practice experiences in improving the customer journey in their country. Partners were to perform the analysis with the use the DMAIC model, using the template included in Annex 2. The input per country is included in Annex 3.

The effectiveness of any kind of improvement has to be checked in reality to ensure that there is actual continuous improvement. Following recommendations to measure actual improvement have been gathered from the REFURB partners:

- Analysis of current level of compliance to the different (sub-) steps of the Customer Journey model for existing nZEB solutions;
- Regular check/revision of existing nZEB solutions to verify that its major stumbling blocks are removed;
- Simply take measures of key performance figures and compare their before and after values to see if the numbers have improved. Key performance figures can be retained offline and online via numerous research methods, such as simple counting, interviews, questionnaires, surveys, focus groups, etc.
- Use the digital platform Salesforce to measure and identify current dropout rates for each step of the CJ, and check if numbers have improved;
- Benchmark current performance of existing nZEB solutions to other energy saving initiatives;
- Set targets and goals and regularly monitor to which extent the target has been reached;
- If the aim is to keep homeowners within a certain geographical area (a neighbourhood, …..;) in the CJ towards nZEB, maps such as a heat map can prove their worth. Simply compare ‘before and after’ screenshots of the area of interest to check for improvement;
- Carry out a customer satisfaction survey sometime after the nZEB renovation. Use the survey results to keep improving communication with customers.

## 3.3. CONCLUSIONS AND RECOMMENDATIONS ON THE IMPROVEMENT OF THE CUSTOMER JOURNEY

Based on the combined input from the REFURB partners, some conclusions and recommendations regarding a general approach for continuous improvement of the Customer Journey towards nZEB can be made.

**Conclusion: Pragmatic approach prevails**

Considering the input from the REFURB partners, it is fair to conclude that a pragmatic approach, leading to best practices, is mostly applied instead of strictly abiding to the steps of a general (theoretical) underlying model. Only a few general underlying models for continuous improvement were mentioned, being 'trial, error and correct' and the DMAIC model.

**Recommendation 1: Optimal organization of the supply side**

It is recommended to optimally arrange the supply side of an nZEB solution to ensure that supply partners will continue to learn from each other. Being able to exchange lessons learned is a vital precondition for further development of nZEB solutions and ultimately long-term growth of the nZEB renovation sector across the European countries.

Very often, multiple suppliers are involved in the realisation of a one-stop-shop offer. Continuous improvement of the supply chain cooperation ensures that a customer is offered a safe customer journey throughout. Improved supply chain cooperation can be achieved with quality agreements, a back- office secretariat for support, network and training and by appointing a SPoC as central spokesperson.

**Recommendation 2: Support and unburden the customer**

Offering a SPoC to the customer is an important way of supporting and unburdening the customer. Web tools on current energy use and the potential for energy saving, as used in Belgium and Netherlands, can raise awareness but can also provide a platform to support and unburden the homeowner/ customer, mostly in the first (but critical) steps of the Customer Journey.

**Recommendation 3: Ambassadors of nZEB renovation**

Both homeowners and supply partners can become active ambassadors of nZEB and the nZEB solution they purchase or represent. Having active local ambassadors, among homeowners and supply partners, can considered a recommendation as its trickle effect might be a way to ensure full market uptake of nZEB in the long run. It also indicates that supply partners will need to have (basic) marketing skills, for instance in effective use of multi- media communication channels (also see D5.5 on the competence profile of the SPoC).

**Recommendation 4: Effective communication, apply target group approach**

Continuous improvement in communication with the homeowner / customer, both offline as well as online, via websites and dedicated web tools is important to ensure effective communication on nZEB. Effective communication equals non- technical and tailored information provided at the right time, meeting the needs and wishes of the homeowner. Sending homeowners 'targeted messages' will considerably increase the probability of keeping them within the journey, especially within the first steps of the CJ (step 1 -4), with its many major stumbling blocks.

The area of effective communication on nZEB is to be considered a work in progress. The profile of the target actor should be taken into account (for instance, gender). For instance, in order to also address a female audience, the message could focus more on comfort instead of technical aspects

related to nZEB. Incorporating all lessons learned with regard to effective communication can be seen as major recommendation for improving the Customer Journey, as communication with the homeowner plays a role in each step.

# 4. Quality assurance approach for one stop shops

Based on previous chapter, two main conclusions can be made:

- Quality assurance should be interpreted as a feature of the compelling offers to create and contribute to customer confidence and not as a goal in its own right. As such, quality assurance can take the form of a toolbox of quality assurance measures embedded in the compelling offers[86]. Which kind of measures and under which conditions etc. must be tailored to the composition and the local context of the compelling offer. Including guarantees for energy savings is one way to create customer confidence, but there are a lot of other options possible that can achieve the desired result.
- Quality assurance measures can also apply to the demand-side, as the aim is to ensure a good customer experience of the NZEB renovation. For instance, quality assurance and performance standards for technical installations will not achieve the desired result when not maintained or used properly by the consumers. This also includes measures targeting the customer journey and customer confidence.

This is elaborated in the following chapters.

## 4.1. APPROACH FOR PERFORMANCE EVALUATION

### 4.1.1. Energy performance indicators

Chapter 2 discussed options for performance evaluation methods. The literature study and reviewed cases indicated a number of options for energy performance indicators.

*Energy indicators included in EPC [kWh/m².year, etc.]*

The Energy Performance Certificate (EPC) is still the most widely available instrument for building energy performance information in Europe, as it provides homeowners and occupiers with objective information to assess, compare and improve the energy performance of their properties. Although the reliability of the EPC varies across regions and Member States, it is a familiar and objective means to verify the energy performance. In theory, it is available as soon as homes are rented/sold

Energy performance assessments prior and after the renovation are an accepted means to verify the performance of the deep renovation and can provide a first indication of expected energy savings

*Energy label [A+, A, …, F,…]*

The energy label provides intuitive and easy-to-understand information on the energy performance of the property. The label is already applied in a number of regions and Member States (e.g. Estonia, Denmark, Netherlands). EPCs in Flanders – Belgium was used to have a numerical value but will indicate the label as well from 2019 onwards.

*Measured energy use, compared to a baseline [kWh]*

The energy consumption on daily, weekly or monthly basis has the potential to influence energy consumption behaviour of the inhabitant, but additional support is needed to ensure interpretation of these figures. In case of Buurkracht, comparison is made with the average consumption of the neighbourhood or similar users or buildings. In case of Stroomversnelling and Transition Zero, tenants

[86] COHERENO (2014) Hands-on recommendations on Quality Assurance and Customer Confidence for NZEB renovations

can compare their usage with a predetermined benchmark (= the basis for the EPV). Another possibility is to enable a comparison with the energy indicators included in EPC, although the energy performance gap has to be taken into account.

***Energy costs [EUR]***

Energy consumption figures can be abstract and thus difficult to grasp for homeowners or tenants. Translating it to cost makes it more tangible, as illustrated by Buurkracht.

### 4.1.2. Standardized approach for measuring and monitoring

The discussed cases illustrate possible approaches for measuring and monitoring. A distinction can be made between self-reporting and automatic monitoring.

***Self-reporting***

Energie ID illustrated the potential of self-reporting of the energy consumption. This approach can be useful for awareness raising purposes. Complementing the visualised data with nudging techniques as applied in Buurkracht has the potential to influence user behaviour and incite investments.

***Automatic monitoring***

All discussed platforms allow automatic monitoring. A distinction can be made between monitoring systems associated with certain product solutions (e.g. heat pump coupled with measurement systems or ventilation system) and neutral monitoring equipment. Which equipment to be used depends on what's available on the market.

Privacy and security can be a concern of participating households and have to be properly addressed.

## 4.2. CUSTOMER JOURNEY AS FRAMEWORK

The best practices reported from the REFURB partners were analysed to generate the REFURB toolbox for continuous improvement of the Customer Journey towards nZEB. Those best practices can be grouped together based on their 'target area' within the Customer Journey:

- **Before the customer journey even begins**: Here the focus is on improving the cooperation between (local) partners on the supply side i.e. improve the supply chain cooperation;
- **At the beginning of the customer journey (step 1-2 of the CJ)**: Here the focus is on increasing the probability of raising awareness and interest in energy saving and nZEB among (latent) customers;
- **During the customer journey (step 3-9 of the CJ):** Here the focus is on ways of increasing the probability of customers moving on from one step to another with the ultimate aim of having an nZEB renovation carried out;
- **End of the customer journey – sharing (step 10 of the CJ):** Here the focus is on ways of increasing the probability and effectiveness of customers willing to share their (positive) experiences regarding energy saving and nZEB renovation;
- **End of the customer journey – wanting more (step 11 of the CJ):** Here the focus in on increasing the probability of customers wanting more i.e. when nZEB has not yet been reached or when customers feel inclined to set even higher energy performance goals for their dwelling, energy neutrality (step 11);

The best practices are discussed per the identified Customer Journey steps in the following paragraphs. More detail information on the best practices per country can be found in Annex 3.

### 4.2.1. Before the customer journey begins: improving the supply side

Denmark, Slovenia and the Netherlands commented on best practices to improve the cooperation between players on the supply side i.e. improve the supply chain cooperation. Improving cooperation between supply partners is important as (usually) no single company can provide the customer a complete, and preferably one-stop-shop offer for nZEB renovation. Arranging the supply side effectively was already discussed in earlier deliverables D3.3-D3.4 and will also be discussed in D4.3 Compelling offers.

Best practices to improve supply chain cooperation include:

- Install and utilize a back-office secretariat for supply partners to unburden supply partners; to coordinate and also to unburden supply partners that represent a particular nZEB solution;
- Maintain and keep strengthening knowledge on nZEB among supply partners; this refers to all best practices used within the Danish concept Green Growth Business (GHB): Offering dedicated training to energy consultants, organising network meetings and mixed focus groups for relevant stakeholders and by having the supply partners carry out a SWOT analysis as well as a VNG Customer Journey compliance analysis for existing nZEB offers;
- Apply context mapping[87]; and gain a better understanding of your targets group(s);
- Group stakeholders with similar interests in the field of energy efficient solutions and renewable energy together in an Energy Service Centre (ESC). Pick a strategic location for the ESC i.e. where there are lots of customers are present, for instance at a (very) large shopping mall;
- Have local suppliers adhere to pre- determined quality requirements. This could be arranged via a public- private cooperation;
- Arrange and communicate on a nation- wide organisational structure including attractive funding;
- Involve (local) government; to ensure (short – term) funding of the market-uptake;
- Involve (local) government to coordinate the supply – side, the network of stakeholders (all partners);
- Government as nZEB customer; the government can step in and become nZEB customer herself by renovating public buildings to nZEB. This enables the supply side to grow, learn and develop further.

### 4.2.2. At the beginning of the customer journey (step 1 and 2)

All European homeowners are potential nZEB customers. However, most of them are not yet aware of this. In Belgium these unaware customers are referred to as latent customers. At this stage of the Customer Journey, best practices aim to raise awareness and interest among growing groups of (latent) homeowners and preferable in such a way that they are also inclined to move on to the next step in the Customer Journey.

Best practices to decrease dropout at the beginning of the CJ (step 1 and 2) are:

[87] Context mapping is an approach to design in which designers use people's everyday lives to inform and inspire themselves for ideation. In context mapping users and designers work together on the basis of expertise: designers are experts of the innovation process, whereas users are experts of their own experiences. It makes mainly use of qualitative research, analysis and conceptualization methods and supports empathy with the end-users and inspiration for better solutions. http://contextmapping.com/about/

- Provide the homeowner with tailored information. Random communication on energy saving and nZEB renovation is not very effective. Information that fits the wishes and needs of a homeowner is much more effective. By using statistical information, socio/ demographic information e.g. on the family decision structure, by knowing the ins and outs of your target group and with the help of Salesforce such tailored information can be generated;
- Benchmark energy use homeowners on local scale using an online tool; A benchmark among neighbours triggers homeowners to take action to also reduce their own energy use;
- Set up a dedicated advisory office (Energy Solution Centre or some type of back office) to which customers can turn to for holistic advice on energy saving and nZEB renovation;
- Choose convenient places to meet large groups of homeowners; for instance (large) shopping malls. Can be combined with an ESC to enhance its effectiveness;
- Reach homeowners with local and tailored campaigns on energy saving; local campaigns are very much appreciated by homeowners;
- Communicate on involvement of the local government; involvement of the local government regarding energy saving/ nZEB renovation builds trust and interest among homeowners right from the start;
- Assign a SPoC to provide its tailored services; for instance, a municipal SPoC can make house visits and meet homeowners face-to-face. During these visits he will have the opportunity to make homeowners aware of their energy use and the potential for energy saving;
- Communicate on Green Procurement by (local) government; it can be a powerful trigger to inform homeowners when the (local) government decides to renovate public buildings to nZEB, it sets a good example. Also, homeowners are less inclined to start saving energy if their (local) government does not lead by example;
- Involve tenants in the renovation process right from the start. An increase in rent after renovation can form a barrier for tenants. The solution for this possible barrier: Inform tenants right from the start and as much as possible as to what they can expect during and after the renovation. Highlight the benefits of the energy renovation, such as improved comfort. Make tenants part of certain decision- making process, for instance by offering tenants some choice in aesthetic solutions;
- Utilize natural moments, life changes (pension, children leaving the home and so forth) to time the communication on nZEB; use statistical data to get an insight in these natural moments for homeowners. Form target groups accordingly;
- Communicate on energy saving and nZEB renovation outside the summer months.

Both Belgium as well as the Netherlands report on the use of various dedicated supportive web tools to increase the probability of homeowners becoming aware, interested and active within the Customer Journey. Denmark uses the website for ProjectZero to provide homeowners with (independent) information on nZEB renovation.

Important aspects to ensure the user- friendliness and effectiveness of such web tools have been reported:

- Design the web tool from a user- perspective and not a technical perspective. Avoid technical language and technical questions. Have the web tool represent factual reality;
- Design the web tool with a multi- disciplinary team to ensure broad understanding;
- Test the web tool as a beta version with a focus group of end users first; make necessary adaptations based on feedback received;

- Keep the user interface design (UI)[88], short and simple. Websites need to approachable to all homeowners. If needed, shorten the online CJ as not to scare homeowners away. Having an 11 step CJ, does not mean that all steps need to be mentioned on the website.
- Design the Customer Journey within the web tool in such a way that the homeowner can decide where exactly i.e. at what particular step the journey begins;
- Use as little text as possible, apply an attractive visual communicative style throughout;
- Communicate clearly if there is a public- private cooperation underlying the web tools as this creates a sense of trust among homeowners;
- If there is an energy advisor (SPoC) linked to the web tool that is designed to raise awareness and interest, then have it preferably be an independent advisor. Homeowners initially prefer to communicate with an independent energy advisor to help them explore their options;
- In case of public – private cooperation; include independent information only;
- Long- term public – private cooperation may be needed to ensure funding i.e. its existence and proper functioning;
- Provide a link to multi – media channels (Twitter, Facebook) to ensure broad contact with various customers;
- Ensure user- friendliness and full functioning of the web tool when it is accessed via iPad or iPhone;
- Include contact information. Who can customers turn to when they have questions and how?
- Link the web tool to dedicated projects/ campaigns targeting certain geographical areas or specific target groups.

### 4.2.3. During the customer journey (step 3- 9)

Once customers are aware and interested, it is important to keep them active and moving on along the Customer Journey. Best practices for increasing the probability of homeowners/ customers moving on (step 3 to 9) are:

- Ensure effective and proactive follow- up of leads via a back-office; the back-office follows up via calls or email. But, homeowners will need to feel inclined to leave their contact information along the way to make a follow- up possible. By using a dedicated web tool, contact information can be retained;
- Assign a SPoC to provide its unburdening services; either commercial or independent, the SPoC is there to personally remove all barriers, to offer tailored advice and to help homeowners/ customers throughout the journey;
- Continued neighbourhood approach; Local campaigns can also be used to trigger homeowners into taking action after awareness and interest has been raised. Local follow-up is an effective way of keeping homeowners engaged and active within the journey;
- Nation-wide renovation scheme including attractive funding is preferred; for instance, the KredEx renovation scheme serves as a powerful trigger; this is also due to its 'first in, first out' policy;
- Have the government practice Green Procurement all the way towards nZEB; if the government communicates on its determination regarding nZEB renovation of public buildings, this may motivate homeowners to do the same;

[88] User interface design or user interface engineering is the design of computers, gadgets, appliances, machines, mobile communication devices, software applications and websites with the focus on the user's experience and interaction https://www.sciencedaily.com/terms/user_interface_design.htm

- Empower customers during the renovation process; for instance via the use of a dedicated app that allows customers to monitor the process and alerts customers on decisions they themselves need make;

### 4.2.4. End of the customer journey: Sharing (step 10)

An nZEB renovation that has been carried out successfully may serve as a trigger for other interested homeowner, provided that the experiences from homeowners are shared in an effective manner. Best practises to increase the probability for effective sharing of customer experiences:

- Focus on sharing good local cases of nZEB; local cases resonate the most with homeowners;
- Train the supply side to effectively share their (local) good cases of nZEB via websites, social media and smart apps;
- Train the SPoC to effectively encourage customers or housing corporations to share their good experiences with nZEB renovation;
- Measure and 'control' customer satisfaction; to continuously ensure the customers feel safe and will want to share their experiences;
- Monitor online customer reviews; monitor the reviews customers placed on social media and provide effective follow-up if needed. This protects 'the brand' so customers feel safe and inclined to keep sharing;
- Make it possible for good cases of nZEB to be shared via various multi- media channels; customers can decide where they feel most comfortable sharing their nZEB experiences (Netherlands, Denmark)
- Regularly pitch good cases of nZEB during the heating season;
- Offer homeowners some type of reward in return for sharing their experiences;
- Dedicate a specific webpage to the personal reviews from customers. Write it from a customer- oriented approach and preferably also include a picture of the homeowner.

### 4.2.5. End of the customer journey: Wanting more (step 11)

If the customer has not yet reached nZEB level in his energy renovation, it is key to motivate the customer to want more. In addition, a customer can also be triggered to aim for a higher energy performance than nZEB, energy neutrality. Best practises to increase the probability of customers 'wanting more' include:

- Pro- actively track down local nZEB+ ambassadors; homeowners that have already carried out deep energy renovation, are natural nZEB ambassadors that will stimulate their neighbours, family and friends to do the same.

## 4.3. BEST PRACTICES

This chapter illustrates the approach with best practices of the REFURB consortium.

### 4.3.1. Best practices: Slim Wonen in Leeuwarden (NL)

When potentially interested homeowners enter the energy portal www.slimwoneninleeuwarden.nl, they are quickly 'assured' of the performance of the available energy saving measures. This 'trust building' is achieved in a number of ways. First, a company can only join/ be part of the SLIM consortia when it (agrees to meet/) meets certain quality standards. SLIM companies are required to be a member of relevant (esteemed) cluster organisations (such as UNETO-VNI, Bouwend Nederland) and need to be certified to carry out the work. The list of all quality standards can be found on the online energy portal.

Next to meeting quality demands, companies affiliated to ‘Slim Wonen’ also make these six promises to homeowners:

1. We provide an integral approach; all possibilities for energy saving are mapped;
2. We provide good, complete and clear advice;
3. We offer tailor-made advice; the customer wishes are leading;
4. The customer has a single point of contact; one SLIM advisor handles all contacts;
5. For us, a deal is a deal. We provide reliable and good service;
6. We provide service from A to Z; striving for 100% customer satisfaction from start to finish.

The online portal also includes testimonials from homeowners that have already carried out energy saving measures. Reviews and experiences from fellow-homeowners are very valuable to potentially interested homeowners. Reviews and experiences are shared with all the residents of Leeuwarden via the 'Slim Wonen in Leeuwarden Facebook' page, Twitter as well as a YouTube channel. Interested homeowners can of course also always contact the municipality of Leeuwarden for more information on quality assurance.

### 4.3.2. Best practice: ESCO Harkema (NL)

In the Netherlands, Fryslân has a pilot in the municipality of Harkema, in which deep renovations of single family homes using an energy performance contract is being explored. The involvement of the local cooperative is a critical success factor and the strong local citizen engagement as a result of it.

Within the innovative regional concept known as ‘ESCo Harkema’[89] , discussed in D4.5 'Compelling offers', an energy performance contract is used to guarantee energy saving for the private homeowners. With the energy performance contract, the customer does not run any risks and the ESCo 'company' is ensured of its return on invest. The homeowner simply lends the money for investing in energy saving measures (20 years in total for zero- energy) and pays it back via the amount of money that is monthly saved on energy bills. However, the ESCo Harkema will not be exploited by a commercial ESCo company. Instead, the local energy cooperation will be shareholder in the new FRESCO BV, the Frisian ESCo. Volunteers from the local energy cooperation will support any local homeowner who wants to join. Any profit generated, will flow back to the local village/ community.

The energy performance for the ESCo Harkema is guaranteed by a consortia of (local) companies involved and applies to an agreed period (also mentioned in the contract) after completing the energy measures/ renovation. The FRESCO 'company' will arrange the contracts and guarantees with the company/ companies. The customer is completely unburdened. All the agreements are included in the energy performance contract.

The actual energy performance after renovation is measured via monitoring tools (i.e. monitoring tools available on the market to verify energy consumption). The actual energy performance also depends on the energy behaviour of the customer. The homeowners are expected to adhere to their 'normal/ regular energy behaviour'; this is also included in the contract. Considering the special construction of this particular ESCo, it is very likely that (local) homeowners will be very motivated to do so.

[89] https://www.dwaande.nl/uploads/bestanden/Werken%20en%20ondernemen/uitvoeringsprogramma-2017-2020-energietransitie.pdf.

# Conclusions and recommendations

The ultimate goal of energy renovation towards nZEB is to reduce energy consumption and thus $CO_2$ emissions. Therefore, quality assurance in nZEB renovations requires attention throughout the entire renovation process, from the early stages until hand-over and further on during the use phase, from all involved parties.

Preserving quality in nZEB renovations is a hot topic with a broad interpretation. Energy performance guarantees are considered by some stakeholders as a key leverage tool for market uptake of nZEB renovations. However, in the new focus of this market, consumer-centred instead of building-centred, studies have proven otherwise.

As explained in the previous chapters of this report, quality is handled differently per country depending on the market situation. While certification of the supply side is imposed in the majority of them, performance guarantees are neither legally implemented nor found in practice in general.

Only the Netherlands offer energy performance guarantees in a system set up together with the government and the supply side. The Nul Op de Meter (NOP) Keur, created within Stroomversnelling (the Dutch continuation of Energiesprong) guarantees energy performance for zero energy dwellings (= no energy bill, the house produces its own energy = EPC = -0,42). Housing corporations in the Netherlands receive an EPV (= 'Energie Prestatie Vergoeding) compensation based on the number of achieved 'energy label jumps'. The key of success of this system is that the supply side was involved in the setting up.

Some loans or financial incentives for energy renovation are linked to the quality of the works or the energy performance of the building afterwards (e.g. KfW funding for 'Effizienzhaus'). Nevertheless, there is no guarantee to actually achieve energy savings to the expected extent, because they are usually based on the EPC calculations instead of on the real savings. It is well known, that the EPC calculations are not reliable when it comes to energy consumption, because they are mostly based on theoretical values and are therefore not accurate to estimate real savings.

When giving performance guarantees on energy savings of homeowners, risks might arise for the supply side due to the rebound effect. No supplier can give a real guarantee for the dwellers' behaviour. Smaller companies may particularly suffer when different contractors work together. They will be responsible for their products but not for the performance of the final system. Only in highly comparable buildings of a certain type, which are equipped with a predefined package solution on a large scale, a generously calculated performance guarantee might be an option for the supply side and provide benefits for the homeowner. However, there is a need for monitoring after the works are finalized, in order to ensure actual energy savings.

In order to counter the fragmentation of the supply side and to encourage collaboration along the supply chain, collaborative events[90] brought about good progress. There still is a need for stronger collaboration and trust building between 'traditional' partners such as contractors, designers and consultants. In addition, collaboration is recommended with new types of stakeholders such as renovation advisors, project managers, ESCO's, renovation stores, one-stop-shops, and non-profit organisations. Therefore, the single-point-of-contact revealed highly relevant for market uptake since this is supposed to be the entity to launch and organise those kinds of events.

The renovation process is based on a trust relationship between the consumer and the supply side. The way a performance guarantee is offered to the homeowner in the current market setup may undermine this needed trust. Nevertheless, it might be appropriate to give guarantees on an average performance of a number of buildings e.g. street level, not at individual building level. One could guarantee a minimal energy saving combined with a (wide) range based on the current energy use of the homeowner; this is measured via monitoring. It works in the same way as a mobile phone subscription, if you use more than your phone/ energy bundle, you will have to pay extra. Homeowners are also accountable for their behaviour and proper use of the installations.

Benchmarking the homeowner's energy use with that of similar households and confronting him/her with it (with smart meter and some type of screen), is much more stimulating for them to take up energy saving actions than any kind of energy saving guarantee or 'cold' calculations on the return on investment could be. Influencing consumer behaviour has proven to be much more fruitful.

These findings are in accordance with the European Commission addressing the importance of 'informing and empowering consumers through metering and billing'[91] because smart meters allow customers a real time feedback on their energy consumption. This in turn allows consumers to take control of their energy bill and identify and suppress unnecessary energy consumption. Rather than waiting for annual bills, consumers can have an immediate and accurate feedback on their energy consumption. They become more aware of their actual energy consumption and can change their use of equipment and their patterns of behaviour. Obviously, consumer engagement and consumer acceptance is the key to delivering energy savings by behavioural changes.

In order to achieve the ultimate goal to reduce energy consumption, the main challenge is to create customer confidence[92], getting homeowners on board of a customer journey towards nZEB and keeping them until completion. This aspect is graphically illustrated in the heat map of the VNG Customer Journey where the major stumbling blocks (red blocks) are concentrated at the beginning of the CJ (see figure below). There are barriers that prevent onboarding and there are drop out moments along the journey. Triggers can be imposed to keep homeowners moving in the CJ; barriers can be lowered or taken away all together.

[90] So-called 'Business Collaboration Events' have been implemented within the COHERENO project http://www.cohereno.eu/fileadmin/media/Dateien/Cohereno-report-customer-confidence.pdf.

[91] European Commission Staff Working Document 'Good practice in energy efficiency'; Brussels, 30.11.2016; https://ec.europa.eu/energy/sites/ener/files/documents/5_en_autre_document_travail_service_part1_v4.pdf; p. 19 et seq.

[92] See COHERENO (Collaboration for housing nearly zero-energy renovation) report on creating customer confidence through quality assurance - http://www.cohereno.eu/fileadmin/media/Dateien/Cohereno-report-customer-confidence.pdf.

Within the REFURB project, we found out that performance guarantees are neither a trigger for homeowners to complete their nZEB renovation nor a major barrier in entering the customer journey. However, this does not mean that quality issues should be neglected or that actions should not be put in place in order to achieve the expected energy savings. It is rather an appeal for a **holistic quality approach:** the entire customer journey should have quality checks and balances built in. Not just at the end, where measures are installed and the homeowner is starting to use them.

This report illustrated different ways of embedding quality assurance in compelling offers for NZEB renovation services. It was argued to complement performance guarantees of energy savings as the prerequisite for customer-confidence with improving the customer relationship by providing guidance along the customer journey, building customer confidence using a toolbox of quality assurance measures and illustrating the potential added value of a Single Point of Contact as a facilitator for NZEB renovations.

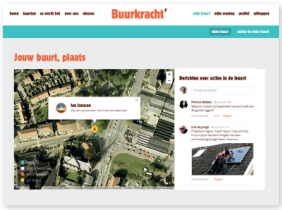
In addition, having a guarantee on energy savings per se does not create any appealing window of opportunity; a leaky roof or the need for more space does. Again, the homeowner has to already have some kind of intrinsic motivation to want to safe energy (step 1 and 2 of the CJ). Only those who enter the CJ will have energy savings in the end. That is why, especially in the initial phase, it is important to speak the customer´s language and address the aspects that actually motivate the customer at the right moment.

It has been observed that most of the homeowners decide to go for a step-by-step renovation. In that case, they should re-enter in the CJ loop after Step 11 - wanting more into step 4 – considering the offer, to make sure they reach the nZEB level. The following actions are proposed to keep homeowners in the renovation process:

- Offering a roadmap to nZEB based on the modules;
- Addressing ‘co-benefits’ energy savings combined with related pros such as good indoor climate, comfort, health, and well-being as well as impact on market value;
- Sending follow-up offers based on their roadmap (use of CRM/database);
- Community gatherings in a fun setting, where people who have taken the first steps receive a thank you and can share experiences;
- Offering continuing insight in the amount of money and energy saved (cumulative effect) through smart meter data;
- Have local consortia of energy related companies join forces to offer one complete nZEB renovation package; this local consortia guarantees the energy performance, it is their shared responsibility (for instance used in the Netherlands, guarantee is a so called ‘no energy bill’ being reached;
- Involve the local government: public-private-partnership to get consumers to step into the CJ (for instance, via the Slim Wonen website) and to create trust from the start;
- Dedicate efforts on CRM (Customer Relationship Management); keep track of (local) customers in SalesForce (see D5.3) and organize come together meetings for homeowners to stimulate them to take the next step for their dwellings;
- Consortia of local contractors could also reward their faithful customers with incentives (a discount, some type of present);
- Offer a certain subsidy as a ‘reward’ if a customer is willing to go to nZEB in one go.

# Annex 1 – Buurkracht activation letter

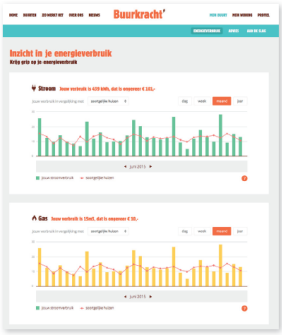

**Op je eigen Buurkrachtpagina vind je het laatste nieuws uit de buurt, zie je op de buurtkaart welke buren er mee doen en kun je berichten plaatsen of reageren op een bericht.**



## Zet jezelf op de kaart

Om te laten zien wie je bent, kun je een foto uploaden bij profiel en een boodschap neerzetten.

Klik op profiel en vervolgens op privacy dan kun je aanvinken:
- of je getoond wilt worden op de buurtkaart
- of buurtgenoten je mogen e-mailen, bijvoorbeeld naar aanleiding van je boodschap
- of het buurtteam contact met je mag opnemen als je interesse hebt in een maatregel



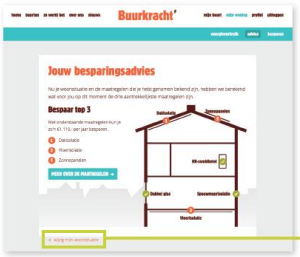
## Inzicht in je energieverbruik

Door je slimme meter te koppelen, zie je hoeveel stroom en gas je verbruikt. En kun je dit vergelijken met het gemiddelde verbruik in de buurt. Je vindt je verbruik door op mijn woning en vervolgens energieverbruik te klikken.

**Verbruikgegevens opvragen**
Bij profiel onder slimme meter kun je je persoonlijke code invoeren waarmee je Buurkracht machtigt de verbruikgegevens van je slimme meter op te halen (deze kun je elk moment ook weer intrekken).

Deze code krijg je, als je een slimme meter hebt, per brief thuisgestuurd. Maar je kunt deze ook (opnieuw) aanvragen via nieuwe code aanvragen.

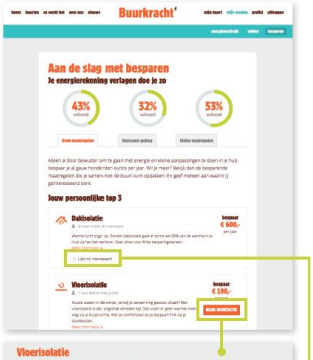
Zodra je verbruik zichtbaar is, ontvang je van ons een e-mail. Dit duurt ongeveer anderhalve week. Nu kan jij – en alleen jij – je energieverbruik op de voet volgen.



## Persoonlijk advies

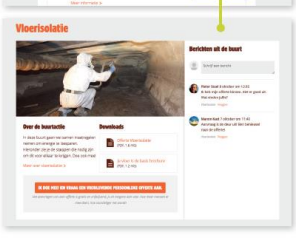
Heb je je woonsituatie ingevuld, dan vind je onder mijn woning een overzicht van de voor jou drie aantrekkelijkste maatregelen.

Je kunt je woonsituatie via 'wijzig mijn woonsituatie' altijd aanpassen.



## Aan de slag met besparen

Wil je weten wat je kunt doen om je energierekening te laten dalen? Onder besparen vind je een overzicht van verschillende maatregelen. Onder grote maatregelen vind je je Bespaar top 3 terug, maar zie je ook nog andere mogelijkheden. En besparen hoeft niet veel te kosten. Want wat dacht je van gratis besparen met duurzaam gedrag?



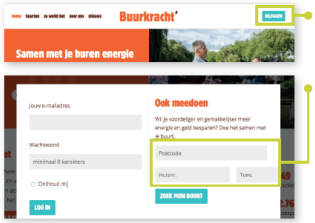
## Informatie en buurtacties

Per maatregel vind je relevante informatie en zie je of er in jouw buurt een buurtactie loopt. Is dat het geval? Dan kun je meedoen en geheel vrijblijvend een persoonlijke offerte aanvragen.

Is er geen buurtactie? Geef dan aan dat je hier interesse in hebt. Als nog meer buren geïnteresseerd zijn, kan het buurtteam hiermee aan de slag gaan. Het is dan wel aan te raden om bij profiel en privacy aan te geven dat het buurtteam contact met je op mag nemen, zodat ze je kunnen informeren als ze een actie gaan starten.

## Aanmelden en inloggen op buurkracht.nl

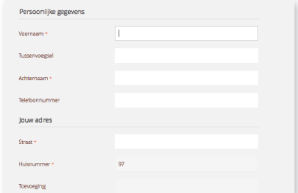
**Wil jij op de hoogte blijven van de acties in jouw buurt? Inzicht krijgen in je energieverbruik en weten welke maatregelen je kunt nemen om je energierekening omlaag te krijgen? Meld je dan gratis (en vrijblijvend!) aan op buurkracht.nl.**



1 Ga naar **www.buurkracht.nl** en klik op Inloggen.



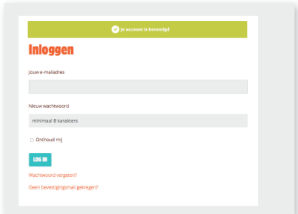
2 Vul je postcode, huisnummer en eventuele toevoeging in onder Ook meedoen.



3 Vul je gegevens in.
De velden met een * zijn verplicht. En vergeet niet om onder aan een vinkje te zetten bij de voorwaarden. Klik op Versturen.

Je ontvangt nu een **bevestigingsmail** op het opgegeven e-mailadres met daarin een link.

Klik op de link om je aanmelding definitief te maken.



4 Klik je in je e-mail op Ik bevestig mijn aanmelding, dan zie je dit scherm.

Vul je e-mailadres en je wachtwoord in. Vink je vervolgens Onthoud mij aan, dan blijf je ingelogd.

Je bent nu ingelogd op je persoonlijke pagina die gekoppeld is aan jouw buurt.

Buurkracht

# Annex 2 –Country reports: template

## FORMAT

In the following format each country described models they already use to improve the quality of their every day work as well as some best practices.

### <Country> – Description of general underlying model(s)

Please describe the model or models you use to improve your quality. Max. 1-2 pages. Even if you do not have a Customer Journey in place at the moment, you will do something to improve your every day work. Otherwise you would be out of business already….

Please describe the broad steps you take in this general underlying model in the same way as the DMAIC model is described in concept report template (see Chapter 2).

### <Country> – Description and analysis of 1-2 improvements

Please describe 1-3 improvements you have made in the past. Max 1 page per improvement. Even if you do not have a Customer Journey in place at the moment, you will have made improvements to the way you work / do energy renovations. Otherwise you would be out of business already….

Use the DMAIC model for your description and answer the following questions in your description:

**Define**

What was the problem you faced and why was it a problem?

**Measure**

How did you objectify and measure the problem to make it as clear as possible? How did you get input from your customers on the problem (e.g. focus groups, surveys, interviews) and what did they say about you and the problem at hand?

**Analyse**

How did you get to the root cause of the problem? (e.g. brainstorming, using fishbone diagram). And what was that root cause?

**Improve**

How did you go about creating a solution? What did you deploy to come up with a creative solution? (e.g. co-creation with stakeholder, using artist or free-thinkers). What was your solution? Did you test your solution and how did you test it? How did you implement the solution and what where the results?

**Control**

How did you monitor your improvements to ensure continued and sustainable success?

# Annex 3 – Country reports: analyses

In this chapter all input received from the REFURB partners is presented:

## 1.1 DENMARK

For Denmark, the REFURB project team has been inspired to work with the Customer Journey developed by VNG (Vereniging van Nederlandse Gemeenten) and which was adapted by the REFURB 2.0 project.

### 1.1.1 Theoretical models

As already mentioned, the Danish REFURB team has been very inspired by the Customer Journey. The challenge is however, that it requires both a public and a private participation to create an inspiring, safe and robust journey along its 11 steps. No single "company" or "organisation" can create this, the challenge is therefore to assess the customer requirement (challenges) in a close partnership between (local) public and private partners and to create a sustainable financial model or funding for operating the partnership.

Deep energy renovation is also (by 2016) challenged by low energy prices, economic growth/boom and a less political attention given to energy and climate. With these less attractive frame conditions, it is not possible to make "save money" a key argument for energy renovation. The "selling" arguments need to change from pay-back time on energy saving, to homeowners responsibility for lifetime improvement, the non-economic value of easy maintenance and comfort, health, convenience, value securing, smart solutions etc. Beside this, timing is important. [93] An annual Danish survey to 3,000 homeowners, support the tendency of lower interest in energy REFURBishment, showing that in 2015-2016, 52-55 % of the homeowners are interested. In 2012-2014, 63-72 % were interested in energy REFURBishment.

Four current Danish concepts have been analysed. Below, the Customer Journey assessment of these concepts are listed, including:

- **The ZEROhome concept** (ZERObolig) created 2010+ by ProjectZero a public private partnership in Sonderborg (6 Partners). The partnership received national (demand side development) and EU Socialfund funding (craftsmen education). From 2015 the Partnership had no external funding, but was only funding from local partners. ZEROhome (ZERObolig) require min. 1.5 man/year resources to support the entire Customer Journey in its target area Sonderborg.
- **The Green Business Growth** (Grøn Erhvervsvækst**)** concept was created 2010 as a public-private partnership in Region South Denmark (21 partners across 8 municipalities). The partnership received EU Regionalfund funding. From 2014 the concept had been taken over by CLEAN, and is today only funded by its partners (Today 15 partners across 6 municipalities). From 2017 the annual budget is 1,8 man/year including 0,5 man/year for the energy focus.
- The **Better Home** concept – created and operated since 2015 by 4 major Danish technology suppliers.

[93] https://www.bolius.dk/fileadmin/user_upload/Boligejeranalyse/Bolius_Boligejeranalyse_2017.pdf

- The national **Better Housing** (Bedre Bolig**)** concept - created and implemented 2014 by the Danish Energy Agency. The concept received initial funding 2014-2016 for education and promotion with an annual budget of 2,2 mio. EUR. Today the concept is totally market driven. Private business schools have taken over the concept and the 450 educated Better Housing Consultants are free to use the marketing concept/material and best practice cases on their website to create their own business.

For further information about the individual concepts, please see REFURB D 2.2 and D3.2-3.5 reports.

The below table is an assessment of how the analysed 4 Danish energy-retrofit concepts comply with the customer journey requirements as described by VNG.

| **Phase/ Issue#** | **Customer requirement** | **ZEROhome (ZERObolig)** | **Green Business Growth (Grøn Erhvervsvækst)** | **Better Home** | **Better Housing (Bedre Bolig)** |
|---|---|---|---|---|---|
| Becoming aware 1A-2A | I receive information about energy saving at a relevant moment | Partly/ in progress | Partly/ in progress | No | Compliance |
| Becoming aware 1B-2B | I receive information about energy saving from a party I consider to be reliable (e.g. Municipality, contractor etc.) | Compliance | Compliance | Partly/ in progress | Compliance |
| Becoming aware 1C-2C | I receive information about energy saving from my social environment (social media, friends, neighbours, etc.) | Partly/in progress | Compliance/ Partly (Facebook) | No | No |
| Becoming aware 1D | It is clear why energy saving is important | Compliance | Compliance | Compliance | Compliance |
| Becoming aware 1E | I believe the promises made in the context of energy saving (return, environment, comfort) | Compliance | Compliance? | Partly/in progress? | Compliance |
| Becoming interested 2D | I have information that reflects the aspects that are important to me (status, comfort, environmentally friendly, financial return) | Partly/ in progress | Partly/ in progress | Compliance | Compliance |
| Becoming interested 2E | The financial advantages are clear to me | Compliance | Partly/In progress? | Compliance | Compliance |
| Becoming interested | I know whether and the | Partly/ | Partly/In progress | No? | Compliance |

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|---|---|---|---|---|---|
| 2F | extent to which energy can be saved in my home ('I already save energy, I'm already doing it') | In progress | | | |
| Becoming interested 2G | I understand the advantages that energy saving could offer my particular home situation (return, environment, comfort) | Partly/ In progress | Partly/In progress | No?<br>(a very simple on-line tool tells the costumer if there is energy saving potential) | Compliance |
| Becoming interested 2H | I am able to observe or experience how energy saving works in practice | ? | ? | ? | ? |
| Becoming interested 2I-3E | I am given the time I need to consider it | Compliance | Compliance | Compliance | Compliance |
| Becoming interested 2J-3F | I am given the opportunity to take a collective approach with residents | Compliance<br>(local energy events) | Compliance<br>(local energy events) | No | No |
| Becoming active 3A | It is clear to me why energy saving is urgent | Compliance | Compliance | No?<br>(The standard is an offer from a craftsman without an energy check-up ) | |
| Becoming active 3B | I feel encouraged to proceed to action (heat photo, grant, invitation to local meeting) | Compliance<br>(local meetings) | Compliance?<br>(cases showing the inspiring examples/local meetings) | No ? | Compliance<br>(case selection) |
| Becoming active 3C | It is clear why investing in energy saving is a priority for me over other expenditure such as a holiday, new bathroom, etc. | Compliance | Compliance? | No?<br>(The standard is an offer from a craftsman without an energy check-up ) | Compliance |

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|---|---|---|---|---|---|
| Becoming active<br><br>3D | I have an overview of the measures and the suppliers | Compliance | Compliance<br><br>(list of educated energy craftsmen) | No<br>(Better Home chooses the most relevant craftsmen to visit the costumer, - not up to the costumer to choose between craftsmen. Only 4 suppliers connected to the concept) | Compliance (list of educated Better Housing advisors, - some of them also suppliers) |
| Considering the offer<br>A4-11A | I have access to an independent contact / professional adviser (electronic) that unburdens me from the beginning to the end of the process | Compliance | Partly/in progress (list of Better Housing advisers). Not an offer that is highlighted) | No (see 3D) | Compliance (list of educated Better Housing and independent advisers) |
| Considering the offer<br>4B-5B | I am aware of the advantages in the short and long term, including the financial return | Partly/<br>In progress<br>(the independent energy adviser "Charlie" gives advises) | Partly/in progress (the educated energy craftsmen can give guidance) | No (there is no requirement to the education of the craftsmen connected to the concept | Compliance (The Better Housing advisers are educated to make long term Better Housing Plans) |
| Considering the offer<br>4C-5C | I know that I can pay / finance the measure(s) | Compliance | ? (not in GBG hands, up to the energy craftsmen) | Compliance | ? (not in the hands on the agency) |
| Considering the offer<br>4D | I have no problem acquiring a reliable understanding of the properties, use and price of the measure´s | Compliance | ? (not in GBG hands, up to the energy craftsmen) | ? | Compliance |
| Considering the offer<br>4E | I have access to someone who advises me about the measures that are most appropriate for me | Compliance | Partly/In progress (access to energy craftsmen) | Compliance?<br><br>(the visiting craftsmen give an offer | Compliance |

| | | | | | |
|---|---|---|---|---|---|
| | | | | including 4 selected suppliers. The offer is not necessarily based on a long term energy saving plan) | |
| Considering the offer 4F | I can learn from the experience of acquaintances or friends | Compliance? (How?) | Partly/in progress (in the future there will be more focus on social media and sharing the experience and good cases) | No? | No |
| Considering the offer 4G | I know the extent to which the energy saving measures correspond to my situation (home, budget, quality guarantee) | Compliance (Charlie – independent Energy adviser offers Better Housing Plans) | Partly/in progress (a few Better Housing plans are offered through the educated energy craftsmen/educate Better Housing advisers) | Partly/in progress (a few Better Housing plans are offered) | Compliance (Better Housing plans are offered) |
| Considering the offer 4H | I have adequate assurance (guarantee) with regard to the expected return | Partly/In progress | No | No (no assurance regarding the expected return, but assurance in the quality of the products from the 4 suppliers) | Compliance (The Better Housing advisors must have an assurance to be on the list) |
| Considering the offer 4I | I have sufficient understanding to be able to choose between different products related to the selected measure(s) | Compliance | Partly/in progress<br><br>(it is not in the hand of GBG, but it is up to the energy craftsmen/Better Housing advisers to guide the costumers) | No (the concept is not to choose between different products, but the costumer can always get an alternative offer from | Compliance<br><br>(A part of a Better Housing plan, but unfortunately costumers will not pay for the guidance) |

| | | | | | |
|---|---|---|---|---|---|
| | | | | other companies) | |
| Considering the offer 4J | I am aware of the one-off impact ('inconvenience') of the installation on my home and living conditions. | Partly/in progress | No | No | Compliance (some tips and tricks for good energy behaviour and a good in-door climate is given in the Better Housing Plan) |
| Financing 5D | I have a reliable indication of the price | ? | Partly (it is not in the hands of GBG, - up to the energy craftsmen) | Compliance (a concrete offer is given) | Compliance<br>(A budget is a part of the Better Housing Plan) |
| Financing 5E | I have an insight into the extent to which I can pay for it myself | Compliance | Compliance (it is possible to get an overview through an on-line financing tool is offered at the website) | No (up to the costumer) | Compliance (it is possible to get an overview through an on-line financing tool is offered at the website) |
| Financing 5F | I have a good idea of the financing options and how I can make use of them | Partly/In progress (cooperation with local banks) | Compliance (on line tool on the website plus cooperation with local banks) | No (up to the costumer) | Compliance (on line tool on the website) |
| Financing 5G | I can make use of an appropriate financing option (e.g. energy performance contract, favourable loan, grant) | Compliance | No | No? | No |
| Financing 5H | I can easily apply for financing | Compliance | Partly/In progress | No? | No |
| Selecting a supplier 6B | I have a list of suppliers and can easily compare them in terms of options, price and quality, and guarantees | Compliance (list is available on website and also advertised) | Compliance (225 energy craftsmen to choose between) | No (the concept is 4 selected suppliers) | Partly/ in progress (in theory it is also possible to choose Better Housing Consultants, that can give guidance in the phase of selecting a supplier, but in practice has no |

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|---|---|---|---|---|---|
| | | | | | consultant been selected to guide in this phase) |
| Selecting a supplier 6C | I can make a choice partly based on the experience and advice of other users | Compliance | Partly/in progress (A number of cases with advises and experience of others will soon be available) | No? | Compliance (a case bank is available) |
| Selecting a supplier 6D | I can opt for full-service supplier(s) | No | No (not in the hand of GBG, but up to the energy craftsmen) | Compliance | No |
| Selecting a supplier 6E | I can opt for (partial) self-installation | Compliance | No (not in the hand of GBG, but up to the energy craftsmen) | No | No |
| Selecting a supplier 6F | I have a positive initial contact with the supplier(s) | Partly/In progress | No (not in the hand of GBG, but up to the energy craftsmen) | Compliance | No |
| Selecting a supplier 6G | I know how and when the supplier(s) can implement the measure(s) | Compliance | No (not in the hand of GBG, but up to the energy craftsmen) | Compliance | No |
| Selecting a supplier 6H | I receive a quotation on time | Partly/In progress | No (not in the hand of GBG, but up to the energy craftsmen) | ? | No |
| Selecting a supplier 6I | I receive an unambiguous, complete and reliable quotation that satisfies my requirements. | Partly/In progress | No (not in the hand of GBG, but up to the energy craftsmen) | Compliance | No |
| Selecting a supplier 6J | I trust the brand and the suppliers' promise | Partly/In progress | Compliance<br>(the brand of the energy craftsmen is good) | Compliance | No |
| Selecting a supplier 6K | I want to be able to choose the suppliers myself | Partly/In progress | Compliance | No (not the concept) | No |

*Table 6: Assessment of compliance between the Customer Journey and four Danish energy renovation projects.*

### 1.1.2 Best practices for Customer Journey improvement

The Customer Journey has been fully adapted by the Danish REFURB team as a robust platform for launching future compelling offers, even if there was no common Danish Customer Journey in the past. As the analysis made for the four Danish energy-retrofit concept shows, none of these seems to be (today fully) compliant with the Customer Journey and its (ideal) identified customer requirements and issues.

As two of the concepts are in the controlling hands of the DK REFURB-partners, the ambition is however in cooperation with the concept-partners, to improve to Customer Journey focused mainly on removing the "major stumbling blocks" to avoid the customers checking out or aborting the journey before its final destination.

#### *1.1.2.1 The ZEROhome (ZERObolig) concept – based on DMAIC methodology*

**Introduction**

The ZEROhome (ZERObolig) concept was initially in 2010 created to offer on-site energy consultancy at house-owners location. More than 1,800 visits to home-owner families have been made since 2010 with a rejection of only 35% (M- measure) not continuing the journey. The successful families have continued their journey by wanting more – and more than 25% had after 4 years completed up to 4 iterations of initiatives with an average investment per family/home of €20.000.

**Define**

*What was the problem you faced and why was it a problem?*

The ZEROhome program was created to find/develop efficient ways to get home-owner families (in the territory of Sonderborg-area) interested in energy retrofit. The initial method was trial error and correct as there was no best practice projects to benchmark against.

This means, that there was a huge number of challenges to be faced to first attract interested homeowner families, second motivate and qualify them to take personal energy retrofit actions.

It was assumed, that creating a safe choice for the homeowners was important and that there needed to be a "person" to talk to in the loop. This assumption was based on the feedback given from the "ZEROfamily" program executed during 2009 with 115 families. Later it was discovered that "this person" should be and energy advisor independent of technology suppliers and only promote the solution, not the brand.

The initial problem was HOW does ZEROhome achieve big numbers in homeowner families being interested in the program. Later the question was changed to WHY can´t ZEROhome grow the acceptance rate beyond 63% with an average investment of 155.000 DKK per family?

Actually, an acceptance rate of 63% with an average investment of 155.000 DKK was both the double acceptance rate and the double investment figure per family, benchmarked to other energy advising initiatives experienced in Denmark. But the project management wanted to constantly improve the performance of the program and its impact.

Today´s key challenge for ZEROhome is focused on how local partners can create a robust Customer Journey? This is internally by the project management named ZEROhome 4.0 - the fourth major iteration of the ZEROhome concept. Other important components of this new iteration, is integrating the compelling offer as described in the REFURB D4.4 Report.

## Measure

*How did you objectify and measure the problem to make it as clear as possible?*

Simple measures were established in 2010 to measure the progress and success of the program, these included:

- Number of homeowners applying for an energy check at their home (bookings)
- Number of energy checks completed
- Number of families continuing (the journey) with initiating retrofit activities
- Number of energy retrofit activities per family and accumulated investments per family

The data were collected by quarterly questionnaires mailed to all families being visited by the energy advisor. Every quarter a report was compiled and compared with the previous, to identify progress and learnings. The project management and the steering committee reviewed the report and initiated corrective actions to improve the effectiveness and impact.

Later the project management gained access to statistical data enabling the project to improve its understanding of socio/demographics of the families involved.

## Analysis

*How did you get to the root cause of the problem? And what was that root cause?*

In order to secure a deeper understanding of the family decision structure, a PhD study was initiated in 2013 in close cooperation with KU Copenhagen University and SydEnergi – the regional electricity supplier. During anthropology studies of 10 selected families for three years, the importance of "language" (like home and not house), female involvement (often just men addressed in communication and being part of energy reviews) and correct timing (buying a new home, expanding the home when family grow, breakdown of installations etc) was discovered and discussed. The research findings have been shared and integrated in the ZEROhome project during the research lessons learned.

The Projects (extended socio/demographic data) analysis of the families rejecting/aborting the journey, have indicated that the rejection was made by families with "less surplus" (by definition of savings, education etc). Benchmarking the two populations (having completed and having aborted the journey), however also indicate that there were less young families and females involved in the successful completed journey, indicated that the approach had less appeal to the young families-segment and the engagement of females.

Analysis also strongly indicated, that it makes no sense to promote energy retrofit from early May until early September, as families during the summer live an outside life – without any care about heating, lighting, indoor climate and comfort. However, craftsmen can easily be busy retrofitting the homes during the summer, it is just the decision-making that need to be timed outside the summer-season.

Analysis also show that there in Sonderborg are multiple examples of local citizens, who have multiplied the number of other neighbour society/families engaged (in energy retrofit) simply by contacting their personal network and acting as ambassadors.

Discussions and analysis shows that economic incentives play a key role for initial steps taken within families. The ProjectZero/Sonderborg experience is however, that for a second or third or fourth iteration, a good experience (including all aspects) from the first iteration, can be a stronger driver than just economic benefits.

Discussions with homeowner families also show that the actual consumption figures are often not known to families, as "automated bank payment-services" are taking care of the utility bills without notice given by the families. This indicates a need for a stronger visibility of meters and consumption in the homes.

Rural area homeowners have been involved in special "get rid of your old oilburner" campaigns, implemented in close cooperation with the rural area (development) workforce at Sonderborg Municipality. The campaigns, including local meetings, seem to impact the decisions and the latest survey (May 2017) report, that 40% of the participating/responding families have already replaced or have active plans of replacing their oilburner with a renewable alternative solution. Local campaigns seems to have a long term positive impact on decision making in Sonderborg`s 34 rural area districts.

The above assessment (chapter 5.1) of how ZEROhome responds to the Customer Journey, is an integrated part of the analysis carried out to create ZEROhome 4.0.

**Improve**

*How did you go about creating a solution? What did you deploy to come up with a creative solution? What was your solution? Did you test your solution and how did you test it? How did you implement the solution and what where the results?*

As mentioned, the ZEROhome project has since 2010 been a continued improvement process based on trial, error and corrective actions including measurements.

Based on the REFURB project and the above learning, a number of improvement actions will be implemented – to secure a stronger alignment of the entire process with the Customer Journey discovered as part of creating the compelling offer. These initiatives include the following corrective actions:

- It is therefore important to identify local ambassadors and engage them in future plans and initiatives as friends, Facebook and social medias are important for reaching out and making promotion during step 1-3. Local ambassadors are people/families in the local society, who have already implemented own energy retrofit initiatives.

- Local best practice citizen renovation examples are already available at ZEROmap: http://www.projectzero.dk/da-DK/ZERObolig/ZEROmap.aspx. These examples need to be exploited stronger in the local society as no national campaign – but only local promotion based on the ProjectZero vision for Sonderborg and the support of Sonderborg municipality can create the necessary trust for safe initiatives along the Customer Journey.

- The timing of step 2-4 should take place outside the summer-season based on the learnings from analyzing the timing of the actual booking of the energy advising and the energy retrofit activities.

- Information should come from independent (non-commercial) sources (step 1-2-4+). ProjectZero, its website, Facebook and the Charlie advisor represent such independent sources, which must be maintained by private/public parties, even the project long term needs to be driven by market forces. This is a learning from the Customer Journey requirement.

- The step 1-4 should be more focused on specific occasions like families buying a new house, major defects in the buildings, pension savings being paid out – which could also be named

the “burning platform” or the window of opportunity. This learning is based on the PhD study and feedback from families.

- Specific packages should in step 2-4 be presented to meet the specific occasion and create a compelling offer matching the burning platform. This learning is based on the PhD study and feedback from families.

- The packages promoted in step 1-4 should address young families and empty nesters segment different as values and opportunities are different, the female values (and language) should be integrated as the female party is part of the decision making. This learning is based on the PhD study and feedback from families.

- The whole supply chain following step 5-x should be trained to support the journey, even if there is a lower risk of drop-outs during these steps. However, creating “positive experience” for the customer might motivate the customers (families) to become active ambassadors and also “wanting more”. This learning is based on understanding the Customer Journey and the customer requirements.

- It is important to be able to answer the economic equation for the initial energy retrofit iteration by specific economic incentives, tax deductions, low interest loans. This learning is based on feedback from research, reviews and the Customer Journey.

The above corrective actions will improve and create a stronger, more robust and shared Customer Journey in Sonderborg. The paradox is however still - on one hand in the public domain to promote and create confidence with a process, that on the other hand brings the customer into a private sector with no common rules. Therefore, it is important that the private sector is educated and trained to respond in the same way, to make the customer feel safe and motivated to sharing the experience (CJ step 10) and to want more (CJ step11).

**Control**

*How did you monitor your improvements to ensure continued and sustainable success?*

Initially the control was based on the above-mentioned measures and measurements, which were time consuming, but doable as the ZERObolig project was within the project management teams control. Transforming the old concept into a stand-alone (in society) ZEROhome concept based on a shared Customer Journey, requires new defined points of control for reporting both quantitative and qualitative issues along the Customer Journey.

The qualitative measures include

- Numbers of homeowners entering the initial phases of the Customer Journey
- Number of families continuing their journeys with additional iterations

The quantitative measures include

- Homeowners sharing their observations along the journey
- Homeowners sharing their recommendations and improvement suggestions along the journey

A major milestone is achieved when homeowners start partnering with the concept, and take responsibility for the continued improvement of the journey process.

### *1.1.2.2* The Green Business Growth (Grøn Erhvervsvækst) concept – based on DMAIC methodology

**Introduction**

CLEAN Green Business Growth (GBG) is a Danish public-private partnership in South Denmark, which provides training for craftsmen on energy efficiency in buildings, creates jobs in the energy efficiency field and promotes energy efficiency among homeowners and potential partners. The whole concept of GBG is to use the educated energy craftsmen as the good ambassadors to meet the private homeowners and support them by creating energy events and visibility of good cases about energy efficiency in buildings.

It has generated income increases for the people, who it has trained and contributed to increasing turnover among its partners. GBG has created a documented 165 new green jobs within energy efficiency in buildings, generated a 29% income increase for our craftsmen members and has in total generated a documented €14 mio. turnover increase for its partners, in a span of 3 years, 2011-1014 and through bottom-up approach.

In all, 225 people in eight municipalities have been trained using the latest know-how on energy saving opportunities, renovation, sales and business development. On completing the course, they can enhance their skills and business networks through participation at energy events, networking meetings on new technical solutions and further training. The focus in GBG. 2010-2014 was on training, network meetings and visualization. In 2016 the GBG focus was on energy event. In 2017 the focus in on training.

## Define

*What was the problem you faced and why was it a problem?*

The GBG project had 21 partners and was external funded in the period 2010-2014 (€0,5 mil. /year) and 3,5 persons/year). From 2014-2016 the project had 18 partners and was only funded by its partners (€0,17 mil./year) and 1,5 persons/year.

In 2016 GBG started a strategy process on how to develop GBG, because of less interest in energy renovation and a market that is challenged by low energy prices, economic boom and a lower political focus on energy and climate. On the other hand, the partners experienced a growing interest in climate adaption in relation to buildings.

## Measure

*How did you objectify and measure the problem to make it as clear as possible?*
CBG have made different kinds of surveys to measure both the success and the problem:

1. **Surveys to energy craftsmen** (step 6 – selecting the supplier) (electronic survey) every year asking them about business development and new orders, but also about their need for upgrading their education and expectations for network meetings and services from the secretary. In 2016 the energy craftsmen have confirmed, that there is plenty of work and they do not have time for attending energy events, where the costumer can be met, unless the secretary/partners organise it and they can be sure of getting leads. Only few of them are interested in lending an energy trailer for free for meeting the homeowners themselves.
2. **Interviews with energy craftsmen** (step 6 – selecting the supplier). Once a year, qualitative interviews with energy craftsmen has carried out in order to support the quantitative surveys. The latest interview was august 2016. Beside this energy craftsmen are asked for good cases, contacts to homeowners on energy REFURBishment to be mentioned on the GBG website and Facebook site of homeowners and professionals.
3. **Occasionally, focus group of energy craftsmen, financial institutions and real estate dealers** (step 4 – considering the offer) have been gathered in order to be a part of Better Housing initiatives in South Denmark with GBG and the Municipality of Odense as organisers of energy events with homeowners, energy fairs etc. Lately the group has been active in commenting on financial constructions and the compelling offer.
4. **Steering Committee/Partner meetings** (step 1-6 in the costumer journey). GBG has a steering committee of 5 persons, that meet twice a year plus partner meetings twice a year (municipalities, energy supply company, building supplier, educational and financial institutions). By this kind of organisation, a quality and test of the ideas of the secretariat is secured and prioritized. Among the partners, the challenge of energy renovation as not being in the top of costumers mind any longer (since 2015/2016 with economic growth and low energy prices). Accordingly, the costumer journey has been discussed and each partner have given input on where they as partners can make an effort and where the secretariat shall prioritize to make an effort with limited resources.
5. **Working group of partners** (step 1-6 in the costumer journey). GBG has working groups for energy education, energy event and communication, where partners take active part and use 100-200 hours every year. By this way, the partners take responsibility in the activities of GBG.

Accordingly, to the surveys from GBG, Bolius, an organisation of homeowners, every year made a survey to homeowners, asking them about the priorities in the home. Are they interested in energy REFURBishment, what are they motivated by, where do they get their information and guidance from etc. The conclusion from the last survey, showed that homeowners in 2015-2016 are much less interested in energy REFURBishment than in 2012-2014.

## Analyse

*How did you get to the root cause of the problem? And what was that root cause?*

**1. How can we empower homeowners to make energy REFURBishment with the help of energy craftsmen**?

**Method: SWOT analyses on strength, weaknesses, opportunities and treats on problem**

At team meetings and partner meetings 2016/2017, the root cause was analysed to be: Lower interest from homeowners and energy craftsmen on energy REFURBishment caused by lower energy prices, economic growth plus plenty of work on other jobs than energy REFURBishment. The time has changed, there are too few craftsmen, so the energy craftsmen are not tempted to take the difficult jobs like energy REFURBishment. There is no longer a demand for long term better Housing plans with recommendations for energy investment. People will not pay for guidance. If we are to focus on energy REFURBishment, there is a need for changing the message to be on comfort and indoor climate. It is not possible to argument for energy REFURBishment for economic and climate reasons only. The frame conditions and political focus on energy savings in buildings are not optimal.

**Method: Annual cycle for communication on the right time**

To time the communication about energy renovation and get homeowners attention, the secretariat has constructed an annual cycle for communication and decided where to pitch good cases in the heating season (sep.- mar.) on energy REFURBishment and use of green energy.

**2. How shall we organise GBG in the future and what shall be the focus with limited resources?**

**Method: Costumer journey analyse 2017,** where we marked, what factors could keep costumers on the track and what would make them drop out. The partners were invited to a brainstorm/ input on where they could see themselves making a difference in the costumer journey and to consider, what they could do themselves so the secretariat not only work as consultant for each partner but separately but for the partners.

The result of this analyse was that the focus from the secretariat, should be on initiatives, that partners across the 6 municipalities all could benefit from and that focus on step 2/3 (becoming interested/becoming active) in combination with step 8 (exchanging experience). Beside this, there was a wish to focus on step 4/6 – considering the offer/selecting a supplier. The plan was to get the educated energy craftsmen closer to GBG and encourage them to work as energy ambassadors towards private homeowners by offering them both education, an energy craftsmen meeting and visualization /marketing of their own good energy cases.

**A focus on both climate adaption and energy efficiency in relation to buildings**

Due to not supporting frame conditions on energy REFURBishment and less interest from society, home owners and energy craftsmen, GBG will from 2017 change, so it has focus on both energy efficiency and climate adaption in relation to buildings, with a majority of focus on climate adaption due to external funding have been granted here. This means, that for 2017 the energy path in GBG has been reduced to a budget at 0,06 EUR/year and 0,5 person/year. Consequently, GBG has decided to focus on specific and limited parts in the costumer journey and to find external funding for again to be able to expand the energy path. Accordingly, the partners own hours (obligation for each partner to use 100-200 hours per year) mean quite a lot and they therefore must prioritize how to use the secretariat and what they can carry out themselves.

## Improve

*How did you go about creating a solution? What did you deploy to come up with a creative solution? What was your solution? Did you test your solution and how did you test it? How did you implement the solution and what where the results?*

**For the energy path in GBG**

The focus in 2017 will be on:

A. Good cases on energy REFURBishment -step",

B. Visualization and spreading the news on social medias (FB-group of homeowners and professionals),

C. New educational offer for the energy craftsmen on "Efficient craftsmen, - optimize your business with new knowledge on energy efficient buildings and use of social medias and smart apps".

D. Analyse/surveys on the effect of partner energy events with focus on implementation of energy renovation and heat pumps instead of oil heating.

Beside these initiatives organised by the secretariat, the partners should be drivers in organising a yearly craftsmen event and local energy events organised by the partners themselves.

For the energy path in GBG for 2018 and 2019, it is prioritized to find funding for more focus on energy efficient buildings. The first priority here is to implement the roll-out plan for the Danish REFURB compelling offer, in a cooperation between PZ, AAU and CLEAN in South Denmark. For getting funding from the region of South Denmark the idea has to give growth to SME´s in the region and to involve energy efficient equipment (electro related equipment). For getting support from the Interreg program the concept has to involve cross-border trading, green growth and eco-innovative initiatives within energy efficiency and energy resources.

**For the climate path in GBG**:

GBG has received funding for 2 years to develop communication material for private homeowners, education for entrepreneurs in climate adaption solutions knowledge of how to use social medias efficient. The idea of this concept is to let the entrepreneurs work as the good ambassadors for climate adaption. The whole business model is inspired from the GBG energy path where energy craftsmen are educated and used as energy ambassadors.

**Control**

*How did you monitor your improvements to ensure continued and sustainable success?*

The new concept of GBG version 3.0 with both an energy and climate path will be measured. Measureable success criteria can be set up, characterized with “activity goals”, “output goals” and “effect goals”.

For the energy path in GBG version 3.0 for last part of 2017, an activity goals at 3 good cases and an energy education with participation of 20 persons, a survey on the effect of energy events are examples of activity goals. There are not written output goals, but the energy education will be evaluated by the participants asking them about satisfaction with the professional level, the themes, the teachers and location and catering. This is a natural thing to do, to improve and repeat the educational offer in another geography next year.

For 2018-2019 new goals for activity and output for the energy path will be defined at a steering committee meeting. These will be modified if external funding is granted.

As for effect goals, such as jobs created a number of houses renovated or a certain growth rate, there will be no goals, before the energy path in GBG has first to be strengthen and new funding added. For 2010-2014, the goal was to create 300 new jobs. 165 new jobs were created in this period. For the period 2010-2014 the growth rate at SME companies of energy craftsmen were measured through statistic data and business numbers at the first quarter of each year. The growth rate of 225 educated energy craftsmen was compared to craftsmen, that has not been energy educated. A growth rate of 29 % has been shown 2011-2014, but in 2015 the analyze showed that the growth rate has stabilized. The measurement on growth rate has stopped in 2017, because it would not be possible to document, that an eventually growth comes from a smaller and smaller effort from GBG.

In the period 2010-2016 a lot of energy events took place. At each event, the number of persons attending the event and the number of leads to the energy craftsmen were measured. There was not a specific goal, but measuring the number of leads also documented that the events had a positive effect.

For the climate path in GBG version 3.0, there has also been put up both activity goals for a number of climate events, communications materials, network meetings, educational training for a number of participants, knowledge exchange events and finally a number of posts on social medias. Output goals have been for a number of followers on social medias. No effect goals have been put up.

### 1.1.3 Denmark conclusions

Based on the above assessment of the four Danish concepts for energy retrofit and the DMAIC analysis of the ZERObolig and the Green Business Growth (Grøn erhvervsvækst), the conclusion is that the challenge is at local level to integrate the DMAIC improvement learnings into a new joint Customer Journey, which will create a robust, customer safe, high quality process - ramping up future energy retrofit activities in a continued iteration process aiming for nZEB renovation level.

However, the challenge is still to maintain a balance between a public and private cooperation process securing the homeowners a safe journey. All customer requirements along the 11-step journey must be addressed and quality assured - and local stakeholders therefore need to participate in making the local journey safe for the customers.

# 1.2 BELGIUM

## 1.2.1 Theoretical models

No theoretical models have been identified. However some practical approaches are described below.

## 1.2.2 Best practices for Customer Journey improvements

Two best practices were reported: The renovation coach and MyEnergycompass and the continuous improvement from the commercial company Bostoen.

### *1.2.2.1 RenovationCoach & MyEnergycompas*

In the renovation program as developed by Leiedal, 2 main instruments enable homeowners to renovate:

- The web tool MyEnergycompass (MijnEnergiekompas.be) generates tailor-made advice on the energy performance of their dwelling, and the options to renovate towards NZEB.
- The RenovationCoach assists homeowners in their renovation process by guiding them through their choices and the practical organisation of the renovation.

These 2 instruments are complementary to each other and aim to guide as much homeowners as possible through the Customer Journey. MyEnergycompass focuses on the steps 1-4 (from becoming aware to considering the options), the RenovationCoach on steps 4-6 and beyond (from considering the options to the selection of suppliers).

The goal of MyEnergycompass is to reach homeowners that have a potential (latent) interest in renovation. They might set up a renovation project in the next year, but also in the coming 5-10 years. So it has a broad target audience. The goal of the tool is to activate homeowners to start to renovate and to increase their energy ambitions.

Therefore, they need to be better aware on the energy performance of their dwelling. MyEnergycompass assigns an indicative energy label to all dwellings in the region, with a scale from A to Z (which is uncommon in Flanders, BE) and based on statistical analysis of the EPC-database. This creates a benchmark: amongst dwellings, and towards nZEB (A-level).


*Figure 14: Printscreen of MyEnergycompass*

MyEnergycompass allows homeowners to create an improved estimate of the energy label, by running through a questionnaire. This way, the tool takes the effective state of the dwelling into account. Consequently, this information enables to generate a 3-page–report with renovation advice. This tailor-made report sketches the options to renovate to NZEB, and allows the homeowner to consider his/her options.

MyEnergycompass also checks on the type of renovator the homeowners is, and what kind of information and unburdening he/she wants. In the report, the information presented is adapted to that: information on financial issues, for a DIYer, for people in search for a deep renovation or a stepwise approach, contacts from contractors…

And of course, as it is the ambition to get people active (step 3), MyEnergycompass directs homeowners to the RenovationCoach. Although many homeowners have ambitions and intentions to renovate, many see a lot of barriers to start a renovation process. The RenovationCoach is there to reduce their barriers and to activate the latent renovation potential. He is a go-between the homeowner and the building sector.

The RenovationCoach will:

- Give independent advice, tailor-made, at the dwelling.
- Show the way to financial incentives and assist with the administration.
- Assist in the selection of contractors and building professionals.
- Guide in the monitoring of the planning and the budget.
- Calculate the energy savings.
- Offer his expertise in comfortable and healthy living.


Summarized, the approach according to the DMIAC-methodology can be described as:

- Define: the goal is to activate the latent potential of homeowners to start a (nZEB) renovation.
- Measure: currently, about 1% of the dwellings are renovated per year. This must increase to 2-3%.
- Analyze: homeowners are too little aware on nZEB-ambitions and fear a renovation process.
- Improve: MyEnergycompas and the RenovationCoach guide homeowners though the Customer Journey.
- Control: monitoring of the use of the tools, and aim for a broad market introduction of the concept of RenovationCoach.

#### *1.2.2.2 Continuous Improvement at Bostoen*

At the building company Bostoen the marketing and sales department uses four tools to secure continuous improvement of the Customer Journey (connected to different phases of the Customer Journey):

1. Marketing automatization
2. Salesforce as Customer Relations Management (CRM)
3. Client corner application
4. Control of Customer Satisfaction

These tools are based on the stages in the sales funnel (lead, opportunity, qualified prospect, committed and transacted).

The **sales funnel** visually describes the sales process from initial contact to final sale from the point of view of the salesmen. It uses the metaphor of a leaky funnel, into which a seller can 'drop' sales opportunities.
The stages of a sales process refer to a potential customer's degree of readiness to commit to a deal (from the seller's perspective).

As a sales opportunity moves down the funnel, time to closing decreases and the probability of the sale occurring increases. The sales funnel metaphor enables you to analyze and manage a portfolio of sales opportunities.

The different stages of the sales funnel are described underneath.

**Lead (Suspect):** A lead (also known as a suspect) is someone you have not spoken to. But if a lead appears similar in profile to your target customer, you may decide that they are worth pursuing.

**Prospect (Opportunity):** A prospect has confirmed interest in your offering. You have had a conversation, provided the person with information about what you do, and both of you have agreed to a next step in the sales process.

**Qualified prospect:** Qualification is the most critical and demanding stage of the sales funnel. In the qualification process, you verify that the prospect has a need for your product, that the prospect sees value in your offering, that there is sufficient budget for a deal, that you have access to the decision-maker, and that there is an agreed-upon timeline for the sales process. The qualification process can be complex and lengthy.

**Committed:** When a customer has agreed to move forward with a deal, they are "committed" (also known as 'verbal commitment'). What remains is to work out the details of the contract, delivery and payment, all of which have the potential to 'undo' the commitment. The commitment may be offered contingent upon certain terms being met.

**Transacted:** A sale has transpired when a contract is signed by both parties. From a salesperson's perspective, the fulfilment of the contract is the responsibility of other parts of the organization, and the salesperson can now focus on the next opportunity. In the case of early-stage start-ups, however, frequently the person that sells is also involved in fulfilling the contract. A signed contract can be booked as revenue from an accounting perspective.

Each of the four tools focuses on a different stage of the (potential) client in the sales funnel.

**Marketing automatization**

Bostoen is creating a digital platform to make the interested suspects (named leads) more interested than they already are.

This tool for marketing automatization has two purposes:

1. To qualify better incoming leads (and as such approach them directly accordingly to their qualifications).
2. To offer personalized information to the leads.

This tool to secure continuous improvement of the Customer Journey is used in the first three steps of the Customer Journey: becoming aware, becoming interested and becoming active.

**Salesforce as Customer Relations Management (CRM)**

The incoming leads are in entered in the Salesforce by the CRC (Customer Relations Contact).

The Salesforce is a digital platform for the salesmen to do the customers relations management.

The salesman follows up the personalized lead to convince the lead to become a new customer. He contacts the qualified lead to check the opportunities. Then he makes an offer to get a commitment from the lead and finally a signed contract (transacted).

The ultimate aim of a CRM system is to smoothen the sales process and distinctly categorize the category of prospects so that each of them is communicated with according to the stage of the sales funnel (or Customer Journey) they are in.

The CRM platform of Bostoen also shows a lot of concluding graphs about for example the reason they drop of the sales funnel or the source of the lead, as shown in the following figures. These graphs can be used to measure the continuous improvement.

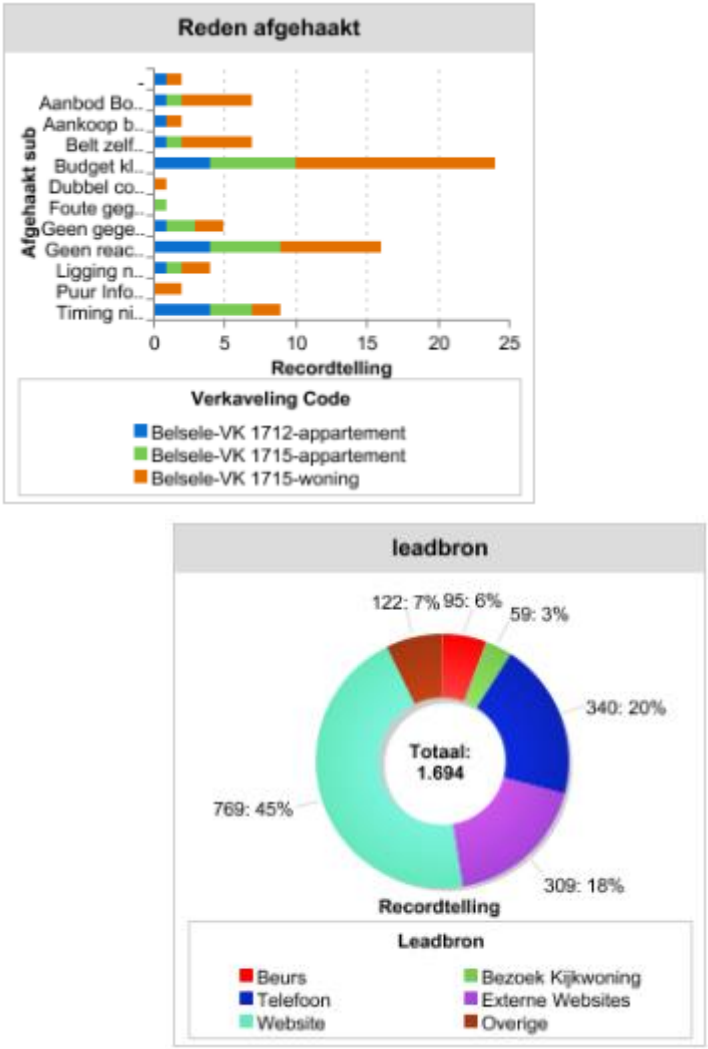


*Figure 15: Examples of the CRM platform of Bostoen.*

This tool to secure continuous improvement of the Customer Journey is used in the next steps of the Customer Journey: becoming interested, becoming active, considering the offer, financing, selecting a supplier.

**Clientcorner application**

When the deal is closed (or the contract is signed), the lead becomes a customer of Bostoen and gains access to the application for customers. By logging in to this application (e.g. on his mobile phone), he can follow the decisions on materials, the proceedings of his project and prepare himself for the next steps of the building process (e.g. for the utilities for electricity, gas and water). The application sends notifications to the customer when action from his side is necessary.

The figure underneath shows the opening page for the building project of a customer.

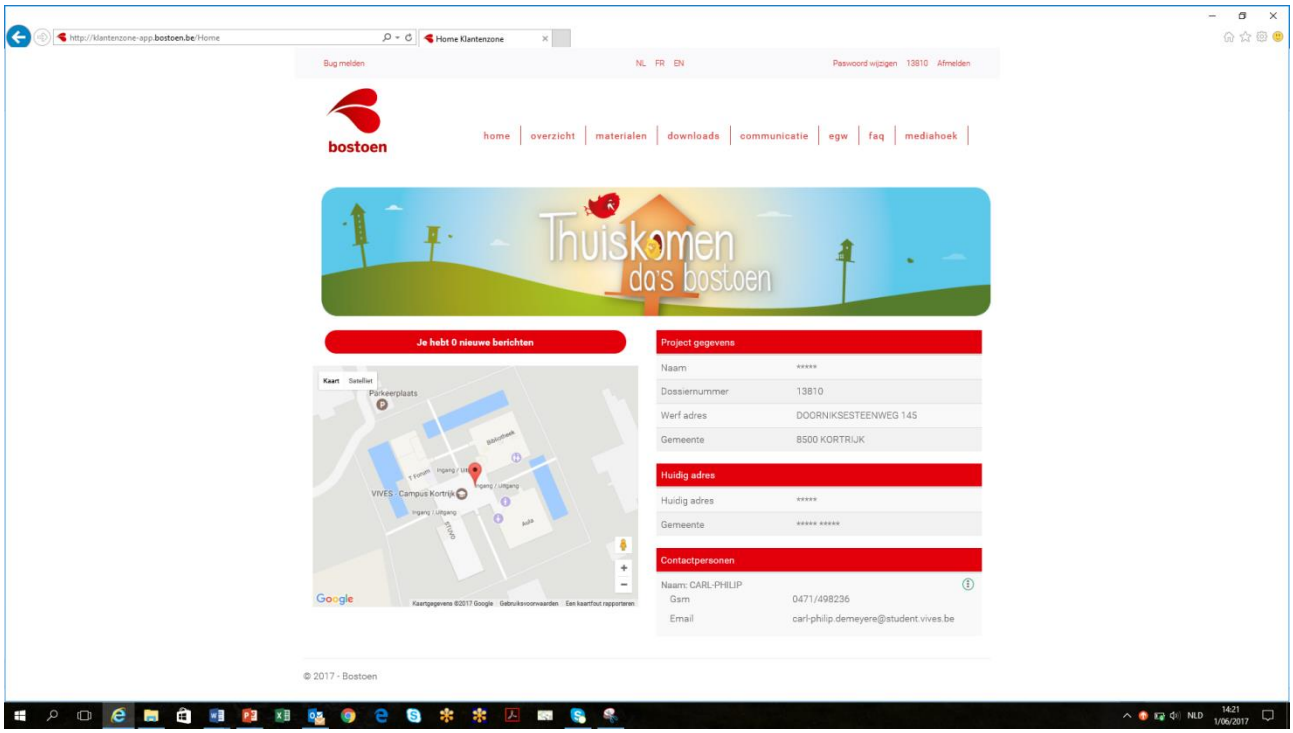


*Figure 16: Printscreen of the Clientcorner tool of Bostoen*

This tool to secure continuous improvement of the Customer Journey is used in the sixth step of the Customer Journey: installation and payment.

**Control of Customers Satisfaction**

About six months after the delivery of their house or apartment, customers are contacted by an independent company that checks their satisfaction by asking some typical questions.

The result of this control of the customers satisfaction is used by Bostoen to optimize their service and thus improve the Customer Journey once again.

This tool to secure continuous improvement of the Customer Journey is used in the next steps of the Customer Journey: experience, organising and sharing experience.

Summarized, the approach of Bostoen according to the DMIAC-methodology can be described as:

- Define: The goal is to activate the latent potential of customers to start a project with Bostoen and to improve the communication with the customers during the building process.
- Measure: The improvements are measured by the control of customer satisfaction after the delivery of the house to the customer.
- Analyze: Customers need to be unburdened and guided in the process of their building project.
- Improve: The four tools described above (Marketing automatization, Salesforce as Customer Relations Management (CRM), Clientcorner application and Control of Customer Satisfaction) guide the (potential) client though the Customer Journey.
- Control: The control of customer satisfaction after the delivery of the house to the customer ensures the monitoring of the results and the continuous improvement of the tools and the Customer Journey at Bostoen.

### 1.2.3 Belgium conclusions

#### *1.2.3.1 RenovationCoach & MyEnergycompas (Leiedal)*

Nevertheless the two instruments (MyEnergycompas and RenovationCoach) are only in place for a short time and are to be considered to be in a test phase, in their whole development process a lot of improvements have been made to the concepts. These improvements were based on study of best-practice examples, literature feedback of stakeholders and focus group… The description of improvements below refers to these improvements. Of course, in the future new improvements will be made based on the experiences.

Below, there is a description of two improvements. The DMAIC model is used to describe.

**User-friendliness of MyEnergycompas**

**Define.** A barrier to run through web tools to check the energy performance of the dwelling is that it is often too little designed form a user perspective, but rather from an expert perspective. E.g.: ask people about "'R" and "U values", types of insulation materials, or thickness of insulation in a roof. This scares off many homeowners and causes massive drop-out because they cannot give a proper answer.

**Measure.** The drop-out of users during all steps of the tool.

**Analyse.** The tool was developed with a multidisciplinary team: experts on communication, housing quality, energy quality, front- and back end developers, programmers, graphic designers and infographic experts. With this group the problem statement was made and solutions were developed.

**Improve.** The goal was to use as little text as possible, but be visually communicative (icons, symbols, intuitive design). And the feeling and the opinion of the homeowner dominates the factual reality (e.g. if a homeowner feels it is not well insulated, he will be willing to improve this). An extensive test phase ("Bèta-version") allowed testing it with many potential end-users and making improvements.

**Control.** The drop-out of the users of the tool in every step is monitored. If there is a larger drop-out in one or another step, the problem will be analysed and solutions will be discussed, implemented and evaluated.

**Market introduction of the RenovationCoach**

**Define.** A renovation coach is a new concept in the renovation process. Homeowners are not familiar with it: what can he do? What is the added value? What does it cost?... The RenovationCoach cannot be appraised yet by other homeowners. So they might not be confident with is, although confidence is key element in the success.

**Measure.** In similar schemes, about 20% of the contacts with a renovation coach lead to cooperation.

**Analyse.** Stakeholders workshops and focus groups with potential end-users showed the added value of the model. Create confidence has a lot to do with the profile of the RenovationCoach: a building professional, but with an independent profile.

**Improve.** The recruitment of the RenovationCoach was essential to get the right profile. A good communication campaign is a key element to convince homeowners, with info brochure, website, presence at events, multi-channel communication (also via municipalities)… The first home-visit of the RenovationCoach is for free. This way, homeowners get to know the RenovationCoach and he can start building confidence.

**Control.** Via following-up the drop-out and the rate of contacts vs. homeowners coached.

#### *1.2.3.2 The continuous improvement of the Clientcorner at Bostoen*

Below the description of the improvement of the Clientcorner at Bostoen. The DMAGIC method is used to describe it.

**Define.** The existing Clientcorner at Bostoen is a web application (only usable from a computer), not adapted to the new corporate identity and the new methods of online communication. A responsive web application that can be used on computer as well as on tablet and on smartphone was needed.

**Measure.** The results of the control of customer satisfaction and the lead time before the use of the new Clientcorner application will be compared to the results of the new situation.

**Analyze.** Before the start of the Clientcorner application the project definition were evaluated and discussed with employees from the IT, sales and marketing department. The new app should improve the communication with the clients and thus shorten the lead time and increase the customer satisfaction.

**Improve.** During the development of the Clientcorner application the results were evaluated and discussed with colleagues from the IT, sales and marketing department to ensure the best solution. The next improvement stage will take place when clients en employees are using the app.

**Control.** The control of customers satisfaction after the delivery of the house to the customer will monitor the improvements and ensure continuous improvement of the application after the commissioning.

# 1.3 SLOVENIA

Out of literature research and best practices of mechanisms supporting renovation in Slovenia, the following topics have been exposed:

### 1.3.1 Theoretical models

- Existing policy programs should provide tools and awareness rising action to upscale communication and participation. Communication component is essential for the success of the process – raising awareness and becoming interested. A fair communication acted by skilled energy assessors convincing owners to make investments, is a powerful mechanism for stimulating the market. This ensures the higher impact of renovation actions. Identified actions: CENTER ENERGETSKIH REŠITEV (Energy Solutions Centre)

- Implementation of monitoring and evaluation, comprising appreciation by target groups, from the beginning of the action. Identified actions: PROJEKT ENERGETSKE PRENOVE STAVBE (PEP; Project of Energy Renovation of buildings); PROJEKTNA PISARNA ZA ENERGETSKO PRENOVO (Project Office for renovation of Public buildings)

- Integration of regular inspections in certification procedures, especially for major renovation, thereby assuring quality and reducing long term risks. Identified action: EKOSKLAD (Eco-fund) - requirements linked to the deep renovations and supervising process.

**AWARENES RISING CAMPAIGN**

**Energy Solutions Centre** - **ESC** (Centre energetskih rešitev) is an Economic interest grouping established since 2013 as a platform for innovative solutions towards sustainable energy of urban built environment, construction, mobility and management/ maintenance of energetic systems. The ESC is integrating and harmonizing various stakeholders with similar interest in field of energy efficient solutions and renewables. Five constituting partners, enterprises Jelovica, Petrol, Nord, Knauf Insulation and Zelene energije, have under the same roof in one of the prominent shopping centres – BTC in Ljubljana, on 1200 sq. m of exhibition space under the acronym ESC (CER), presenting innovative solutions aimed at maximization of energy efficient construction and improving living conditions. The Centre is having a good resonance in the environment as more than 2.500 visitors were noted.

In our opinion the notion of implementing the energy efficiency awareness rising into shopping centre with a good turnover of visitors makes multiple sense – provides a good visibility to specific energy efficient solutions (consumers are presented with catchy solutions, that brings potential costumer closer to energy efficient solutions – from becoming aware to becoming interested), presentation of basic information to thermodynamic and basic physical characteristics – information sharing. Additionally, the ESC provides basic advisory service to motivated individuals, with the shortcoming of non-independent advices. As a platform the ESC provides an active environment for multi-sectorial integration of institutions/ stakeholders (policy, business, education, research and NGOs). The members are given support in knowledge transfer and support to human resources.

**Define**: One of the main obstacles in driving individuals into deep renovation is besides the economic independence, connected to the motivation and drive of the individuals and owners groups to pursue the goal of acting energy efficient. Even more, as the deep renovation requires substantial funds to be activated, it is even more important for the customer to get good appraisal to the economics of the investment. The environmental and social benefits behind such investments have

to be taken in account, as otherwise feasibility of such investment could hardly be defended. Also the information to the available funding options is presented in one place.

**Measure**: The main challenge in Slovenia is to move the mindset of the costumer and create awareness towards importance of using and producing energy in a sustainable way. Although there is a growing trend in Slovenia of energy renovations, partially connected to favourable funds (Eco-fund), most of them are low key investments involving partial solutions attributed to limited outcome.

The ESC provides an opportunity for a change of priority settings from sole economic effects to the broader sustainability benefits influencing the behaviour of individuals. Of course the economic benefits should be clearly underlined, but the focused information could have a profound effect on the interest of individual – being in trend – acting as trendsetters. It's an important social drive force influencing behaviour of groups, individuals. The other side of the equation is linked to catching the interest of potential future costumers.

**Analyse**: In Slovenia a regularly conducted Energy efficiency survey titled REUS is implemented annually from 2009 on. The results are serving to provide preliminary information for authorities to prepare goal oriented policies and strategies aiming at development of sustainable energy, but also as vital information for marketing of the companies seeking competitive advantage versus parent enterprises. Thereby the enterprises approach the supply side of equation from the other side, by creating a perceived demand and from this end attract future costumers into energy efficient measures/ solutions. The companies and institutions that have initialized the ESC get an additional boost in comparison to parent enterprises/ companies, getting a competitive advantage by acquiring the firsthand information from customers and a foresight to their real needs. This in turn ensures a good rate of return from the initial investment in near future.

**Improve**: The solution to build up an Energy Solutions Centre presents a good practice example for Slovenia and could be favourably taken in other larger cities. As more and more people are due to a stressed lifestyle having less time to be confronted with the energy efficiency problematic, such exhibition/ advisory space-(s) creates an opportunity for creating a positive surge towards novel energy solutions. The expansion of reference exhibitions spaces would slowly lead to upturn of investments into sustainable energy solutions.

**Control**: Monitoring number of visitors to the ESC and number of individuals looking for the advice on deep- renovation. The survey sheet is used for the measurement of visitor satisfaction of the ESC and especially the satisfaction of the advisory service. The collected information may help improving the services and upscale the potential of the exhibition space. It is to be noted, that without additional tax reductions and novel investment schemes, the development of deep renovation will be a slow process, but nevertheless the compliance with directives provisions, will be steering the development in the right direction. Also, the non-favourable rising of fossil energy prices, will unbalance the slow uplift of deep renovations.

**PLANNING, SUPERVISION, PROCUREMENT for PUBLIC buildings**

**Project office for renovation of public buildings**

In compliance with EU directives towards the renovation of public buildings fund, the area of energy renovation of existing public building fund falls under the development priority Sustainable energy use. The responsible ministry of infrastructure perceived a high importance to this task and in October 2015 established a project office for renovation of public building fund, encompassing experts of construction, mechanical engineering, lawyers and economist, facilitating the renovation. A project office will act as facilitator to a public sector and prepare instructions – detailed guidance, guide to eligibility of costs and technical guidelines – with the advisory role to public subjects in energy REFURBishment of public buildings.

Their scope of activities ranges of:

- preparation of supportive environment and required documentation
- providing advisory service and (expert) support to public sector, energy services suppliers, applicants, public-private partnership providers and beneficiaries in preparation and during the implementation phase of operations/ investments.
- establishing records (record of public buildings to be renovated) and evidencing changes in implementation
- revision and control of operations/ investments
- knowledge transfer (knowledge base, best practices)

The public buildings fund represent app. 10 percent of whole building fund and the EU directives are obliging the member states to renovate 3 percent of public buildings annually or take alternative cost-effective measures to achieve equivalent improvement in energy efficiency. As an important part of energy REFURBishment of public building fund leans on energy contracting model, the necessary guidance will be provided, from the preparation of contracts to the supervision of the process and later on the supervision of works.

**Define**: The main challenge the public authorities and administration are facing, is the lack of knowledge (expert knowledge and supportive environment), expertise in technical requirements and legal specificities (selection of investments measures), but also restrictions applicable to energy REFURBishments. Also a lack of funds for investing into deep energy renovation seriously hinders the process.

**Measure**: Therefore the responsible ministry of infrastructure identified the main obstacles and through focused interviews and expert brainstorming came to the solution to revise the existing process of planning, designing and leading investments and consecutive implementation of REFURBishment. The intermediate person - project office for renovation of public buildings was devised to act as advisory service and facilitator of public investment into deep energy renovations – providing expert counselling, advisory role in evaluation of public-private partnership, but also in preliminary supervision process. The outcomes of identification of obstacles are listed above.

**Analyse**: Slovenia was facing the challenge to comply with the EU directive 2012/27/EU on energy efficiency and focus on 20 percent improvement of energy efficiency on the level of primary energy consumption. Therefore after extensive negotiation process the decision on the level of national authorities was taken (Ministry of infrastructure, Directorate of energy), to establish the project office, as facilitator of REFURBishment of public buildings in Slovenia.

**Improve**: The solution to establish the project office for renovation of public buildings could be further improved by adapting existing EnSVET advisory service for private investors, operators of private and residential buildings. The existing advisory service provides a preliminary support only, lacking the long-term support to investors, which would be recommended to keep them on the track to deep renovation process. The lack of project supervision in the process by the independent institution, financed by the state could provide real assistance to the investors.

**Control**: In order to control the process the project office from the beginning established a record of public buildings to be renovated and is following the renovation process by evidencing changes in implementation. Additionally, the control of provisions of operations/investments and ESCO contracts will be regularly implemented.

### 1.3.2 Best practices for Customer Journey improvements

COMPREHENSIVE PLANNING, GREEN PROCUREMENT and SUPERVISION of the RENOVATION

**Project of energy renovation of buildings** (Projekt energetske prenove – PEP)

Project of energy renovation of buildings provides a set of advisory – planning services for investors, willing to implement financially adequate and high quality energy REFURBishment - deep renovation. The service provides optimal implementation of step-by-step deep renovations, taking in account the Life cycle analysis (LCAA). The main challenge is to persuade the investor (of the necessity) to choose a subcontractor implementing the advisory and supervisory service, which is not obligatory, but crucial for ensuring the effectiveness of implemented measures.

One of the advantages is that the subcontractor steers the decisions, leads the planning process, supervises the construction process and thereby facilitates investment process from the design till finalization. This ensures optimization of investment size and would be meaningful for all investments over 20.000 Eur, corresponding to financial efficiency. The aim of PEP is to provide systematic and holistic perspective and concerted actions for deep renovation. In case of larger project already their size, complexity impose comprehensive assessment. Also the investors often get lost in the planning of deep renovation due to vast information available and therefore rely on experiences of relatives and friends. This often leads to offers that are not easily comparable and evaluated. The PEP takes care of this and ensures that providers/ suppliers prepare comparable tenders/offers.

The pricing of PEP depends on the complexity of renovation/ REFURBishment, planned analyses and outsourcing methods. Indicated price for the PEP is in vicinity of 10 to 15 % of investment costs. The experiences show that the construction costs and operation cost get lowered from 10 to 25 percent, therefore the PEP pays for itself.

Phases of project energy renovation of buildings:

1) Technical design of energy REFURBishment – planner with PEP project manager prepare comprehensive deep renovation plan, involving the investor in all decision-making phases. The time schedule and involvement of all stakeholders is also predefined in this phase.

2) Technical terms and conditions before designing process – examination of applicable acts, which could have a profound effect on energy REFURBishment (municipality, administrative unit, Institute for the protection of cultural heritage), deriving the binding conditions for design.

3) Preliminary building assessment (energy performance certificate) – detailed architectural snapshot and assessment of measured energy performance. Providing systematic analysis of buildings performance, structural components and energy systems.

4) Financing and funding – evaluation of available financial resources and potential financial incentives. The investor is presented all possibilities and the application for grants is facilitated.

5) Analysis of economics (cost analysis of measures) – on basis of analysis of buildings energy consumption and architectural snapshot, the simulation/calculation model is prepared aiming at verification and phases (sequences) of energy renovation measures. The aim of analysis is to identify the needs, cost effectiveness optimization of measures. The achieved energy savings of energy measure or a group of measures are assessed taking in account the LCCA (for 30 years).

6) Detailed design (PZI, projekt za izvedbo), schedule of works – on basis of prior-stage analyses the detailed design documentation is prepared. Parts of detailed design may be used as:

- the detailed design forms the basis for preparation of offers by tenderers;
- the basis for supervision of implemented works;
- project for issuing consent;
- precondition for the building permit;

7) Tendering process – the PEP project manager assist the investor in preparation of tender documentation and in negotiation process with tenderers assists the investor.

8) Supervision of energy REFURBishment process – technical supervision of the construction/ renovation process, compliance with detailed design

9) Energy performance certificate, correction factors (residential buildings) – after the works are finalized the quality assurance is performed. The energy performance certificate is novelized and new correction factors are taken in consideration.

**Define**: One of the main problems connected with the deep- renovation process is tied to the complexity of the process and vast information base available, which poses a challenge for motivated owner/ future investor in decision making. Also the investor cannot have expertise on all topics; therefore the support is often needed. Investors often get lost in planning process/wander and therefore rely on the experiences from the acquaintances, or let them be steered by the suppliers. As this may lead to the dropping out of the investment, lower quality of implementation, the service - project for energy renovation of buildings has been proposed (PEP). The PEP is provided by the expert or a company (institution) covering expertise on energy renovation, construction, mechanical engineering and economics.

**Measure**: The challenge is easily objectify-able – lack of expertise leading to non-optimum investment into deep renovation. The main factor is sociological. It is not so easy persuading the investor that such service is on one hand required and on the other hand the PEP provides real benefits and cost efficiency.

**Analyse**: The project for energy renovation of buildings provides technical (expert) assistance in the process, but cannot be made an obligation to the energy REFURBishment. In the end only for larger investments and ESCO companies such path is followed. The problem is recognized, but due to additional costs the solutions is not taken seriously by individual investors.

**Improve**: As already mentioned in the identified models in use in Slovenia, if there is an additional (independent) support for investors provided by the project office for energy renovation of public buildings (public investors), such service could be at least partially co-financed by the public funds.

Another possibility would be to make such process an obligation in granting subsidies for deep renovation by the Eco-fund. This would ensure the optimization of the process and simplify the procedure of monitoring efficiency of investments. Additionally, good practices which subcontracted experts to assist them from initiation to finalization of investment should be disseminated.

**Control**: An annual assessment of the performance of deep-renovation investments should be made regularly available, publishable. This information should be published in order to raise awareness and face the potential investors with the benefits. Also a survey of effectiveness of various REFURBishments should be implemented regularly – providing statistics (hard data) to the future investors.

## 1.4 ESTONIA

In Estonia, there are two large renovation segments: -Multifamily houses (MFH) which by definition are houses with three or more dwellings and single family houses (SFH). There is a small segment in-between (paired houses, semi-detached houses, terrace houses) but it has been almost neglected by all major stakeholders. These two segments have been treated totally differently.

For years SFH were "left on their own" and only recently there have been some financing measures - subsidies on renovation. For this segment, there is a situation where demand exceeds supply by far so the customer journey here can be described as "first come, first served". In other words there is no need for marketing or improving for now.

The renovation of MFHs has been the sole responsibility of the KredEx Fund. Although inherently a financial institution, KredEx has a Housing and Energy Efficiency Division in its structure. For years it has been the only state wide unit of its kind that is dealing with energy efficiency in housing.

At the beginning of 2010s the subsidising of renovation of MFHs began. Looking back there was rather small effort needed to get the subsidising going. There were a couple of ad campaigns on TV or in printed media and a couple of pilot projects were conducted. When subsidising had gathered momentum, there was just the task of distributing the money. There exist the two kinds of consultants (or SPoC). One of them is fully reimbursed by KredEx. They aim to raise awareness of Housing Associations which represent the owners in a MFH. Their goal is to explain the financing scheme and the necessary steps in order to apply for the subsidies.

### 1.4.1 Best practices for Customer Journey improvement

There are no statistics on the impact of those consultants. Conclusions cannot be drawn.

# 1.5 NETHERLANDS

### 4.5.1 Theoretical models - Buurkracht

The Buurkracht model for improvement is based on DMAIC and is graphically described in Figure 6, Buurkracht model for continuous improvement.

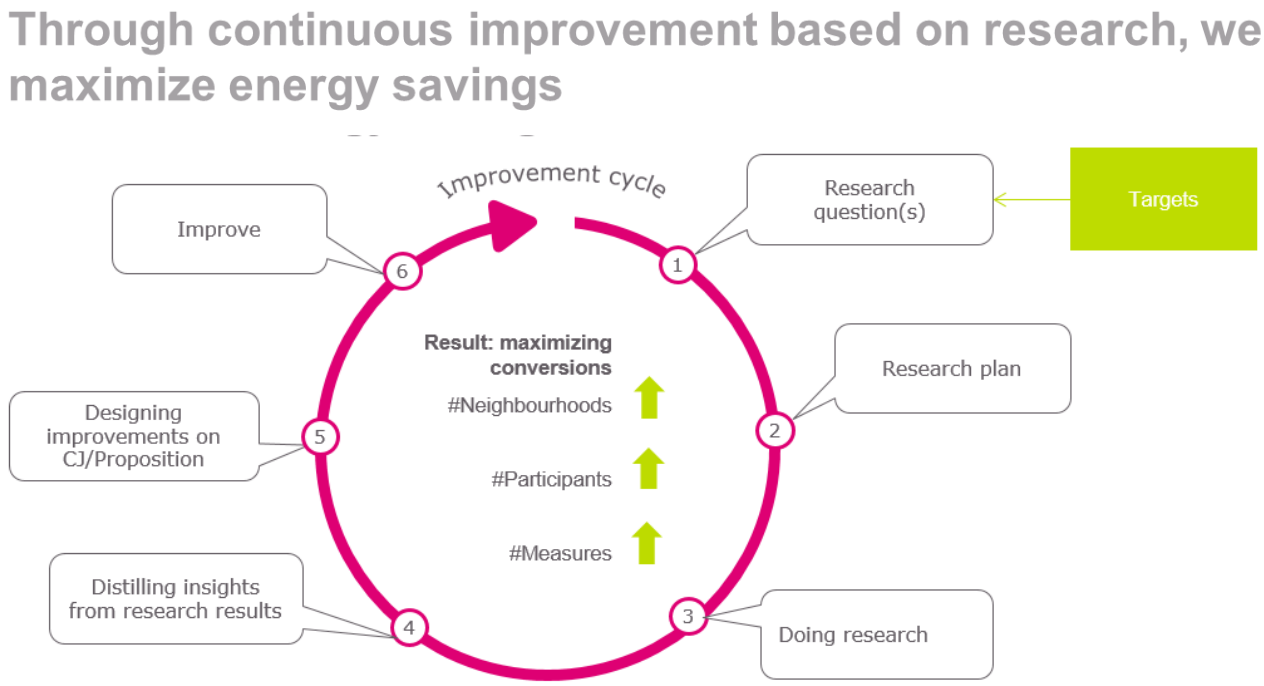


*Figure 17: Buurkracht model for continous improvement*

### 4.5.2 Best practices for Customer Journey improvements - Buurkracht

Winter/Spring 2015 we conducted a large scale qualitative study on the Buurkracht Customer Journey. In this study all aspects of DMAIC were addressed, although we did not explicitly use that model.

The study was based on the Context Mapping Method: Context mapping is an approach to design in which designers use people's everyday lives to inform and inspire themselves for ideation.

In context mapping users and designers work together on the basis of expertise: designers are experts of the innovation process, whereas users are experts of their own experiences. The methodology is developed at Delft University of Technology and is nowadays spread in design practice worldwide. Explorative techniques are used to learn about the needs, wishes, motivations and experiences of everyday people and use this in designing. It mostly makes use of qualitative research, analysis and conceptualization methods and supports empathy with the end-users and inspiration for better solutions.

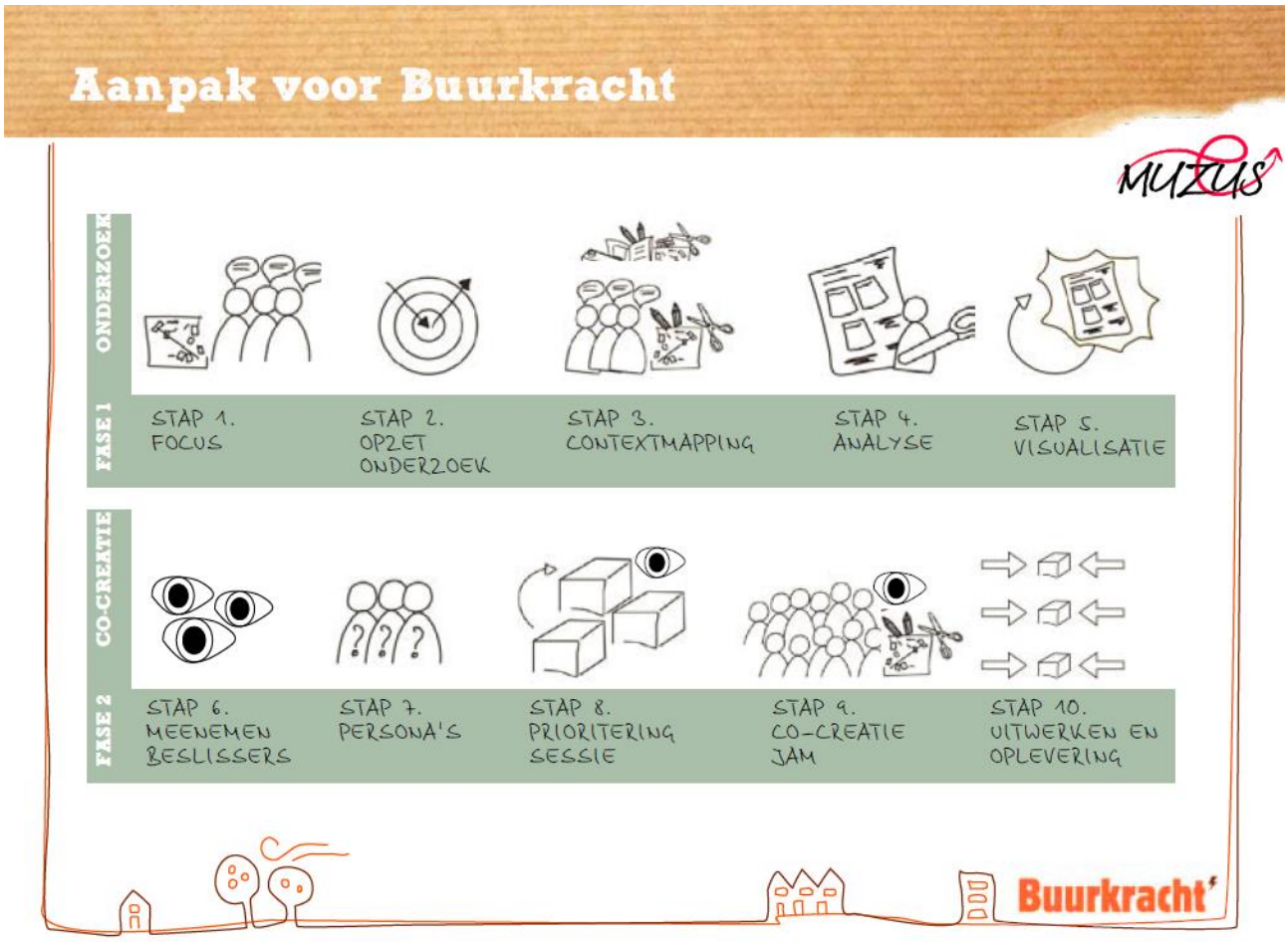


*Figure 18: Description of the context mapping approach*

Step1: Focus. Together we the research we clearly defined the problem
Step 2: Setting up the research
Step 3: Context mapping
Step 4: Analysis
Step 5: Visualisation of the insights
Step 6: Engaging decision makers within the company (in order to secure budget for actual production of the solution)
Step 7: Describing persona's (but in the end, not carried out)
Step 8: Prioritizing the insights
Step 9: Co-creation Jam: a co creation day with lots of different stakeholders to design concepts together, based on the insights
Step 10: Finalising concepts, testing and implementation

**Define**

Buurkracht has clearly defined targets on the number of neighbourhoods we want to serve and the number of measures we want to achieve. And also on the ultimate goal: CO2 savings (derived from the number of measures taken). The problem was (and is partly) that although we were a doing alright and better than other initiatives on saving energy, we still do not reach our targets. That is why we launched a study to gain insight in the fact that:

- Within Buurkracht neighbourhoods 20% of the inhabitants becomes an active member of Buurkracht. Meaning 80% does not.
- Within the group of active neighbours, 20% takes measures. Again 80% does not.

Of course we wanted to know why, but we also wanted to design (in co creation) solutions, test them and implement them.

**Measure**

In order to gain deep insights, we selected a research and service design company to help us set up a comprehensive study. We explicitly did not leave everything to this company but we were very actively involved ourselves, doing interviews and analysing data for example.
To gain this deep insight it was necessary to get information from 3 target groups, being:

1. People who are an active member of Buurkracht, but did not take measures.
2. People who are an active member of Buurkracht and have taken measures
3. People who are neither active, nor have taken measures

The first two groups were known to us in the way that we have their contact details (when they become an active member they created their personal account on our web platform). The third group was not known to us. In order to reach them we conducted street interviews in a custom-made little Buurkracht house, based on a wooden IKEA bunk bed:

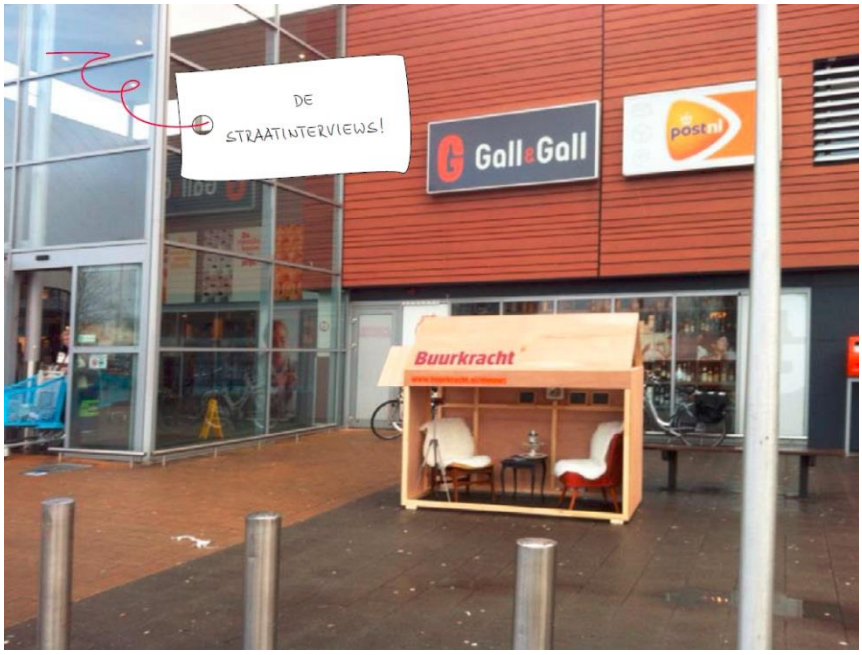


*Figure 19: Buurkracht mobile house for street interviews.*

For the other two groups we started off with sending so-called sensitizing packages/cultural probes. These were used to make people more aware of their everyday practices regarding energy use before in-depth interviews were conducted at their house. The packages contained -among other things – a photo camera to take pictures and an energy-diary to log (write down) their current energy use. All interviews were recorded (both sound and video) because we also wanted video material to inspire colleagues with what real people had to say. Video leaves a much stronger impression than just reading about the results afterwards.


*Figure 20: Example of cultural probes*


*Figure 21: Returned diaries*

**Analyse**

All the results from all the interviews and the sensitizing packages were written down and important statements were collected from them and grouped together:


*Figure 22: Analysis of insights.*


*Figure 23: Detail of the analysis of insights*

After this, the insight clusters were visualized:


*Figure 24: Visualization of triggers to save energy*

**Improve**

We organised a Co-creation Jam to come up with the solutions. We invited a lot of stakeholders (colleagues from other energy companies, 'normal' people from neighbourhoods, colleagues from Buurkracht, people from NGOs etc.) and a sketch artist for an entire day of co-creation. Starting point were the visualized insight and a set of questions combined with the Business Model Canvas. The sketch artists supported the creation process by visualizing ideas and thoughts the groups had (6 groups consisting of approx. 7 people each dealing with one insight cluster). At the end of the day the concepts were pitched before a Dragon's Den of senior managers from our parent company (to engage them and to get their valuable feedback)

The most promising concepts were then developed, tested and implement. For example, our Energy Savings calendar stems from this but also 'Buurkracht for Business' in which colleagues instead of neighbours save energy together.

*Figure 25: Pictures of the co-creation sessions*

*Figure 26: Picture of the Dragon's Den*

**Control**

We implemented a dashboard in our Salesforce system to keep track of all important conversions in Buurkracht. In Salesforce all kinds of data about neighbourhoods, participants, measures taken etc. are logged. The dashboard cleverly combines all the sources to give a real-time overview of where we stand.

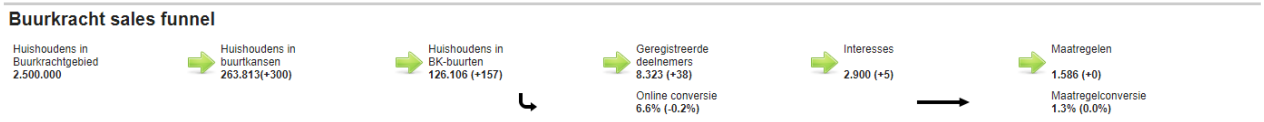


*Figure 27: Salesforce funnel*

## 4.5.3 Best practices for Customer Journey improvement – Slim Wonen in Leeuwarden

### *4.5.3.1 Shorter Customer Journey, follow-up and tailored support*

Slim is the Dutch word for smart. 'Slim Wonen in Leeuwarden' is a municipal multi-faceted program (initiated in 2013) that triggers and supports private home owners to carry out energy saving measures. This is achieved via:

1. Thematic events in the neighbourhood;
2. Large-scale neighbourhood approach to energy saving
3. The online energy portal: www.slimwoneninleeuwarden.nl

A consortia of local and regional SMEs can offer their energy services (including nZEB) via the energy portal www.slimwoneninleeuwarden.nl. The program is well-known in the city of Leeuwarden and has proven its worth over the years. The interface of the energy portal offers private homeowners an approachable, seven step Customer Journey towards energy saving (Figure 1). The online Customer Journey has been brought back to seven steps for a reason: This shorter version of the journey proved to be much more effective as compared to the full eleven step journey. The seven steps are (also see Figure 1):

1. Energy check; Do I use too much energy
2. Energy saving scan; How can I save energy
3. Selecting local contractors; Who do I hire to do the work
4. Financing; How am I going to pay for this
5. Checklist; Is the work coming along nicely
6. Satisfied or not? Your opinion counts! Share your experience and win nice prices
7. Do I still have energy left; Become a Slim ambassador

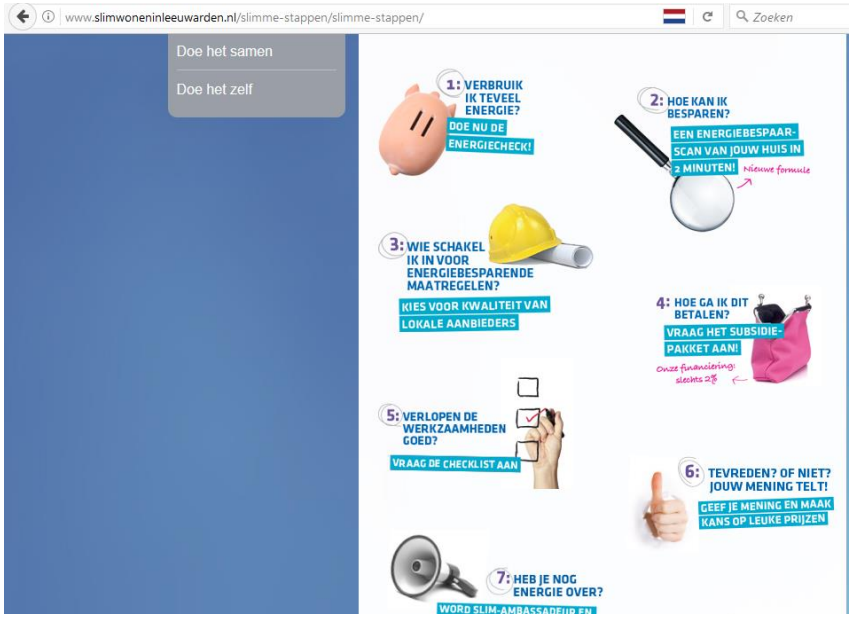


*Figure 28: The 7-step Customer journey Slim Wonen in Leeuwarden*

The online energy portal builds awareness, trust and literally 'pulls' the customer through the Customer Journey by offering tailored support whenever customers need it. 'Slim Wonen in Leeuwarden' has a strong customer- orientated approach. The customer can ask for practical support at any point in the journey. The support can range from receiving (extra) information to requesting help with the interpretation of quotations for energy saving measures. In essence, any type of support will be provided to unburden the customer and to avoid dropout.

The support team in the back-office (Duurzaam Bouwloket; on behalf of the municipality) offers this tailored support. Customers can also ask energy coach Klaas for personal advice and assistance. Klaas meets with homeowners in person. He will access and discuss the current energy performance of the dwelling with the homeowner. Help with filling in forms for subsidies or sustainable loans is also a possibility. He can also answer any remaining questions 'on the spot'. Klaas is there to completely unburden the homeowner; he takes away any relevant barriers. The support from both the back-office as well as Klaas have been very effective in keeping homeowners in the journey. Their contact information is provided on the online portal.

Besides from offering support, the back-office also engages in an active follow-up by calling or emailing homeowners/ customers. For instance, when a homeowner has asked for support or advice earlier (and left their contact information via the online energy portal) and nothing has happened ever since, the back-office will call or email to make enquires. An email or call will trigger the customer once more and also gives the back-office the change to take away any relevant barriers. With a good follow-up system customers are encouraged to continue their journey towards energy saving.

Lastly, 'Slim companies' need to adhere to certain quality demands from the moment the work starts. For instance: They need to ensure that the customer has a single point of contact (SPoC), a one-stop-shop offer (OSSO) and will only receive one bill afterwards. The energy portal informs customers about the quality assurance right from the start. This immediately builds positive expectations and trust right away.

The quality demands for Slim companies are discussed in more detail in D5.4 'Quality assurance of the renovation packages'.

#### *2.5.3.2 Slim Wonen in Leeuwarden – Customer review system*

Customer experiences can be shared on the online energy portal, the 'Slim Wonen in Leeuwarden' Facebook page and via its Twitter account. The energy portal has a special webpage fully dedicated to customer experiences, it is called 'Zij zijn Slim'. Having good reviews and positive experiences with energy saving is very important as it encourages other homeowners to do the same.

Customer reviews posted on online media are frequently monitored by the municipality. 'Slim Wonen in Leeuwarden' is comparable to an established company brand; it has a high reputation to keep up. If a homeowner were to report any misunderstandings on social media, the municipality and the Slim consortia will surely follow- up on this. Full customer satisfaction is a key principle of 'Slim Wonen in Leeuwarden'.

#### *2.5.3.3 Slim Wonen in Leeuwarden – Monitoring and control*

The aim of the online energy is to reach and support as many homeowners as possible along the entire journey. It is up to customer to decide where actually the journey begins. The back- office uses several tools for monitoring the process. For instance, by generating a report on these performance figures:

1. Number of customers reached;
2. Growth in hits and unique visitors on the site;
3. Number of Facebook followers;
4. Number of energy scans executed;
5. Number of requested quotations;
6. Number of unique investments;
7. Number of questionnaires filled in;

Customers are asked to share their experiences in step 6 of the journey.

8. Number of reviewers;
9. Number of new ambassadors;

Performance figures have been used to make an appealing visual representation, for instance for promotion and communication aims (Figure 18).

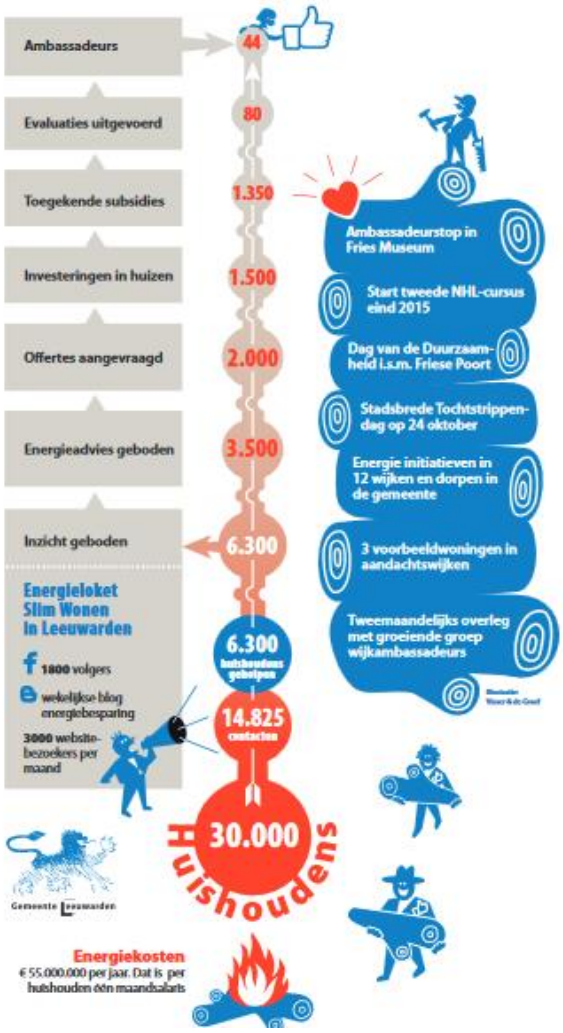


*Figure 29: Infographic Slim Wonen in Leeuwarden (28 October 2016)*

The current performance of the online portal becomes clear when the performance figures are compared to those of the years before. Steady growth of the figures are indications of the continuous improvement of Slim Wonen in Leeuwarden.

Besides from a report, the back-office can also can generate a quarterly spatial overview of energy measures taken in Leeuwarden (Figure 3). With such a special overview, performance can be measured on a geographical scale.

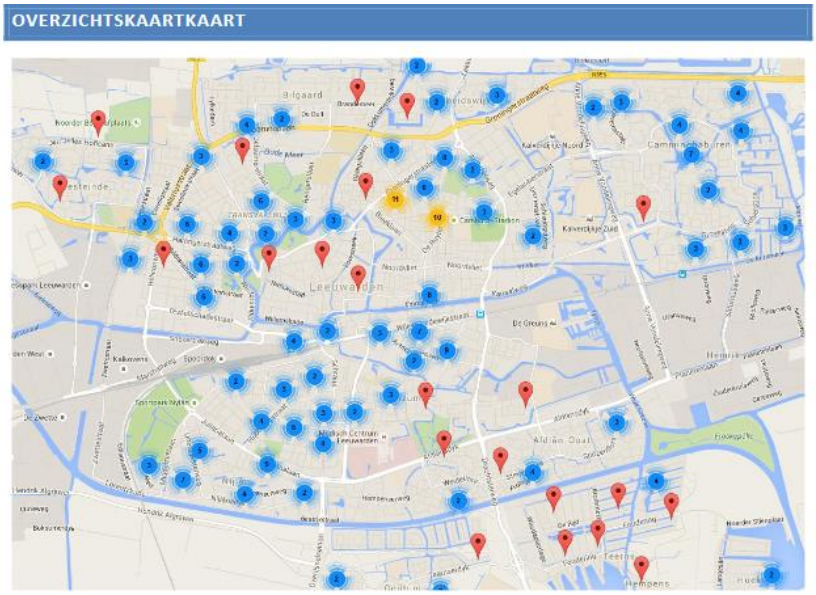


*Figure 30: An example of a quarterly spatial overview of energy measures in Leeuwarden which were initiated via the energy portal [www.slimwoneninleeuwarden.nl](http://www.slimwoneninleeuwarden.nl)*

A heatmap for Leeuwarden is also a possibility. The heatmap shows high concentrations of energy activities/ measures, displayed on a geographical map of Leeuwarden (Figure 20):

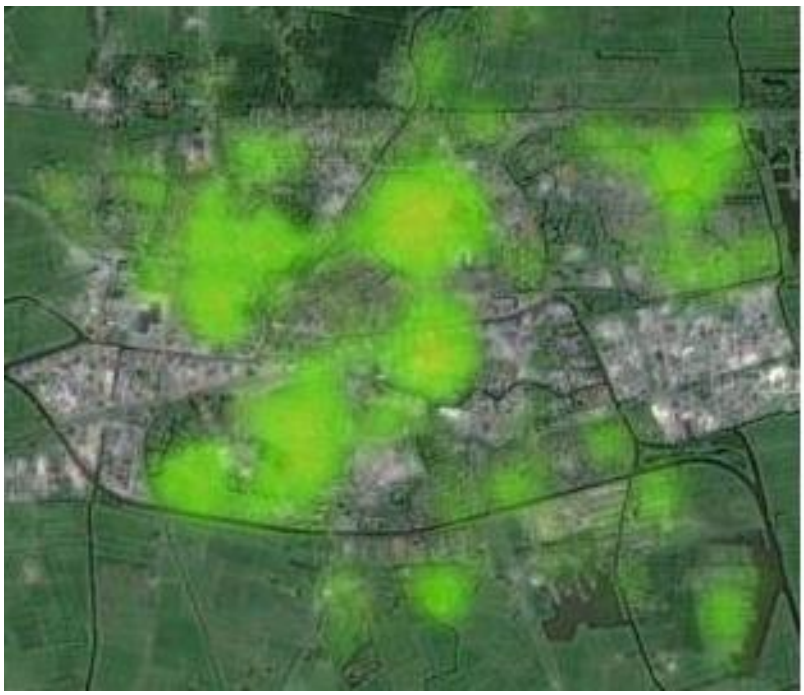

*Figure 31: Example of the heatmap in Leeuwarden An example of a quarterly spatial overview of energy measures in Leeuwarden which were initiated via the energy portal [www.slimwoneninleeuwarden.nl](http://www.slimwoneninleeuwarden.nl)*

Both 'epicentres' as well as 'blind spot neighbourhoods' become visible on a heatmap. This information is very interesting to the municipality, as Slim Wonen in Leeuwarden is also known for its neighbourhood approach. In 'blind spot neighbourhoods', a tailored and appealing energy project can be very helpful 'to spread the word' and get things started. After all, Slim Wonen in Leeuwarden

aims to reach as many homeowners as possible and to encourage them all to start saving energy. A neighbourhood/ target group approach works very well in this case.

Summarizing, the approach of Slim Wonen in Leeuwarden according to the DMAIC model is as follows:

**Define –** Information on energy saving needs to be approachable, trustworthy, manageable and independent. Customers want and need to be unburdened as much as possible. Also, energy saving measures need to pay off as promised.

**Measure –** The current energy performance of all privately owned dwellings in Leeuwarden can be seen as the baseline for further improvement.

**Analyse –** Awareness and trust are at the root of decisions regarding energy saving.

**Improve –** Slim Wonen in Leeuwarden builds awareness and trust by providing straightforward, independent, trustworthy information and tailored support. The customer can also expect the work to be carried via a transparent process with a single point of contact, one-stop-shop offer, trouble-shooting if necessary and only one bill in the end.

**Control -** The performance of the energy portal is assured by an active follow-up from the back-office, tailored support, customer review monitoring and by analysing performance figures/ spatial overview and heatmap.

#### *4.5.3.4 Best practices for Customer Journey improvement – Neighbourhood approach in Leeuwarden*

The neighbourhood approach to energy saving has proven to be very effective in general. This also applies to the city of Leeuwarden. Here an analysis of an example of the neighbourhood approach from Slim Wonen in Leeuwarden, with use of the DMAIC model:

**Define -** Several neighbourhoods in Leeuwarden have the typical poorly insulated dwellings dating back from 1960 - 1970. Poorly insulated homes result in a lack of comfort and a high energy bill. In addition, their owners often have less money to spare. Homeowners can make their homes much more comfortable and save a lot of money if they decide to invest in insulation. If an entire neighbourhood can be tackled all at once, there might be the possibility of receiving a discount.

**Measure-** The baseline for the neighbourhood could be: The current number of private homeowners that have already requested information on insulation. Or the current number of energy saving measures (including insulation) that have been carried out so far.

**Analyse -** The root cause: Homeowners are not aware that insulating their homes for a good price will considerably lower their energy bill and will also make their homes much more comfortable. They currently do not invest in insulation because they do not (yet) have insight in the benefits/ gains nor costs.

**Improve-** To make the homeowners aware of the benefits/ gains of insulation, Slim Wonen in Leeuwarden organised a tailored insulation auction in the neighbourhood. Prior to the auction, the benefits and pay offs of insulation were explained to the homeowners. The auction was only open to companies who agreed to meet certain quality demands; the work had to be carried out to the full satisfaction of the customer. Eventually, the offers from local and carefully selected insulation companies were auctioned off to the homeowners.

**Control-** The auction resulted in (at least) 200 orders for floor-and cavity wall insulation. In total, a 1000 quotations were issued. This can be considered as a really good yield.

Projects such as the insulation auction, are also designed to cause a ripple effect in the neighbourhood: Homeowners continue to be interested in energy saving, will want more and will visited the energy portal to scan for more energy measures. The back- office can record such an increased activity on the heatmap (Figure 20). The ripple effect can then be quantified via the spatial overview (Figure 19).

#### *4.5.3.5 Best practices for Customer Journey improvement – wanting more*

Of course, there are a lot of other possibilities for thematic or tailored neighbourhood activities that Slim Wonen in Leeuwarden can initiate together with homeowners and stakeholders.

Currently, there is an ambitious bottom-up project aimed to renovate an entire neighbourhood to zero-on-the-meter (zero – energy). Homeowners, 'Slim Wonen in Leeuwarden', companies and other stakeholders are all involved in this project. The first (focus group) meeting was a few months ago; 28 enthusiastic homeowners were present that evening. Here, both homeowners and building companies shared and discussed their expectations regarding suitable zero- energy concepts for the neighbourhood.

If it was not for 'Slim Wonen in Leeuwarden', such an ambitious project might not have been initiated. This proves that starting small – i.e. create awareness on energy saving and offer tailored support along the journey- really pays off in the long run!

# 1.6 GERMANY

## 1.6.1 Theoretical models

Housing companies are long standing professionals with regard to REFURBishment and they can look back on extensive experience. Their renovation process is proven and tested and is more or less the same every time, meaning they are doing the Customer Journey over and over again. Relationships with partners (planners, architects, contractors, suppliers…) are well-established. Therefore, many of the steps of the Customer Journey are not equally important for housing companies, as they are for private homeowners. In order to explain the differences, a short outline of every step of the Customer Journey is given below.

1. Becoming aware: Awareness is not a problem with housing companies/housing cooperatives.
   - Competition as well as maintenance needs force them to keep their building in a modern state, legislation requires certain standards when a renovation is started
2. Becoming interested: see above
3. Becoming active: if action will be taken depends on a number of factors, especially the priorities, as energetic REFURBishment is only one goal of the company amongst many
   - Possible triggers: appeal to companies´ responsibility with regard to climate protection/achieving political goals, stress comfort and health issues for tenants and the competitive advantage of a modernised building stock
4. Considering the offer: there is not an extensive decision-making process, housing companies are aware of advantages and financial options, they have knowledge of the relevant technical issues and can make well-informed decisions
   - Possible triggers: exchange of experience in housing associations can be motivating to try new approaches: there is a technical section of the association, where a professional group discusses new technologies, approaches etc. and suppliers present new products (4F.)
5. Financing: the financing process is established, there are longstanding relationships with financing partners for projects of different volumes, usually renovation projects are predominantly financed by own resources
6. Selecting a supplier: there are basically two options, a tender where the whole project is given to one contractor (which hires subcontractors as needed) or to authorize a professional planner to invite tenders for every renovation step and supervise the process
7. Installation and payment: installation dates are part of the tender and are coordinated by the professional planner/architect
   - possible barriers: tenants might not agree with the renovation or the inconvenience connected to it and take opposition to it
8. Experience: not applicable
9. Organising: service and maintenance contracts for some products are compulsory; architect/planner is familiar with project and is point of contact for problems (9F.)
10. Sharing: see 4., exchange with others in housing association
11. Wanting more: see 4. and 11., exchange with other members of housing association and suppliers keeps companies informed on news

The Customer Journey from a housing cooperative´s or company´s point of view is quite different from those of private homeowners, it is professionalised and well-established. Nevertheless, there is always the danger of getting stuck in an established process and not be able to ‘think outside the box’ anymore and thus miss out on opportunities for improvement of the process. That is why the

exchange of experiences with other companies and architects, planners and suppliers is the most important way of improving the Customer Journey (Step 4, 10 and 11). By listening to and learning from experiences of others, mistakes are avoided and impulses for changes are given.

### 1.6.2 Best practices for Customer Journey improvement

An important problem with energy renovation of rental apartments is, that the rent-increase triggered by the renovation measures, will in most cases exceed the savings of tenants on reduced energy bills. This means, that after the renovation, they have to pay more for their rent plus energy costs than before the renovation, although their energy bills are lower.

When announcing a renovation for a certain building, tenants do have the opportunity to voice their concerns and talk about their worries and hopes with regard to the planned renovation. The problem has so far not been objectified or measured, but there are always tenants who are worried about the renovation costs.

For a housing company, the rent increase after a renovation is the only option of refinancing their investment. Tenant law sets strict boundaries as to the percentage the rent can be increased. Often this percentage is not even fully maxed out, in order to prevent increasing fluctuation and starting a process of expulsion in the building/neighbourhood, which is not necessarily in the interest of the housing company. In addition, many municipal housing companies and housing cooperatives are bound by their statutes to avoid pushing tenants out and contributing to segregation processes in cities.

There is no real solution to a strategic dilemma like this. One possible approach is, to involve the tenants as much as possible in the renovation process. At first, it is important to inform them carefully and with as many details as possible, so they know what to expect. During the information process, it is crucial to call attention to the positive aspects of energy renovation, other than reducing the energy bill. This means, emphasising the benefits such as improved comfort/health due to minimising cold surfaces in the apartment, reduced draught from old windows, improved look of the building and of course a contribution to environmental/climate protection. Additionally, a good way of convincing the tenants is letting them take part in decisions regarding the renovation process, for example the design of the façade (e.g. tenants can chose between three alternative colour schemes or different motives for large-size artistic paintings on the outside wall).

If there is substantial subsidizing, the dilemma can be avoided. It gives housing companies the opportunity to reduce the renovation costs and therefore the amount that needs refinancing via the rent.

One way to control the results of renovation measures (in form of satisfaction of tenants) would be to ask them for their satisfaction with the result, for how they feel about the improvements of the indoor-climate and other key features after the renovation is completed and some time has gone by. The results of the questionnaire could be used to further improve the communication process in upcoming renovation projects.