



Assistant Building's addition to **Retrofit, Adopt, Cure And Develop the Actual Buildings up to zeRo energy, Activating a market for deep renovation**

DELIVERABLE 2.2

TECHNICAL TOOLKIT - preliminary report – M10

LEAD BENEFICIARY:

RENESCO and OTB

OTHER BENEFICIARIES:

ALMA MATER STUDIORUM University of Bologna (**UNIBO**)
D'APPOLONIA (**DAPP**)
National and Kapodistrian University of Athens (**UOA**)
Foundation for Development, Innovation and Technology (**KIM**)
CECODHAS Housing Europe (**CECODHAS**)
Architects' Council of Europe (**ACE**)
ICLEI European Secretariat (**ICLEI**)
Ecuba S.r.l. (**ECUBA**)
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Introduction

The expansion of the deep retrofit market will require the development of commonly agreed, tested and accepted standard process, which will increase the chance of successful replication. In this context, the EU-funded ABRACADABRA project develops three toolkits: a technical, a regulatory and a financial one. This document is an interim outline of the development of the technical toolkit (TTK), which provides a guide and outline process for relevant stakeholders to understand, assess and implement the technical assessment required for the deployment of successful building renovation projects. This toolkit includes an integrated and simplified energy model (SEM) for energy-economic analysis for non-experts, and also for experts that require a short-time for input data and calculations.

In order to make a reliable technical toolkit the development process includes the selection of case studies and a comparison of at least 5 different scenarios for each of these case studies, based on energy and construction costs and on the outputs of the financial model. The impacts of different regulatory incentives and/or barriers also are introduced in the calculation. The cross-geographical approach is essential to ensure that the same methodology is applied in different contexts. To calculate the business performance of deep energy renovations with Adores (volume extensions), this model will be used to support the financial toolkit, which will be developed later in the project.

During the first 10 months of the ABRACADABRA project two rounds of national stakeholders' meetings have been held in the project partner regions (Italy - IT, Norway - NO, Latvia - LV, Bulgaria - BG, Romania - RO, Greece - GR, The Netherlands - NL). The second round aimed at gathering feedback and other ideas about the technical toolkit from the stakeholders (notably construction companies, professionals, private owners and coops). After the second round of national meetings a webinar was held, where the ideas concerning the technical toolkit were presented and shared amongst the partners.

The technical toolkit was prepared under task 2.4, the main responsibility of which lie with the RENESCO in the framework of work package 2, which is led by RENESCO in collaboration with TU Delft (hereafter OTB). The nZEB Toolkits and Policy recommendations tasks of the project (WP2) will run from month 2 to month 15. The toolkits will be used as guidelines and roadmaps to overcome existing limitations and barriers, to promote technical solutions and select the more appropriate financial and economic schemes in order to adopt the right procedures.

Technical Toolkit: global set-up

The deep renovation of buildings requires the engagement of multiple stakeholders in the market. As a result there are a number of organisations where this guide may be important, such as:

- Landlords
- Building Owners
- Property managers
- Project originators and developers
- Planning personnel
- Design professionals
- Construction personnel
- Vendors
- Building technology vendors
- Financiers / investors



A Technical Tool kit sub-workgroup is established (UOA, OTB, UNIBO, RENESCO, ECUBA), in which main problems, tasks are discussed in mean time following up the progress of development. Our work is split in two main parallel work streams.

The toolkit is designed in Microsoft Excel. It contains simple stationary calculations model to assess the building performance before and after renovation, with different AdoRE scenarios. The toolkit considers diversity of the apartment blocks in terms of physical building type (geometry), fuel, use, geography, type of ownership and stakeholders. All necessary data is collected in a data collection sheet, where all the physical, technical, climate and other parameters are acquired. During the development we have met the problem to gather bills for energy use as in some countries residents have individual contracts with energy supply companies, therefore as solution technical toolkit does the calculations basing on climatic conditions and only in cases if bills are available we will use this information to validate the model.

By means of the technical toolkit the stakeholders can compare different retrofit scenarios; they can select different options, starting from "STANDARD RENOVATION" up to 4 different "AdoRES" (new Assistant buildings' addition and Renewable Energy Sources) possible scenarios ground volumetric saturation, Top, Aside, Main Facade, and "ASSISTANT BUILDING", in which option a separate building (on the same premises) is added. The schematic scenarios are visualized below in fig.1.

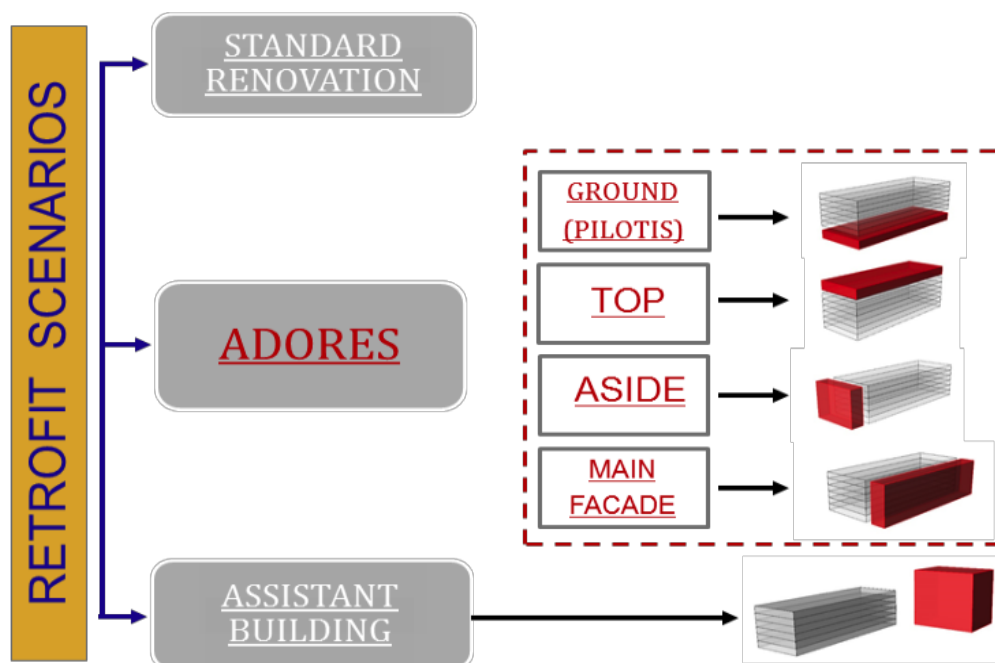


Fig. 1. Schematic representation of the different scenarios

In relation to standard renovation, to take into account the large variations in the climatic conditions of the targeted regions' locations and the different components of existing buildings, the working team has been developed a technical template with pre-defined minimum threshold values for heat losses through envelope and cooling need. The identification of pre-defined U-values is relevant to all possible solutions, choices and techniques for all scenarios. Partners in charge of feasibility studies will describe materials, geometrical/dimensional features for each material, thickness of insulation layers, systems' improvements, and any other necessary solution to reach defined standard.

During the weekly meetings the working team have discussed the implementation of a model usable for all case studies. There are many commercially available applications, yet few of them are available for free. Thus, we decided to develop a Simplified Energy Model, which is going to be validated with current national models to avoid discrepancies larger than 10-15%. The energy model calculations are based on ISO 13790 standard.

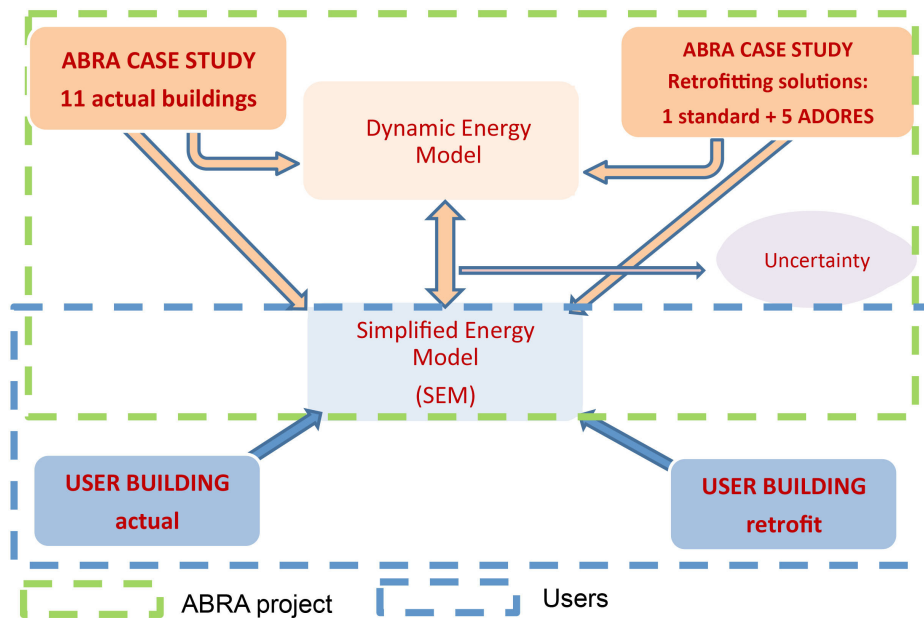


Fig. 2. Schematic representation of the proposed validation scheme

Fig. 2 visualizes the ABRA validation scheme and the borders for ABRACADABRA partners and for external users. The main focus is on SEM, which is tested with 11 cases studies, and then the results are compared with national software and dynamic energy model (Energy Plus). These complex validations are necessary to check weaknesses and make SEM reliable and reach the confident level of uncertainty to use the model for AdoRe scenarios analysis.

Working plan

In order to successfully develop the Technical Toolkit we arranged a working group with the partners **RENESCO**, **OTB**, **UNIBO** and **UOA**, which discusses, on a weekly basis, the progress and the possible questions or problems that appeared during the development stages. Our work is split in two parallel work streams:

The first work stream takes care of the technical feasibility of the implementation of ADORES. The case studies will be drawn in SketchUp and afterwards analysed with energy simulation program Energy Plus. At the end of January, we have fully analyzed two case studies (a Greek and an Italian one), each with five scenarios for volume extension, according to the following scenarios:

- scenario 1: standard retrofit (without any extension);
- scenario 2: ground piles;
- scenario 3: façade extension;
- scenario 4: rooftop extension;
- scenario 5: sideward extension;
- scenario 6: construction of an 'assistant building'.

Next to these scenarios, a scenario 0 has been defined to denote the existing state.

The second work stream focuses on the further development of the SEM. Firstly, with SEM the preliminary energy assessment of the building "as built" is done. Secondly, standard retrofit options and related costs for energy savings are determined and inserted in SEM. In order to validate the model, its outcomes have been compared with national calculation programs.

The Technical Toolkit will be improved and upgraded during the whole project; so far we have set step-by-step targets till the end of January 2017. In this period, two state case studies, one from Italy and one from Greece are analysed. The steps in the development of the SEM are included in the following table (table n 1).

NOVEMBER		RESPONSIBLE
8 th November	"AS BUILT"national case study calculates have to be done	EVERYONE
11 th November	RENESCO will share 2 scenarios packages for standard retrofit (windows, doors, insulation material type, thickness etc.)	RENESCO
14 th November	For all case studies with use of national softwares standard retrofit is calculated	EVERYONE
	Results are filled in common word template	EVERYONE
21 th November	Define the 5 different scenarios milestone	UNIBO
30 th November	UNIBO provides the Greek case study sketch up model for UOA which runs OpenStudio for energy analysis with Energy Plus	UNIBO
	SEM calculation model is improved with 1 st STEP - Plant calculation and all heat loss consideration	RENESCO (supported by UNIBO/OTB)
	Improve data collection sheet and interconnect it with Technical Toolkit	RENESCO
DECEMBER		
20 th December	SEM calculation model improved with 2 nd STEP - Add standard retrofit calculation	OTB
	UOA delivers the energy results for the 5 scenarios on the Greek case study	UOA
	Collected all available information which is needed for successful case study development (Real costs, taxation scheme, energy data)	EVERYONE
	UNIBO provides the Italian case study sketch up model for UOA which runs OpenStudio for energy analysis with Energy Plus	UNIBO
JANUARY		
16 th January	SEM calculation model is improved with 3 rd STEP - Summer condition calculation	RENESCO (supported by UNIBO/OTB)
23 th January	UOA delivers the energy results for the 5 scenarios on the Italian case study	UOA
30 th January	Two feasibility studies each of case have 5 AdoRe scenarios	RENESCO/OTB

Table 3. Step-by-step targets for Technical Toolkit Implementation

One of the steps of TTK development for technical workgroup was to do energy analysis for case studies by using national software's and in mean time validates SEM. The national software's were used to determine reference points on which SEM a calculation is going to be based. The validation consists of key factor analysis as global heat transfer coefficient, heating energy needs, total yearly primary energy needs and others. Despite the fact that verification process is still in progress, so far from the seven case study analysis we have concluded the following:


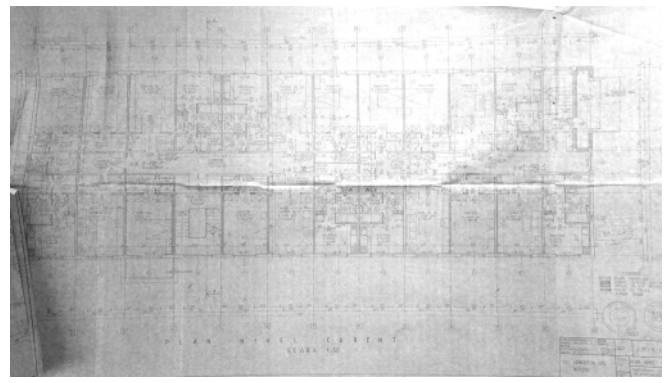


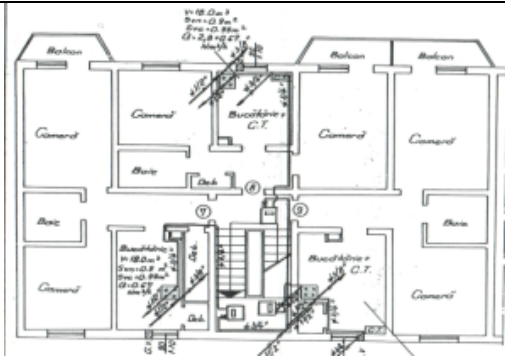
- The results from case study analysis shows that Simplified Energy Model (SEM) results for energy need are a bit higher than the results of the National software's (NS). One of the reasons of this difference is the assumed level of internal and solar gains. While the analysis were carried out the SEM didn't considered any internal gains from hot water system also precise energy amount from internal processes and amount of people living in the building can vary and significantly affect results.
- The second aspect is based on building heat accumulation or thermal mass which is a property of the mass of a building which enables it to store heat, providing heat momentum against temperature fluctuations. For example, when outside temperature are fluctuating through the day a large thermal mass with the insulated portion of a house can serve to the daily temperature fluctuations. This process allows to be heated or cooled relatively separate from the outside or even just retain the occupant's thermal energy longer. The thermal mass in SEM was used as constant which lead to deviations.
- Other important cause of the remarkable difference between SEM and NS (~15-20%) is given by the geometrical and volumetric assumptions. The SEM version only considers rectangular shaped buildings, where external dimensions are used to calculate as percentage from area and volume.
- Despite all the SEM weaknesses, some of the energy calculated parameters are very close between them in the two calculation tools; for example global heat transfer coefficient differs in range from 3-10%.


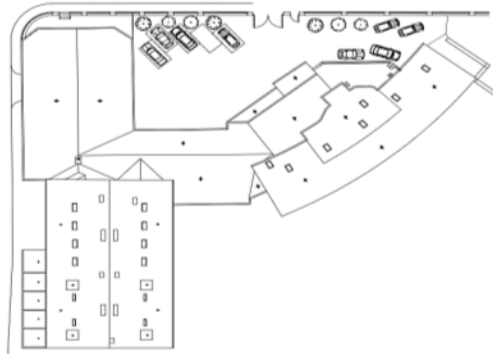




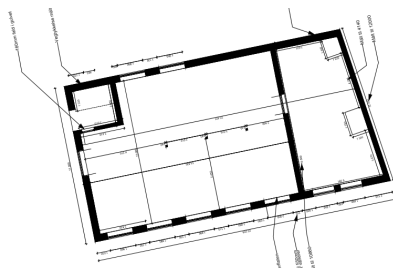


Case studies



We have chosen real case studies to evaluate different scenarios for AdoRe implementation in different types of building/contexts. The study will include the comparison of at least 5 different scenarios for each case study, based on energy and construction costs and on the outputs of the financial model. The case studies are necessary to test the feasibility but they would not necessarily results in the construction sites. Indeed they have been selected as in these buildings were strong interest on financing the intervention. Below are table of our case studies, each with a short description.

LOCATION: ROMANIA , BRASOV, 42, Lanii St.	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION	
1979	
FAÇADE <i>Masonry (brick and block work) cavity wall</i>	
ADDITION SURFACE <i>35 apartments with tot. conditioned area:</i> <i>2327.8 m²</i>	
DESCRIPTION <i>The building is owned by municipality of Brasov, where most of the apartments are rented. There is not available additional area around building. Each apartment has individual gas connection which makes it difficult to gather energy bills. Some of the apartment owners have insulated their owned outside wall to minimize heat losses.</i>	

LOCATION: ROMANIA , BRASOV, 82A, Calea Bucuresti St.	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION 1979	
FAÇADE <i>Masonry (brick and block work) cavity wall</i>	
ADDITION SURFACE <i>20 apartments with tot. conditioned area:</i> 1158 m ²	
DESCRIPTION <i>The building is owned by residents of Brasov. First floor is used for commercial uses. There is not available additional area around building. Each apartment has individual gas connection which makes it difficult to gather energy bills. This is one of the first buildings which used municipality support and as pilot project refurbished several years ago.</i>	

LOCATION: SPAIN , COMUNIDAD AUTONOMA DE ARAGÓN	
BUILDING TYPE: <i>Hotel by office, retail and dwellings.</i>	
YEAR OF CONSTRUCTION	
1958	
FAÇADE	
-	
ADDITION SURFACE	
60 apartments with tot. conditioned area 1638 m ²	
DESCRIPTION	
One of the biggest and complex shaped buildings among case studies. The building is used for different purposes for example: offices, retail and as living place.	
LOCATION: NORWAY , Støperigata 4-6, 4014 Stavanger	
BUILDING TYPE: <i>Empty (old factory)</i>	
YEAR OF CONSTRUCTION	
1912	
FAÇADE	
Brick wall with plaster	
ADDITION SURFACE	

<p>DESCRIPTION</p> <p><i>The building has not been used for several years as it originally was constructed for manufacturing purposes. Now the constructions works are held in order to make it usable for living.</i></p>	
<p>LOCATION: THE NETHERLANDS, Zeesluisweg, The Hague</p>	
<p>BUILDING TYPE: <i>Apartment building with 1 bar, 1 kindergarten and dwellings on the ground floor, and only dwellings on the 1st and 2nd floor</i></p>	
<p>YEAR OF CONSTRUCTION</p> <p>1926</p>	
<p>FAÇADE</p> <p><i>Masonry (brick and block work) cavity wall</i></p>	
<p>ADDITION SURFACE</p> <p><i>16 apartments with tot.conditioned area 1300 m²</i></p>	
<p>DESCRIPTION</p> <p><i>The current building consists of two blocks, separated by a gate. The building mainly is used for dwelling purpose and one part for kindergarten and bar. Extra dwellings (indicated in yellow) are planned above a part of the existing building and behinds this building.</i></p>	

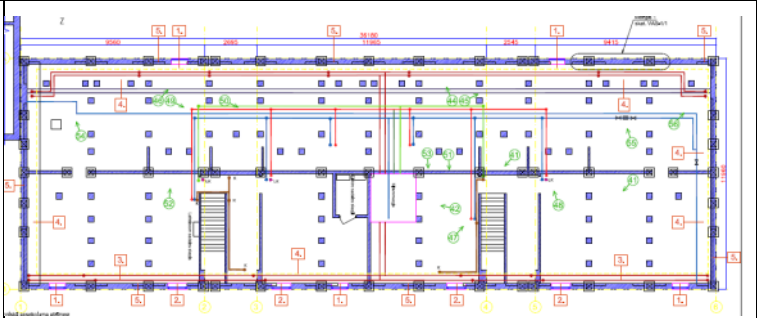
LOCATION: GREECE , Peristeri, Athens, Greece	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION 1970	
FAÇADE <i>Gypsum plaster with bricks</i>	
ADDITION SURFACE <i>15 apartments with tot.conditioned area 934 m²</i>	
DESCRIPTION <i>Residential building which is 100% owned by residents. This case study differs from other case studies as it has ground piles.</i>	

LOCATION: BULGARIA , Ruse, "Mitropolit Grigorij" 6 str.	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION 1969	
FAÇADE <i>Concrete panels with plaster cover</i>	
ADDITION SURFACE <i>60 apartments with tot.conditioned area 3737 m²</i>	
DESCRIPTION <i>Apartment building where same as in Romania residents try avoid heat losses and they insulate their owned outside wall.</i>	
LOCATION: BULGARIA , Ruse, 11 "Okolchica" str.	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION 1966	
FAÇADE <i>Concrete panels with plaster cover</i>	
ADDITION SURFACE <i>72 apartments with tot.conditioned area 49830 m²</i>	
DESCRIPTION <i>Bulgarian case studies have benefit for further analysis as energy audits have been performed.</i>	

LOCATION: LATVIA , Berzupes 23	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION 1970	
FAÇADE - Expanded clay panels and reinforced concrete panels - Between windows and stairwells in places where is no panel wall, it is designed to fill with a wooden finish 50mm on the outside 100mm mineral filler and painted plasterboard sheets inside.	
ADDITION SURFACE 60 apartments with tot. conditioned area 2587 m ²	
DESCRIPTION Residential building which is 100% owned by residents. Since construction the building hasn't have any major improvements except window change. The balcony lifespan is endangered and they may fall at any time. Heat is supplied by district heating system.	
LOCATION: LATVIA , Lielupes 62	
BUILDING TYPE: <i>Apartment building</i>	
YEAR OF CONSTRUCTION 1978	
FAÇADE - Expanded clay panels and reinforced concrete panels. - Between windows and stairwells in places where is no panel wall, it is designed to fill with a wooden finish on the outside 100mm mineral filler and painted plasterboard sheets inside	
ADDITION SURFACE 30 apartments with tot. conditioned area 1654,3 m ²	

DESCRIPTION

Residential building which is 100% owned by residents. Since construction the building hasn't have any major improvements except window change. Heat is supplied by district heating system.



<p>LOCATION: ITALY, Reggio Emilia, viale Magenta, 18-20</p>	
<p>BUILDING TYPE: <i>Apartment building</i></p>	
<p>YEAR OF CONSTRUCTION</p> <p>1936</p>	
<p>FAÇADE</p> <p><i>Double layer brick wall</i></p>	
<p>ADDITION SURFACE</p> <p><i>50 apartments with tot.conditioned area 2870 m²</i></p>	
<p>DESCRIPTION</p> <p><i>Multifamily building which 68% is owned by municipality and the rest by private owners.</i></p>	

Suggestions made by stakeholders and other external participants

As mentioned in the introduction, stakeholders' meetings were held in several partner countries to collect suggestions for improvement of the technical toolkit. Also, on October 24th, 2016, a webinar was held, in which various parts and aspects of the ABRACADABRA project, including the technical toolkit, were explained. This section goes into the remarks and suggestions that were made in these meetings. A distinction is made between general, methodical remarks (regarding the parameters and the output of the toolkit) and technical remarks (regarding the execution of renovations).

General remarks

Participants generally see a high action potential for energy renovations in combination with volume extensions, especially when the respective stock approaches the end of its life cycle, which necessitates interventions for life extension. Opportunities are seen in the use of alternative energy sources, in an increase of the aesthetic value and in industrialization of innovative products and in modernization of the facades, which can also contribute to the aesthetic value. There are also opportunities in connections energy performance improvement not only with volume extension, but also with creating homes for the elderly, a relevant topic in regions with an ageing population. In the Netherlands, for example, there are some experiments with additions of bath rooms and/or bed rooms on the ground floor of single-family homes, so that the respective households do not have to move to a nursing home.

There are not many technical constraints for vertical or horizontal extensions, provided that there is sufficient budget. Naturally, one has to cope with the increased ground pressure of the respective buildings. As for vertical extensions, adding of one or two floors can usually be done without special measures in non-seismic areas. In seismic areas (or when more floors are to be added, or when the width of the existing building is narrow in comparison with the height of the extension) several techniques are available to preserve the stability of the building. In example, these techniques may consist in the creation of external structural portals around the existing building to bear the additional extra weight.

There is a high potential for new toolkits in contexts where, to a certain degree, is lacking willingness to invest, and where practical tools can help to overcome uncertainties felt by many potential investors. Several participants express that they prefer an integrated, "holistic" toolkit, which does not only include technical aspects, but (as is foreseen in the project) also other relevant aspects, such as return on investment, cost assessments, risk assessment and even seismic values assessment. Still it must be accompanied by other tools and capable of creating economical and legislative incentives towards public and public actors. The technical toolkit is seen as a useful means, if inserted in a wider context of social knowledge spreading, and user-friendly for a broad understanding.

Methodical remarks

The following methodical remarks have been made.

- The average heat gain value can vary considerably across Europe. In one of the participating countries the value was said to be 6-7 W/m² instead of 4 W/m².
- An important aspect is to avoid counting in unheated areas as basement and attics while calculating the building heat load. On average these premises losses around 10% of supplied heat, which may decrease or increase depending of building type and size.
- The energy model should take into consideration a scenario in which the building can be historical and fall into the category as cultural and historical object, where faced reconstruction with insulation materials is sometimes forbidden.



- In assessing the renewable potential and the benefits for the building, the seasonal efficiency (e.g. COP) needs to be considered which may vary significantly. Some doubts are expressed if all the relevant bioclimatic aspects are considered.
- In the view of some stakeholders, the technical toolkit should not establish and create a definitive number of renovation standards, but should rather collect as many case studies as possible so that all interested parties can search for the most suitable example of intervention (to their scenario), using a smart filtering system.

Technical remarks

The following technical remarks have been made.

- Insulation must be carried out in a way that avoids condensation. This is especially important in historical (listed) buildings.
- If a building is extended, other building regulations may apply for the new building than for the building before the extension. For instance in Latvia, security and emergency requirements for buildings which have more than 3 floors are different from lower buildings (e.g. it must have two escape stairwells instead of one).
- In renovations the rain water drainage system must be taken into account.
- As mentioned above, the load-bearing capacity of the constructions is important and must therefore be checked.
- While constructing extensions around the facade of the building, as loggias and terraces, there may be need for new base construction in case the existing wall construction will not be able to hold additional load.
- Pay attention to geographical orientation.
- Facilitate sustainability in energy generation and energy use (think of e.g. smart grids, storage).
- British law contains a "Right for Light" so that tenders do not build in a way that creates shade on neighbouring buildings. This regulation is also recommendable for other countries. In this context, there is a need for maps indicating solar exposure of buildings, which can help to assess the possibility to realise new additions.



Next steps

Below are overview (in red rectangle) with phases which have to be done till the end of January. All the actions which involve realizing them are described in the sections above. Further, not only the Italian and Greek case studies, but also the Latvian case studies will be analysed with Energy Plus. When the technical toolkit has reached the final stage, we will use it for the remaining case studies. Technical, Financial and Regulatory toolkit will be tested, developed and applied to the first 10 showcase studies distributed in the 8 ABRA target regions to achieve a large-scale impact from the very first phases of the project. Furthermore, during the project, partners and stakeholders in each target region will be in charge of indicating and selecting other promising candidates for 36 further case studies, ensuring the replicability of the strategy. (Task n. 3.4. in WP 3). Fig. 3 illustrates the upcoming phases in the technical toolkit implementation.

INTERACTION AMONG DIFFERENT SOFTWARES FOR SEM							
Phase 4 - PROJECT COMPLETION							
CASE STUDIES	SCENARIOS						
	S0	S1	S2	S3	S4	S5	S...
ITALY	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	e+	ns	e+	e+	e+	e+
GREECE	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	e+	ns	e+	e+	e+	e+
LATVIA	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	e+	ns	e+	e+	e+	e+
THE NETHERLANDS	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	ns					
SPAIN	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	ns					
BULGARIA	SEM	SEM	SEM	SEM	SEM	SEM	SEM
ROMANIA	SEM	SEM	SEM	SEM	SEM	SEM	SEM
NORWAY	SEM	SEM	SEM	SEM	SEM	SEM	SEM
OTHERS...							

INTERACTION AMONG DIFFERENT SOFTWARES FOR SEM							
Phase 5 - BEYOND PROJECT LIFE TIME							
CASE STUDIES	SCENARIOS						
	S0	S1	S2	S3	S4	S5	S...
ITALY	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	e+	ns	e+	e+	e+	e+
GREECE	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	e+	ns	e+	e+	e+	e+
LATVIA	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	e+	ns	e+	e+	e+	e+
THE NETHERLANDS	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	ns					
SPAIN	SEM	SEM	SEM	SEM	SEM	SEM	SEM
	ns	ns					
BULGARIA	SEM	SEM	SEM	SEM	SEM	SEM	SEM
ROMANIA	SEM	SEM	SEM	SEM	SEM	SEM	SEM
NORWAY	SEM	SEM	SEM	SEM	SEM	SEM	SEM
OTHERS...	SEM	SEM	SEM	SEM	SEM	SEM	SEM

ns Simulation run with energy calculation national software
e+ Energy plus simulation with open studio (in static condition simplified simulation regime)
SEM ABRACADABRA Simplified Energy Model

Fig. 3. Upcoming phases in the technical toolkit implementation

After January 2017, the toolkit will be discussed in the stakeholders' meetings as proposed in WP3 of the DoW. This is very important so that we can gather real time feedback during the development stages and the technical toolkit is usable for involved stakeholders.

In addition, a connection will be made between the technical toolkit on the one hand and the regulatory toolkit and the financial toolkit on the other. The Toolkits will address the following target groups: EU, national and local policy makers in the target countries as well as housing associations and property owners' associations at EU level. UNIBO and financial partners (KIM, ENERGY PRO, MONTE PASCHI) will select or develop the most suitable feasibility study tool for the rapid evaluation of add-ons options, using different calculation approaches: usual financial parameters, life cycle cost (LCC) and taking into account also using previously developed partners' Toolkits.

The technical toolkit, financial toolkit and regulatory toolkit intend to provide guidelines for stakeholders in implementing AdoRes with energy renovations. As there is little knowledge on how to realize nZEB buildings, these guidelines will serve as helpful means in the renovation process.