Attractive, Acceptable and Affordable deep Renovation by a consumers orientated and performance evidence based approach

Contract No.: 784972

Report: The proven measurements carrousel (database)

Work Package: [WP3 – Task 3.1]
Deliverable: [D.3.1]
Status: Public

Prepared for:
TripleA-Reno Consortium partners

Prepared by:
ISSO
Dennis van der Kooij, Jan Cromwijk
[07-03-2019]
Revision and history chart:

<table>
<thead>
<tr>
<th>VERSION</th>
<th>DATE</th>
<th>EDITORS</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.0</td>
<td>2019-03-04</td>
<td>ISSO</td>
<td>First version circulated</td>
</tr>
<tr>
<td>Version 1.1</td>
<td>2019-03-08</td>
<td>HIA</td>
<td>First version peer-reviewed</td>
</tr>
<tr>
<td>Version 1.2</td>
<td>2019-03-21</td>
<td>COM</td>
<td>First revised version circulated</td>
</tr>
</tbody>
</table>

Table of content

Revision and history chart: ................................................................. 2
Table of content .................................................................................. 2
List of figures ...................................................................................... 3
List of tables ........................................................................................ 3
Glossary of terms .................................................................................. 4
1. Introduction ...................................................................................... 8
2. Method development .......................................................................... 9
2.1. How do we describe and visualize measures? ............................... 9
2.2. How do we describe and visualize concepts? ................................. 10
2.3. How do we document measures and how do we save them in a database? .... 12
3. Results ............................................................................................... 13
3.1. Consumer background .................................................................... 14
3.2. Renovation strategies ..................................................................... 15
3.3. Building improvements .................................................................. 15
3.4. Defining possible improvements .................................................... 16
3.5. Choosing measures .......................................................................... 17
3.6. Creating a concept .......................................................................... 18
3.6.1. Pre-concept ................................................................................. 18
3.7. How to define a measure ................................................................. 19
   1. Add measure to corresponding category ........................................ 19
   2. Add usable materials or types ....................................................... 20
   3. Add important side notes ............................................................ 21
   4. Add picture/drawing ..................................................................... 21
   5. Add ETIM classification ............................................................... 21

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION’S H2020 FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION UNDER GRANT AGREEMENT NO 784972.
The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.
List of figures

Figure 1 Visual representation of cavity wall insulation ................................................................. 9
Figure 2 Window and facade connection detail .................................................................................. 9
Figure 3 Visual guide for difference between a measure, pre-concept and concept ........................................... 11
Figure 4 Morphological design flowchart .......................................................................................... 13
Figure 5 Visual representation of insulation thickness .......................................................................... 15
Figure 6 Visual representation of insulation choice ............................................................................. 17
Figure 7 Visual representation of three different concepts ..................................................................... 18
Figure 8 Pre-concept diagram ............................................................................................................. 19
Figure 9 Example from the measures Excel list .................................................................................. 19
Figure 10 Example from the measures Excel list ................................................................................ 20
Figure 11 Example from the measures Excel list ................................................................................ 21
Figure 11 Example from the measures Excel list ................................................................................ 21

List of tables

Table 1 Consumer background information ...................................................................................... 10
Table 2 Consumer background information ...................................................................................... 14
Table 3 Strategy and measures compatibility list ................................................................................. 16
Table 4 Visual representation of floor insulation options ..................................................................... 17
Table 5 Description of the Excel fields to add measures ..................................................................... 20
Table 6 Strategy and measures compatibility list ................................................................................ 22
Table 7 Measures compatibility list ..................................................................................................... 23
Glossary of terms

**All-electric strategy**

The improvements made to the home are made with all-electric in mind. To be able to create an all-electric building, certain prerequisites have to be met. The building has to have a maximum heating requirement. This to be able to use the electric installations efficiently. After having met the prerequisites the building installations have to be upgraded to electrical installations, think about the furnace, heating system, ventilation, etc.

**Circular strategy**

The improvements made to the home are made with reusability in mind. Not reusable PUR foam as insulation is bad for the environment, whereas stone wool insulation’s resource, stone, is broadly available. Stone wool insulation would be the preferred solution in this case.

**Comfort strategy**

The improvements made to the home are to increase the comfort inside the building. Measures to increase comfort could include: balanced mechanical ventilation with heat recovery, low temperature heating in older bad insulated buildings, high temperature heating in newer well insulated buildings, insulating the floors, etc.

**Concept**

A concept is a collection of measures that fit the strategy and the building.

**Deep renovations**

A deep energy retrofit is a cost-effective whole-building process that employs integrative design to attain larger energy savings compared to the ones achieved through the adoption of separate energy retrofit measures. According to the EU Energy Efficiency Directive, the deep renovation process represents a solution able to reduce both the delivered and final energy consumption of a building by a significant percentage compared with the pre-renovation levels; typically, more than 60% energy saving, while increasing user comfort and indoor environmental quality (IEQ) levels.

Deep retrofits are cost-effective since higher energy performance is resulting in the lowest cost during the estimated economic lifecycle of the building, and quicker Return on Investment for implemented solutions through energy savings. However, the concept of “cost-effectiveness” in terms of direct economic payback would not be possible for all cases – i.e. in Mediterranean regions energy consumption is generally lower; this, alongside to fuel poverty cases, make it difficult to pay back the interventions in energy savings terms.

The definition of deep renovation applies within the framework of major renovations, under two conditions: either more than 25% of the surface of the building envelope undergoes renovation or the total cost of the renovation of the building envelope or the technical building systems surpass for more than 25 % the value of the building.

Typically, deep energy retrofits combine energy efficiency measures so that dramatic energy savings are achieved. These include, the integration of energy efficient façades with improved insulation, changing of windows to triple-glazed windows, HVAC systems with heat recovery ventilation, active energy components incorporating RES (Renewable Energy Sources) in the building façade and roof and energy harvesting equipment, moisture management, controlled ventilation and equipment, and solar control."
Ecology strategy

The improvements made to the home are made with the environment in mind. Reusability and broad availability of resources are important for the strategy. For example, not reusable PUR foam as insulation is bad for the environment, whereas stone wool insulation’s resource, stone, is broadly available. Stone wool insulation would be the preferred solution in this case.

Economical strategy

The improvements made to the home are made with budget in mind. The options in this strategy are a good balance of price and returns, or so called no regret measures. Examples are insulation, double glazing with coating, condensing combination boiler, etc. These measures have a fairly low investment cost whilst they greatly improve the home.

End-users

The end user, or consumer, is the person who will use the final product, with or without aid of someone with knowledge of building(services).

ETIM

ETIM (European Technical Information Model) is an international product classification for the building services, construction and maritime sector.

ETIM product classification is a classification of trade products in different classes, where the product properties are recorded in the class. This is done through article classes, characteristics, units and limit values that are described in the standard.

A characteristic describes a property of a product, such as the type of material it is made of, the size or colour of a product. The product classification prevents speech confusion and mistakes, and makes it possible to identify the product and trade data in a standard way and exchange them between the various parties.

Integral strategy

The improvements made to the home are made with complete renovation in mind. The chosen measures reflect lifespan, durability, comfort, costs, general health, safety and saleability. This strategy is a combination of the other strategies.

Lifespan strategy

The improvements made to the home are made with the building lifespan in mind. The building market is tight and old buildings have to be repurposed. To add to the lifespan of a building it needs to be adaptive, to the building owners as well as to the installations and building techniques. Lifespan expanding measures could include, insulation of the roof whilst also replacing the roof, creating room for modern installations and replacing the old ones, replacing a wooden floor with a better insulated stone floor, etc.

Low maintenance strategy

The improvements made to the home are made with low maintenance in mind. Improvements to the building envelope are generally low maintenance and low hanging fruit for this strategy. Further improvements have to be carefully chosen. A lot of new tech installations require more maintenance compared to older tech installations. For example, in this strategy exhaust-only mechanical ventilation is preferred above balanced ventilation as is district heating above a heat pump.
Low energy consumption strategy

The improvements made to the home are made with low energy consumption in mind. The goal of this strategy is to reduce the energy bill as much as possible, first reducing energy usage and generating as much energy as possible. Insulating, airtightness and energy efficient installations are top priority, followed by heat or electricity generation.

Measure

A measure is a product or solution that is part of the renovation of the building.

Morphological design

Morphological design is a method to generate concepts by first collecting all the possible solutions for the different problems. All the possible solutions for each renovation step are collected, which allow a more complete set of concepts. When you have all the solutions ready, you can choose which option best fits your wishes or problem. This allows the best solution(s) for the end user, by leaving nothing out.

nZEB

Nearly Zero Energy Building. The general definition of nearly zero energy building (nZEB) was introduced in the Directive 2010/31/EU of the European Parliament and of the Council (EPBD recast) on 19 May 2010. According to the Article 2 of the EPBD recast, the nearly zero energy building means a building that has a very high energy performance, and the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from on-site or nearby renewable sources. Beyond the general definition of nZEB, every Member State has its own, more precise definition for nZEB. Practically, it can be stated that the energy performance of nZEB is lower than the cost-optimal levels (nZEB is more energy efficient than cost-optimal building), and the differential Global Cost ($\Delta GC$) is negative, so that nZEB is cost effective.

Passive house strategy

The improvements made to the home are made with energy efficiency, comfort and affordability in mind. Furthermore, the passive house strategy is based on the Trias energetica, preventing energy usage, using as much renewable energy as possible and to generate the remainder of the energy as efficient as possible. This, combined with comfort demands and affordability creates a balanced concept for homes.
A carrousel consisting of energetic or sustaining measures and concepts created with these measures. That have been proven in practice. For example a concept to renovate and sustain a pitched roof including the integration of PV. In that concept the measures are roof isolation, roof airtightness and solar PV integration, which have been tested in practice and thus function as proven measures.

Step-by-step strategy

The improvements made to the home are tiered. This strategy is done in several steps and needs another strategy to determine the type of improvements. If the user wants to completely renovate his/her home but doesn’t have the funds currently they can choose this option to spread the renovation over a longer period of time. An example is: you start with insulation and airtightness of the building, followed by a heat pump and finally solar panels.
1. Introduction

TripleA-reno is developing an easy to use digital tool to create nZEB renovation concepts based on morphological design methods. One of the steps towards this goal is to define measures/concepts and how people or consumers interact with them. This has to be achieved on an easy to understand level, so everyone, from consumers to architects, can use the tools.

This deliverable lays the ground work for how the measures will look and how they can be interacted with in the future, how the concepts look and how they can be interacted with and how all the data will be stored. This is done by the creation of a proven measures carrousel, defining energy saving and sustainable energy producing ‘measures’ (with measures both single measures as into a concept combined measures, for example a climatization kit), creating basic information content and visualization guidelines on the ‘measures’, and finally inventing the interactions to be gamified, in a way to make the information in the carrousel interactive (circular, alive).

Below are several questions that have been answered during development of this deliverable:

1. How do we describe and visualize measures?
   - How do we do this currently?
   - How do we do this in the optimal form?

2. How do we describe and visualize concepts which are built up of measures?
   - How do we do this currently?
   - How do we do this in the optimal form?

3. How do we document measures and how do we save them in a database?

The content of this deliverable will be further expanded in the morphological design tool and database implementation.
2. Method development

2.1. How do we describe and visualize measures?

The development of the material for this deliverable started with the collection of the most known nZEB renovation measures used in the Dutch building stock. All the selected measures are documented including the description of types of measure, technical values, important side-notes and an example. To make everything searchable and easy to find a categorisation of the measures followed, dividing the measures in their own category.

Following the categorisation, a search was done on how measures are currently documented. An example for a windowsill in a wall is shown below (Figure 1).

![Figure 1 Window and facade connection detail Source: ISSO](image1)

Most documentation on the measures is technical and not understandable for consumers. The ideal for consumers would be a simple visualisation and some general information instead of product properties and such. A visual example is shown above (right). Furthermore a general description, usable materials or different types and important side-notes have to be added to the measure. Following feedback from the consortium, the parameter ‘cost indication’ has also been added.

Given the many parameters each measure has, the consortium agreed to have different information levels for each measures. With this distinction both an architect (i.e. expert user) and consumer (non-expert user) should be able to use the tool. This means the non-expert users or consumers see general information and a simplified picture of drawing, where the expert users can see a diagram of the building wall and all the properties of the measure.

![Figure 2 Visual representation of facade insulation](image2)
2.2. How do we describe and visualize concepts?

For an end-user to choose which improvements she/he wants for her/his home, one has to know her/his living conditions and how she/he wants to renovate her/his home. The consumer background information tab has been created, to form a general idea on what the wishes of the end user are, as shown below (Table 1). The consumer background definition includes the desired renovation strategies; this, to give a general direction on how the consumer wants to renovate his home.

Table 1 Consumer background information

<table>
<thead>
<tr>
<th>Residents:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of persons:</td>
<td>3</td>
</tr>
<tr>
<td>Electricity usage:</td>
<td>4000 kWh</td>
</tr>
<tr>
<td>High rate</td>
<td></td>
</tr>
<tr>
<td>Low rate</td>
<td></td>
</tr>
<tr>
<td>Gas usage:</td>
<td>1450 m³</td>
</tr>
<tr>
<td>Budget:</td>
<td>€15000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction year:</td>
<td>1955</td>
</tr>
<tr>
<td>Surface area:</td>
<td>99 m²</td>
</tr>
<tr>
<td>Building main material:</td>
<td>Stone</td>
</tr>
<tr>
<td>Building style:</td>
<td>Townhouse</td>
</tr>
<tr>
<td>Orientation:</td>
<td>West</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Country:</td>
<td>Netherlands</td>
</tr>
<tr>
<td>City:</td>
<td>Rotterdam</td>
</tr>
<tr>
<td>Climate:</td>
<td>Temperate maritime</td>
</tr>
<tr>
<td>Renovation strategy:</td>
<td>Economical</td>
</tr>
</tbody>
</table>

However, the information gathered from the consumer background is not enough to be able to reliably choose measures. Based on the information above, a general estimation can be made about the current state of the building, how well it is insulated, how airtight it is, etc. However this does not take the measures into consideration that the end-user might have already implemented himself. The end-user has to be able to add measures that he has already implemented in his home. For example the end-user has a townhouse from 1955 and has insulated his floor in 2005. Buildings from 1955 generally do not have floor insulation so the user must add this measure to the list.

The end-user would now be able to choose which measures she/he wants, and by choosing measures the end-user is creating a concept. The definition of the concept is: ‘A concept is a collection of measures that fit the strategy and the building.’ So no matter which measures the end-user chooses, he will always have a concept that fits his wishes.
However, not all measures can be combined. For instance, high temperature radiators combined with a heat pump. A heat pump functions best in a low temperature system, or is not even capable of producing temperatures that are needed for high temperature radiators. For this reason, a compatibility list has been created, to evaluate which measures complement each other and to provide advices on which measures better be not combined together. This, to prevent the end-user from choosing measures that do not fit each other.

Finally the ‘pre-concept’ has been added to the options. Certain measures consist of different measures, for instance a building extension. The pre-concept is a selection of measures that are part of a concept, which in turn is part of the final concept. Because measures selected for the original building do not have to apply to the building add-ons. For some clarification between a measure, pre-concept and concept, see figure 3.

![Figure 3 Visual guide for difference between a measure, pre-concept and concept](image-url)
2.3. How do we document measures and how do we save them in a database?

To document the measures in a database, some parameters are needed to be able to distinguish which measure is which. The measures have to be categorised and need to have technical data. The general categorisation developed is as follows:

- Building envelope
  - Airtightness
  - Building extensions
  - Façade openings
    - Doors
    - Frames (doors and windows)
    - Windows
  - Insulation
    - Façade
    - Roof
    - Floor

- Building installations
  - Energy generation
    - Electricity
    - Hot water
  - Cooling
    - Active cooling
    - Passive cooling
  - Heating and domestic hot water
    - Heating and domestic hot water
    - Heating and cooling distribution
    - Saving on domestic hot water
  - Ventilation
    - Exhaust-only mechanical ventilation
    - Supply-only mechanical ventilation
    - Balanced ventilation
    - Balanced ventilation with heat recovery

For the technical data we link to an already existing database, through the ETIM classification. ETIM (European Technical Information Model) is an international product classification for the building services, construction and maritime sector.

A characteristic describes a property of a product, such as the type of material it is made of, the size or colour of a product. The product classification prevents speech confusion and mistakes, and makes it possible to identify the product and trade data in a standard way and exchange them between the various parties. At first the current Excel file shall be used for further fine-tuning and to function as a proof of principle, before everything is transferred to the database. Next, a further implementation in the project management environment of the platform will be looked at.
3. Results

The results consist of several parts, first is the morphological design on which the final product will be based. Followed by the measures and how to document them and how measures make a concept.

![Morphological Design Flowchart](image)

**Figure 4** Morphological design flowchart
3.1. Consumer background

First of all the user must define their background, meaning how they live and use energy in their home, the type of home they own and where they live. Based on this data an estimation can be made on which improvements the building already has and how the user’s energy usage will be impacted by the measures they can choose later on. Below a table can be seen with the data needed as a basis.

Table 2 Consumer background information

<table>
<thead>
<tr>
<th>Residents:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of persons:</td>
</tr>
<tr>
<td>Electricity usage:</td>
</tr>
<tr>
<td>High rate</td>
</tr>
<tr>
<td>Low rate</td>
</tr>
<tr>
<td>Gas usage:</td>
</tr>
<tr>
<td>Budget:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction year:</td>
</tr>
<tr>
<td>Surface area:</td>
</tr>
<tr>
<td>Building main material:</td>
</tr>
<tr>
<td>Building style:</td>
</tr>
<tr>
<td>Orientation:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country:</td>
</tr>
<tr>
<td>City:</td>
</tr>
<tr>
<td>Climate:</td>
</tr>
<tr>
<td>Renovation strategy:</td>
</tr>
</tbody>
</table>
3.2. Renovation strategies

Part of the consumer background is the renovation strategy. This strategy defines what the users want to do with their home. The whole list of renovation strategies, with their descriptions, is shown in the glossary of terms.

The strategies are a guideline for the consumer. They aid them with choosing what type of renovation fits them. It also serves as a guideline between the consumer and the architect, to make the communication between the two parties easier.

For instance someone who wants to renovate but does not want any extra maintenance afterwards, she/he chooses the low maintenance strategy. The low maintenance strategy shows all options she/he could take to renovate, insulation, glazing, ventilation, etc. Options demand more maintenance in the long run are disadvised, for instance balanced ventilation compared with exhaust-only mechanical ventilation.

Another example, someone wants to renovate to a passive house level. She/he would choose the passive house strategy. The best insulation, triple glazing, balanced ventilation with heat recovery are advised to reach this strategy.

3.3. Building improvements

Based on the type of building, the year of construction, the building style, etc. an estimation is made about the current building state, how well it is insulated, how airtight it is, etc. The resident may select any improvements already added to the building in this step. This, partly, forms the base for the selectable measures.

Consider for example a building from 1955 with cavity wall insulation and double glass windows. By default, the tool assumes that the building has no (cavity wall) insulation and it has single glass windows. In this step the user fills in that they already have cavity wall insulation and that all the windows have been upgraded from single glazing to double glazing.

![Figure 5 Visual representation of insulation thickness Source: verbeterjehuis.nl](image-url)
3.4. Defining possible improvements

Based on the information filled in previously, possible improvements to the building can be shown. Based on the user information and the building state advice is given on which measures are possible or advised.

Table 3 Strategy and measures compatibility list

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Low maintenance</th>
<th>Ecology</th>
<th>Economical</th>
<th>Passive house</th>
<th>Lifespan</th>
<th>Trias energetica</th>
<th>Comfort</th>
<th>Low energy consumption</th>
<th>Integral</th>
<th>All-electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc 3,5/4,5/6,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rc 5,0/6,0/8,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rc 6,0/8,0/10,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airtightness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double glazing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double glazing with coating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triple glazing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust-only mechanical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply-only mechanical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balanced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balanced with heat recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.5. Choosing measures

When the background data is collected and the possible measures have been defined, the user will be able to choose different measures from the list. For example, the user has a house with crawlspace but without insulation. For the complete list of measures, see ‘Measures.xlsx’. The user will be able to choose from the options as shown below.

Table 4 Visual representation of floor insulation options

<table>
<thead>
<tr>
<th>Stone floor with insulation beneath the floor</th>
<th>Stone floor with insulation under the floor</th>
<th>Stone floor with cavity and insulation</th>
</tr>
</thead>
</table>

Another representation of such a choice is shown below. First the user chooses how she/he wants to insulate, next she/he chooses the material.

Based on the choices and the background data an estimation of the selected renovation measures can be made, including costs, energy savings, payback period, etc.

Materials:
- Blown mineral fibre.
- Polystyrene beads or granules.
- Urea formaldehyde foam.

Figure 6 Visual representation of insulation choice
3.6. Creating a concept
A concept is a collection of measures that fit the strategy and the building. At this stage, the user chooses the measures that she/he wants to implement in her/his home. When she/he has all the measures she/he wants a concept is created, as shown below.

![Visual representation of three different concepts](image)

**Figure 7 Visual representation of three different concepts**

3.6.1. Pre-concept
A pre-concept is a selection of measures that are part of a concept, which in turn is part of the final concept. Meaning, a pre-concept is a building extension that contains several different types of measures. A living room extension, for example, has insulation, windows, a roof and a floor that have to fit the rest of the building. The living room extension forms a pre-concept, as it is not part of the existing building, with its own measures. Another example, is a nearly zero energy module. This module contains a ventilation system, a heating system, a boiler and an inverter. This is a complete package to replace all building services in one go, thus forming a pre-concept. Shown below is the morphological design with the pre-concept implemented as building expansions.

![Pre-concept diagram](image)

**Figure 8 Pre-concept diagram**
3.7. How to define a measure

The following part explains how to add a measure to the list of measures for the project TripleA-reno. A measure is one of the options a consumer/end-user can choose from. The referenced documents can be found in the annex.

1. Add measure to corresponding category

Open the ‘Measures.xlsx’ file and fill in the fields shown above (also described below). In this step you add the name of the measure, where the measure belongs in the whole and a short description, max 180 words, of what the measure is.
Table 5 Description of the Excel fields to add measures

<table>
<thead>
<tr>
<th>Field</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of the measure, for instance: Cavity wall insulation, HR++ glazing, HR+++ glazing, Exhaust-only mechanical ventilation, etc.</td>
</tr>
<tr>
<td>Measure type</td>
<td>To which category the measure belongs, the building envelope or installations.</td>
</tr>
<tr>
<td>Measure subtype</td>
<td>To which category the measure belongs, dependent on the previously selected measure.</td>
</tr>
<tr>
<td>Description</td>
<td>A short description of the measure with a max of 180 words.</td>
</tr>
<tr>
<td>Cost indication</td>
<td>An indication of the costs for the measure per square meter surface area or, if it is an installation, the full price to implement the measure.</td>
</tr>
</tbody>
</table>

2. Add usable materials or types

In the same file as step one, add the material that can be used with this measure. Only add 1 material in each row, this will allow us to easily convert the excel into a database. So if there is more than one material, create several rows for one measure. Don’t forget to fill in the cells mentioned in step 1 for each of these rows.

Usable materials:
- Blown mineral fibre
- Polystyrene beads or granules
- Urea formaldehyde foam
- -

Figure 10 Example from the measures Excel list
3. Add important side notes
In the same file as step one, add any important side notes to the measure, think about limitations, advice, etc.

4. Add picture/drawing
In the same file as step one, add a filename of a picture to the measure. If there is more than one material, create several rows for one measure and add a filename of a picture for each material. These pictures have to be related to the used material. Don’t forget to attach the picture or drawing or send them to us by email.

5. Add ETIM classification
In the same file as step one, add the corresponding ETIM classification code. The code can be found here:

https://prod.etim-international.com/class

Search for the product in the search bar, for instance if you want roof insulation you search for ‘insulation’ several options are shown and you pick the most likely. In this case that would be Insulation blanket-/board. Add the code of this ETIM classification, EC010879, to the Excel file.

ETIM (European Technical Information Model) is an international product classification for the building services, construction and maritime sector.

ETIM product classification is a classification of trade products in different classes, where the product properties are recorded in the class. This is done through article classes, characteristics, units and limit values that are described in the standard.

A characteristic describes a property of a product, such as the type of material it is made of, the size or colour of a product. The product classification prevents speech confusion and mistakes, and makes it possible to identify the product and trade data in a standard way and exchange them between the various parties.
6. Add measure in strategy list

Open the ‘Strategy & improvements.xlsx’ file. Add the in step 1 defined measure to the appropriate row, for instance HR+++ glazing needs to be added to the windows section. To insert a row, pick a cell or row that’s not the header row, and right-click. Pick insert from the list and a new row will be added in that section. Add the measure name and fill in the colour coding as depicted by the legend.

Table 6 Strategy and measures compatibility list

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Low maintenance</th>
<th>Ecology</th>
<th>Economical</th>
<th>Passive House</th>
<th>Lifespan</th>
<th>Trias energetica</th>
<th>Comfort</th>
<th>Low energy consumption</th>
<th>Integral</th>
<th>All-electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc 3,5/4,5/6,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rc 5,0/6,0/8,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rc 6,0/8,0/10,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Add measure in compatibility list

Open the ‘Compatibility.xlsx’ file. Add the new measure to the appropriate row and column, for instance HR+++ glazing needs to be added to the windows section. To insert a row/column, pick a cell or row/column that is not the header row, and right-click. Pick insert from the list and a new row/column can be added in that section. Add the measure name in the row and column and fill in the colour coding as depicted by the legend.

Table 7 Measures compatibility list

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Rc 3,5/4,5/6,0</th>
<th>Rc 5,0/6,0/8,0</th>
<th>Rc 6,0/8,0/10,0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc 3,5/4,5/6,0</td>
<td>A</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Rc 5,0/6,0/8,0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rc 6,0/8,0/10,0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Windows</th>
<th>Double glazing</th>
<th>Double glazing with coating</th>
<th>Triple glazing</th>
<th>Door with double glazing</th>
<th>Door with coated double glazing</th>
<th>Door with triple glazing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ventilation</th>
<th>Exhaust-only mechanical</th>
<th>Supply-only mechanical</th>
<th>Balanced</th>
<th>Balanced with heat recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

This project has received funding from the European Union’s H2020 Framework Programme for Research and Innovation under Grant Agreement No 784972. The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.