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**SEMANCO Semantic Tools for Carbon Reduction in Urban Planning**

# Deliverable 8.2
# Implementation Success Indicators

**Revision:** 10
**Due date:** 2013-04-30 (m19)
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| Dissemination level | | |
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| PU | Public | X |
| PP | Restricted to other program participants (including the Commission Services) | |
| RE | Restricted to a group specified by the consortium (including the Commission Services) | |
| CO | Confidential, only for members of the consortium (including the Commission Services) | |

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| **No & name** | **D8.2 Implementation Success Indicators** | | | | |
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| **Editor** | Gonzalo Gamboa (CIMNE) | | | | |

| | |
|---|---|
| **DoW** | **Task description**<br>Action involving the local actors and stakeholders and collecting data and information to document the process. Regular contact between the partners involved in the three case studies will facilitate mutual learning through problem sharing and inspiration.<br>Coordination of tasks will enable a common database of information to be developed identifying key factors to be contemplated in the ontologies. This task will involve the iterative prototyping of the tools developed in WP5 and as such will require aerial photogrammetry of at least one of the case study areas and will therefore utilise the work subcontracted as detailed in section B2.4.1.The work will involve implementation of the plans (D8.1) exploiting the data and information output from the project in order to focus stakeholders' attention and learn from them what works best in terms of presentation, visualisation and emphasis in order to raise motivation regarding achieving $CO_2$ reductions by behavioural changes to accompany investments in energy performance improvements. The CO2 reduction strategies implemented will have a positive community impact. To ensure this existing community and social impact assessment practices using indicators of quality of life will be employed in a community impact assessment process as part of WP8. These cross-cutting indicators will include the human environment, such as: community cohesion, impacts on housing and employment, cultural resources, aesthetic values, and the availability or access to public facilities and services.<br>**Deliverable description**<br>Implementation success indicators: Detailed common information database structure with all necessary specifications (data ranges, types, reference/benchmarking values, min and max values, etc) to enable subsequent analysis and exploitation of the available data in each case study and to ensure comparability between sites and with other projects. |
| **Comments** | |

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# EXECUTIVE SUMMARY

One of the main features characterizing SEMANCO is that different lines of work are highly interrelated in such a way that the work carried out in some lines depends on the outcomes of another one: capturing users' requirements for tools; developing, testing and evaluating tools while giving feedback to technological development in order to continue either improving or developing tools. Because of this, the implementation of the tools developed in the project will follow three different cycles, each one corresponding to a different stage of the project development.

The purpose of *Task 8.2 Implementation* is to implement the first stage of the plan outlined in *D8.1 Implementation plan*. That is, to apply existing data and tools in real scenarios with actual users, following the **Use case** methodology developed within the project (Madrazo et al 2012). This methodology is used to identify the most important strategic goals regarding carbon reduction in urban settings and the methods and tools required to achieve those goals. A Use case is made up of a series of **Activities**, which are specific actions which have to be performed to fulfil a task within the Use case. Once the set of activities has been identified, tools to support them will be either selected among the available tools or newly developed. These tools will subsequently be integrated to produce the *SEMANCO integrated platform*[1].

The implementation of the use case methodology took place in three locations: Newcastle (UK), North Harbour (Denmark) and Manresa (Spain). Due to the wide diversity of aims, available data and tools across case studies, a different use case has been implemented in each location. However, in general, the three use cases pursue the same objective; namely, *to calculate the energy consumption, $CO_2$ emissions, costs and /or socio-economic benefits of an urban plan for a new or existing development.*

In this first implementation cycle of the use cases, partners in charge of demonstration scenarios have performed most of the activities using neither the Semantic Energy Information System (SEIF) nor the SEMANCO integrated platform since this is currently under development[2]. What has actually been implemented is the use case methodology in each case study. Thus, domain experts and other stakeholders have gathered and integrated data, entered data to simulation models and calculated the performance indicators following the procedures established in the use case. Therefore, by implementing the corresponding use cases of the three demonstration scenarios, it has been possible to test and update the flows of data and activities outlined in D8.1.

This deliverable summarizes several months of work within Task 8.2. In this document, the reader will find **a description of the baseline framework** of each demonstration scenario, the objectives of the implemented use cases and **a description** of **the implementation of use cases and activities** using existing or prototype tools. In addition, the extent to which those activities meet the previously identified objectives of each use case has been evaluated. Then, the report includes **feedback to the technological development** and **defines the issues to be**

[1] The SEMANCO integrated platform is a web-based platform to provide access to data and tools developed in WP5, and to link them to the semantic framework developed in WP4. The integrated platform enables ***a)*** assessment and visualization of energy related data and ***b)*** interventions aimed to improve the existing baselines (for more information see Chapter 9 Glossary).

[2] This issue is almost fully applicable to North Harbour and Manresa case studies. In the case of Newcastle case study, the partner in charge of the demonstration scenario is also part of the technological development strand of the project. Therefore, they take part in the definition of requirements, the development tools and their implementation. This fact entails that the use case methodology is not followed as in the other cases (Manresa and North Harbour), where requirement should be communicated to different people for their development.

**implemented** in the second implementation round. Chapters 3, 4 and 5 present the empirical work conducted in each demonstration scenario. The approach adopted enables comparisons to be drawn between the work conducted in each case study area and common conclusions.

The work conducted in each case study has been the following:

**- Newcastle.** The first implementation round has been successful in calculating the energy efficiency performance, the $CO_2$ emissions and SAP rate of existing, single dwellings using a prototype calculation tool which has since been implemented on the SEMANCO platform. Partners in charge of Newcastle demonstration scenario have delivered several data sources that have been modelled and can be visualized through the 3D maps..

In the next implementation round, users will use the integrated platform to perform the following activities: to determine technical parameters of buildings, to model the energy performance of individual buildings, to calculate operational costs and the potential benefits of energy efficient interventions and to decide on which energy efficiency interventions should be made.

**- North Harbour**. It has been possible to define a baseline of specific energy demands for a set of building typologies. Also, partners in charge of implementation have developed an excel-based tool. By means of this tool, it has been possible to calculate the expected (i.e. calculated) energy performance and $CO_2$ emissions of the target urban area, for the next 10 years. The remaining tasks include calculating operational and maintenance costs, and the delivery of geometric data to improve the 3D model.

Also, in the second implementation round users will use the integrated platform to perform the following activities: to define supply alternatives, to calculate the energy supply system, to compare different alternatives and to determine the total energy demand and demand distribution.

**- Manresa**. The work carried out in this first implementation stage encompasses the manual drawing of building geometries, the estimation of the electricity consumption of buildings, entering the technical and occupation parameters of buildings in the software URSOS (the calculation model), and the calculation of heating and cooling demand using this software and the $CO_2$ emissions.

**Common development**

In practical terms, this deliverable is expected to provide a "detailed common information database structure with all necessary specifications (data ranges, types, reference/benchmarking values, min and max values) to enable subsequent analysis and exploitation of the available data in each case study and to ensure comparability between sites and with other projects". At this stage of the project, the baseline values of some performance indicators[3] in specific urban areas are presented (See Appendix B). Also, it provides a preliminary assessment of the similarities and differences between the sets of performance indicators identified for each of the case study areas (See Table 9). According to the information presented in the table, indicators related to energy demand and $CO_2$ emissions are very similar across case studies. Economic issues are considered from the supply side in the North Harbour demonstration scenario, and from the consumption perspective in the other two cases. Not all case studies deal with energy certification issues and there is still a lack of cross-cutting quality of life indicators across cases, with few exception of Newcastle.

It is worth mentioning that electricity consumption from devices used within the household is a result of very rough estimations in the three demonstration scenarios. One way of improving this issue is to use the tools and services developed within *Task 5.2 Energy analysis, and*

[3] A sub-set of indicators from those defined in D2.2

*optimization and strategic decision tools* in order to estimate electricity consumption using data mining techniques

**Feedback to technological development**

In sections 3.3, 4.3 and 5.3, and as a response to knowledge gained during implementation, each of the partners in charge of implementation for a given case study area indicate where the corresponding use case must be updated. This has involved both updating some of the existing activity forms and, where required, creating new activity forms.

Also, the partners in charge of implementation provide a preliminary indication of whether each activity is performed in the assessment and visualization environment of the integrated platform, or in its intervention environment. This work will be completed within the *integration procedure* of Task 5.4.

This deliverable represents a first step in the implementation and testing of the use case methodology across different country settings. In further implementation rounds, we will be able to assess the usefulness of the methodology in translating a set of user requirements into a set of tools integrated within a semantic framework.

**Work to be developed in second implementation round**

The tasks remaining include calculating a more comprehensive set of energy performance indicators and capturing a set of urban planning indicators. Also, users will perform the same activities as in the first round but using the integrated SEMANCO platform. The creation and comparison of alternative urban plans will be considered, as well as the calculation of operational and maintenance costs, and of the potential for solar energy generation.

# 1 INTRODUCTION

## 1.1 Purpose and target group

The objective of the SEMANCO project is to design, implement and evaluate a semantic-based energy information framework and a suite of tools to support energy efficient urban planning. As a result of this process, the SEMANCO project will deliver a set of decision support tools embedded in the *SEMANCO integrated platform*[4].

In pursuing this goal, the project development faces very often with chicken-egg patterns: users and domain experts define the requirements of the tools (*WP6 Enabling Scenarios for Stakeholders*) that are being developed within WP5. Then, it takes place the implementation of the tools in real scenarios and their evaluation against the requirements expressed by actors and users (*WP8 Implementation*). After that, actors and users are consulted again (WP6) in order to further improve or develop tools (WP5 *Integrated Tools*).

In parallel, within this iterative prototyping of the tools, it takes place the identification of both missing data to be modelled within *WP3 Energy Data Modelling* and additional concepts to be included in the ontologies developed in *WP4 Semantic Energy Information Framework*.

In order to deal with the cyclical development process mentioned above, the *implementation*[5] and *demonstration*[6] of the SEMANCO tools has been structured in three rounds, which follow the *use case methodology*. According to *D1.8 Project methodology*, a **Use case** is, in the context of this project, aimed at identifying a strategic goal regarding carbon reduction in urban settings and the methods and tools to achieve it. A Use case is made up of a series of **Activities**, which are specific actions aimed at meeting the objectives of the use case. Use cases and their corresponding activities are expressed in templates, which include the information required in order to translate real requirements into an integrated platform.

Then, the objectives of each implementation round rely upon the state of the project development and can be defined as follows:

The **first implementation round** is about deploying the methodology of use cases and activities, in the real working scenarios. It is about integrating both data from different sources and the tools for evaluating the energy performance of the built environment. By doing so, we capture the requirements of tools and of the technological platform, and feedback the technological development of the project.

The **second implementation round** will be concerned with the integration of data, tools and users according to the requirements detected during the first round. This integration will be performed using the prototype version of the integrated platform. The platform will include

[4] The integrated platform enables ***a)*** the assessment and visualization of energy related data and ***b)*** the consideration of interventions aimed to improve the existing baseline. This platform will provide access to data and the semantic tools developed in Tasks 5.1, 5.3, 5.4 and 5.6 (which include the development of Building stock energy modelling tool, a multicriteria Energy simulation and optimization tool and the implementation of the Integrated platform, respectively). For more details on the SEMANCO integrated platform see the Glossary and the forthcoming deliverables, D5.4 and D5.6.

[5] *Implementation* refers to the process of carrying out the sequence of activities considered in a use case either with external, prototype or integrated tools (depending on the state of project development). It encompasses gathering and integrating data, entering data to simulation models, calculating the performance indicators and visualize results.

[6] *Demonstration* refers to the validation of the SEMANCO decision support tools in terms of their cost effectiveness and capacity to support informed planning decisions that reduce $CO_2$ emissions in the built environment. Demonstration will take place mostly in the last implementation round, when the SEMANCO integrated platform is fully operative.

basic tools which will be tested to evaluate if they meet the requirements. This will provide further feedback for the development of the next version of the platform.

The **third implementation round** will test the functionalities final version of the integrated platform in real demonstration scenarios.

This deliverable summarizes several months of work within *Task 8.2 Implementation*. It describes and evaluates the implementation of the methodology of use cases and activity templates according to what was planned in *D8.1 Implementation plan* and according to the current state of the project development. It reports the outcomes of the first implementation round in the three *demonstration scenarios*[7]. This is done in a project development stage in which the *SEMANCO integrated platform* is still under development and it is not fully operative yet (i.e. there are some tools and prototype tools already integrated in the SEMANCO platform, and there are some other tools waiting for their development and integration).

According to the DoW, *D8.2 Implementation success indicators* is expected to provide a "detailed common information database structure with all necessary specifications (data ranges, types, reference/benchmarking values, min and max values) to enable subsequent analysis and exploitation of the available data in each case study and to ensure comparability between sites and with other projects". In regard to this, this report presents both a list of the set of indicators which will be calculated by the tools of the integrated platform for each of the demonstration scenarios together with a preliminary set of calculated values for some of these indicators.

This provides a preliminary baseline enabling the subsequent analysis and exploitation of the data available within each case study. For instance, this report presents comparison of the set of indicators used in the three demonstration scenarios and a preliminary evaluation of how far it is possible to compare the outcomes of the calculations between the case study sites within SEMANCO.

In summary, this deliverable presents an assessment of how far the tools being developed are, in their current state, able to address the identified problems. Based on that evaluation, feedback to technological development is provided in order to update or incorporate to the integrated platform the functionalities required to perform the activities. In order to do so, the partners in charge of implementation indicate which activity forms should be created and which have to be updated (and in which manner). Afterwards, the same partners shall deliver the updated Activity forms to WP5, with detailed information of the procedure to retrieve data, to perform a calculation or to visualize information. The feedback to technological development will also consider how these data and tools might be best located within the integrated platform. More detailed information on these issues will be communicated within the *integration procedure*[8] of the SEMANCO platform development carried out in WP5.

[7] A **demonstration scenario** refers to the implementation of a use case and its associated activities in a real location (Cipriano et.al. 2012). Despite the fact that it is not possible to *demonstrate* the value of the SEMANCO tools at this stage of the project development, in this report we refer to the implementation of the use cases in Newcastle, North Harbour and Manresa as demonstration scenarios anyway.

[8] The integration procedure is a cyclical process in which partners responsible of implementation collect the requirements of the integrated platform from actors and users. In order to do so, we use mock-ups of the integrated platform or the prototype tools already integrated in the platform. Then, this information is communicated to partners responsible of Task 5.4 who incorporate those requirements to the SEMANCO platform.

## 1.2 Contribution of partners

The partners contributing to this task are UoT, NEA, Ramboll, FORUM and CIMNE who are in charge of the implementation process in each location. Also, these partners have described of the implementation process in each demonstration scenario.

The editing of the document has been performed by CIMNE in collaboration with FUNITEC.

Internal reviews of the final deliverable were conducted by POLITO.

## 1.3 Relations to other activities in the project

*Task 8.1 Implementation plan development* was concerned with actions involving the local actors and stakeholders collecting data and information to document the process. These actions are strongly related to *Task 6.1 Defining the problem domain and scope of the tools*, which has dealt with the processes and strategies to capture users' requirements. As Figure 1 shows, the work in WP6 has to do with determining the context (legislation, scales, stakeholders) in which the tools will operate, and with identifying and specifying the range of use cases to which they might be applied. This will ensure that the tools developed are applicable beyond the specific contexts of each case study area. On the other side, WP8 has to do with implementation of specific use cases in each case study, to verify the functionalities and purposes of the developed tools, and to provide feedback to the technological development (WP5).

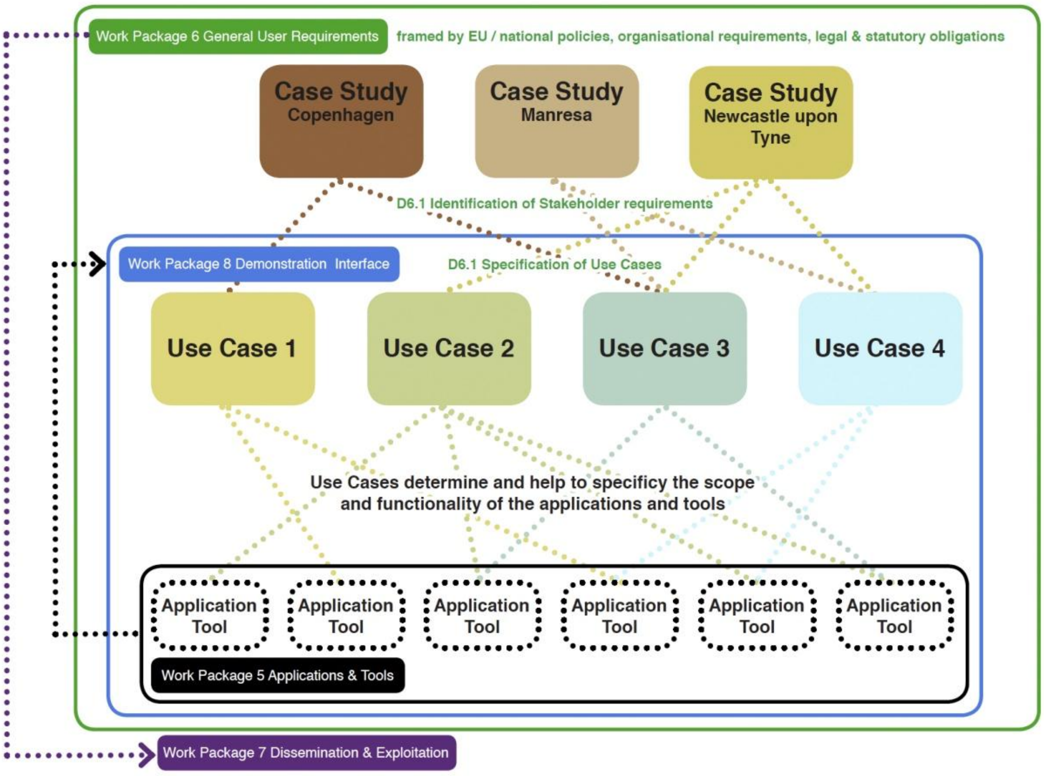


*Figure 1. Relations between WP5,WP6 and WP8, in the project development*

For instance, the selection of the indicators to be calculated in the implementation rounds determines the information which must be presented in the platform. This has direct implications on the process of technological development by an iterative prototyping of the tools (WP5), the data collection and modelling (WP3) and the definition of the ontologies (WP4).

## 1.4 The Structure of the Report

Chapter 2 presents the methodology used to elaborate this report. Chapters 3, 4 and 5 present the description and evaluation the first implementation round in Newcastle, North Harbour and Manresa respectively. Then, chapter 6 presents an analysis of common development issues across case studies and chapter 7 presents the conclusions.

# 2 METHODOLOGY

The work presented in this document is structured and informed by the **Use case** methodology developed for the SEMANCO project (Madrazo et al., 2012). This methodology is used to identify a strategic goal regarding carbon reduction in urban settings (e.g. 'Identification of buildings below/above benchmarks of energy consumption and $CO_2$ emissions in suburban areas') and the methods and tools required to achieve that goal. A Use case is made up of a series of **Activities**, which are specific actions which have to be performed to fulfil a task within a Use case. Then tools are identified and/or developed to perform those activities within the projects integrated platform. In this sense Use cases and their corresponding activities are the main tools used in the project to translate user requirements into the IT development: that is the tools and ontology under development.

A **demonstration scenario** involves the implementation of a use case and its associated activities. Initially a single use case (Use case 10) was selected to be implemented in the first round of the implementations in all the demonstration scenarios. However, due to the wide diversity of aims, available data and tools across case studies, it made more sense to tailor this Use case for each demonstration scenario. However, in general, the three use cases implemented in this first implementation round pursue the same objective; namely, *to calculate the energy consumption, $CO_2$ emissions, costs and /or socio-economic benefits of an urban plan for a new or existing development.*

A common structure has been adopted to present the implementation results in the three case studies, as described in chapters, 3, 4 and 5. The structure is the following:

**Presenting and analysing the empirical research**

*Use case, activities and data flows*

Sections 3.1.1, 4.1.1 and 5.1.1 in the empirical chapters of this report discuss how the use case and activities are tailored to the demonstration scenario conducted in each case study area.

*Implementation process*

Sections 3.1.2, 4.1.2 and 5.1.2 describe the processes carried out in the three demonstration scenarios in each case study area. Following the sequence of activities presented in the previous sections, it explains the process of data collection (geometric, climatic, occupancy and structural parameters, among other) and the input of data into calculation models (e.g. SAP and URSOS software).

*Outcomes of first implementation round*

Sections 3.1.3, 4.1.3 and 5.1.3 present the main results of the first round in each of the three scenarios; that is, the visualization of data in the 3D maps, the definition of the baseline and the calculation of performance indicators in the target urban areas. From this exercise a preliminary set of requirements to inform the technological development of the project were derived.

**Evaluating the first implementation round**

Sections 3.2, 4.2 and 5.2 discuss the evaluation of the implementation processes based on data presented Appendix B. This analysis includes the identification of barriers to successful implementations of the activities in the demonstration scenarios and strategies to overcome these barriers. These strategies will be implemented using updated activity forms or inputs to the integration procedure to develop the SEMANCO platform.

*Evaluation method*

Appendix B contains a set of tables assessing the extent to which the activities planned for the demonstration scenarios in *D8.1 Implementation plan* were conducted in terms of visualization, data modelling and calculations in each case study area.

Visualization and data modelling are mainly implemented by partners working on the technological strands with the project (WP3 and WP5). However, the partners in charge of implementation are responsible for delivering the data to be modelled and visualized. Having this in mind, this report checks whether or not the demonstration scenarios have delivered the required data. Also, the report checks the advances in the development of visualization functionalities of the platform.

Since the SEIF and the integrated platform are not fully developed at this stage of the project, **calculation activities** have been performed by the partners responsible for each demonstration scenario in the case of the case studies in North Harbour and Manresa. In the Newcastle case study demonstration scenario the calculations have been conducted as an integral part of the tool development with the support of stakeholders in the UK case study area and the partner responsible for the demonstration scenario. In all cases the calculations conducted aim to provide a set of relevant performance indicators[9] for each demonstration scenario. Actually, in all cases, domain experts and people in charge of implementation have gathered and integrated data, entered data to simulation models and calculated the performance indicators. Therefore, with the exception of the Newcastle demonstration scenario, there have been almost no actions to involve local actors and stakeholders in this first implementation round.

By implementing the corresponding use cases of the three demonstration scenarios, the partners in charge of implementation have been able to test and evaluate the flows of data and activities outlined in D8.1 and updated prior the implementation. This evaluation is based on the tables in Appendix C, which have the following structure:

- The first column of the tables indicates the activities of the corresponding Use cases of each demonstration scenario
- The second column presents the aims of the implemented activity
- The third column presents the state of implementation after first round.
- Based upon that information, domain experts and people in charge of demonstration scenarios evaluate the degree of fulfilment in each case, which is done using the following scale:
    - Very high – Implementation was able to fully perform the expected task
    - High – Implementation was able to perform most of the expected task
    - Medium – About half of the expected task was carried out
    - Low – Only a small portion of the expected task was carried out
    - None – Expected task was not carried out at all
    - N/A – it is expected to be performed in next rounds
- The fifth column identifies the main drawbacks during the first implementation round in order to further develop a roadmap for the second implementation round and to overcome those problems.

In the main text we summarize the information provided in the tables, evaluate the level of

[9] A sub-set of indicators from those defined in D2.2

implementation achieved and answer the following questions:

1. Have responsible partners delivered the required data to be modelled and visualized?
2. Have we been able to exploit the visualization functionalities of the integrated platform?
3. Have we been able to perform the required activities to calculate performance indicators?
4. To which extent we have been able to calculate the performance indicators?

In *D8.1 Implementation plan*, it was envisaged that questionnaires completed by users and domain experts would be used to evaluate the impact of tools in the demonstration scenarios. However this has not been possible because we overestimated the state of completion of the technological development during the writing of *D8.1 Implementation plan.* This evaluation will instead be conducted in later tasks such as D8.3 and 8.4.

**Feedback to technological development**

Sections 3.3, 4.3 and 5.3 outline the main requirements arising from the first implementation round of the demonstration scenarios. These sections also indicate how the partners responsible for implementation will communicate the calculation procedures to technological development where required[10]. This is much more important in the case of the North Harbour and Manresa case studies than in the case of the Newcastle case study: as in the latter case the implementation and the tool development were largely conducted by the same researchers and UoT and therefore the feedback to technological development occurred during the process of implementation.

In order to do so, the following strategies have been applied:

a) To identify the main requirements arising from each implemented activity. Then, it follows to check whether the corresponding Activity form requires an update. If so, in this report we indicate which Activity forms should be updated and in which manner. Afterwards, the partner responsible of implementation will deliver the updated Activity form to WP5, with detailed information of the procedure (e.g. either to retrieve data, to perform a calculation or to visualize information).

b) To envisage and indicate the location of those requirements within the integrated platform. More detailed information on these issues will be communicated within the *integration procedure* of the SEMANCO platform development (WP5).

**Issues to be implemented in the second implementation round**

Sections 3.4, 4.4 and 5.4, in the empirical chapters, present the tasks and activities to be implemented in the second implementation round of the demonstration scenarios. As the reader will see, in most cases the difference between first and second round is that, in the last, activities are performed by means of SEIF and the integrated platform. Currently, there are some tools and prototype tools already integrated in the platform, and there are some other tools waiting for their development and integration. In order to fully integrate functionalities to the SEMANCO platform, each partner in charge of implementation should deliver the identified activity forms to technological development at the beginning of the second round. Feedback also considers where and how those requirements will be incorporated in the platform. This information will be communicated within the integration procedure to develop the SEMANCO platform being undertaken as part of the work of WP5.

[10] A process that follows the use case methodology; generating of the use case and activity forms to inform the technological development.

# 3 THE NEWCASTLE CASE STUDY

## 3.1 Demonstration scenario

In the Newcastle case, the demonstration scenario focuses on the buildings at the heart of Elswick in the area of Riverside Dene suitable for the retrofitting of energy efficient and reviewable energy technologies.

Currently, local planning officers and social housing providers lack methods to identify practicable and cost-effective measures likely to result in significant energy reduction in all residential accommodation as demanded by the new Government frameworks and guidance. The demonstration scenario in the UK is designed to overcome this by providing planning officers and social housing providers with reliable calculations of the energy consumption, $CO_2$ emissions, costs and /or socio-economic benefits of an urban plan for a new or existing development.

The **first implementation round** of the demonstration scenario focused on measuring the baseline energy efficiency performance of a set of existing, single dwellings. The **second implementation round** will focus on using this base line information to inform calculations of the potential costs and benefits of potential refits to such houses. Finally, the **third implementation round** of the demonstration scenario will focus on how the results from individual buildings can be aggregated to work at the level of user defined areas containing multiple buildings.

### 3.1.1 Use case, activities and data flows

Since the publication of *D8.1 Implementation plan*, the list of activities relevant to each use case has undergone a process of revision and clarification. An updated implementation plan relevant to the Newcastle use case can be found in Figure 2 below.

In this figure the parts shaded in blue represent those where efforts remain. As these show, the progress of the Newcastle use case has differed from the original planning.

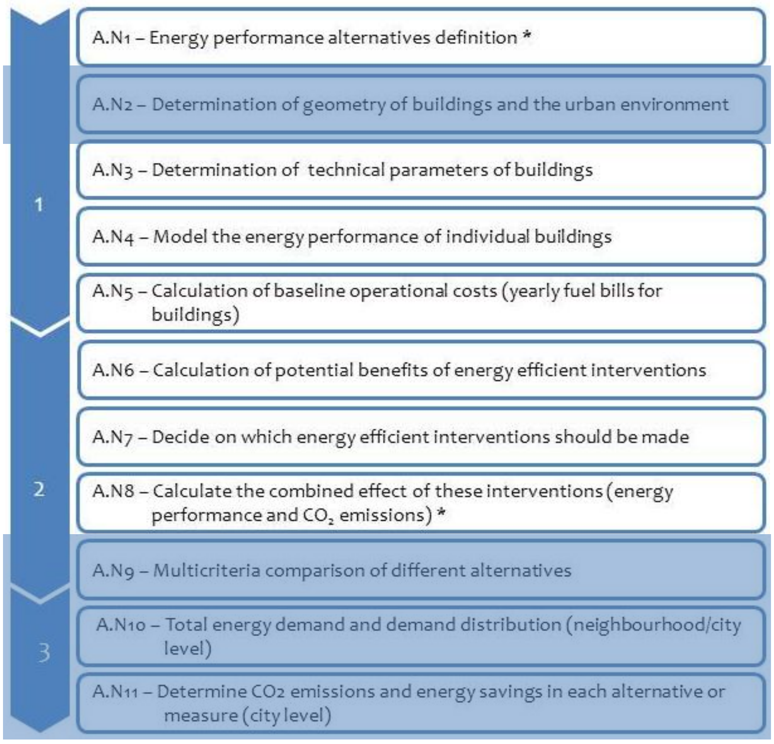


*Figure 2. Flow of activities of the Newcastle demonstration scenario*
**Activities whose activity forms should be updated*

Figure 3 illustrates the data flows that occur within the Newcastle demonstration scenario.

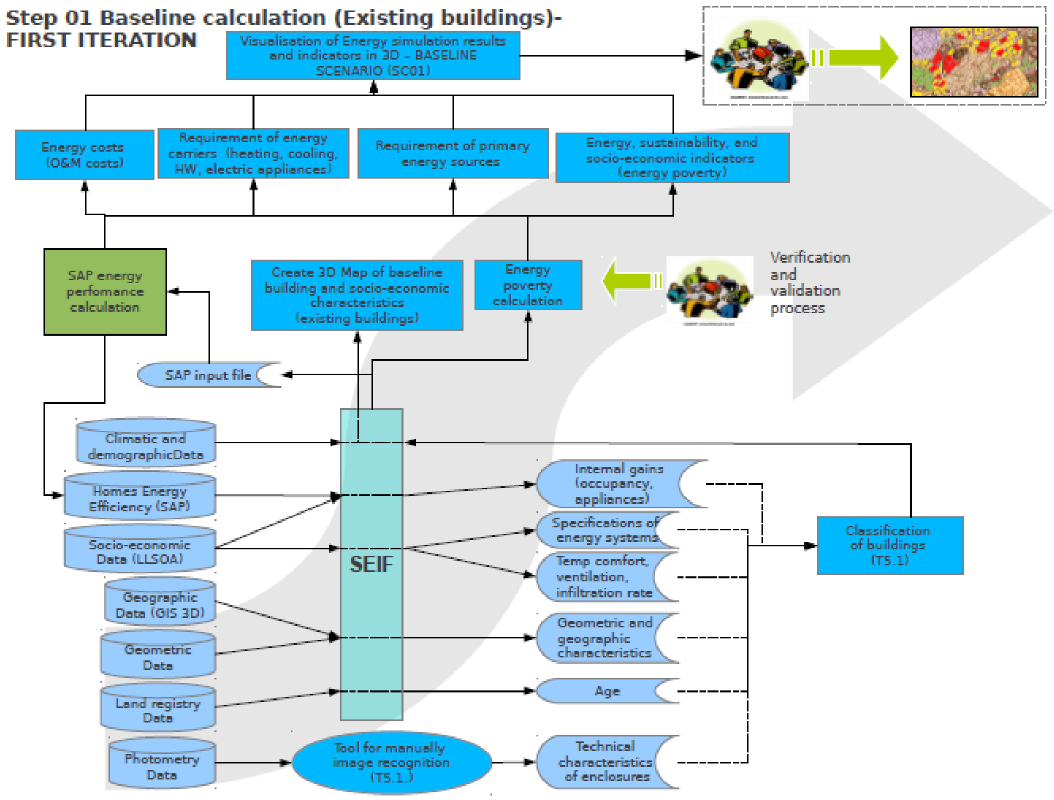


Figure 3. Data flow in the activities of the Newcastle demonstration scenario

### 3.1.2 Implementation process

The following sections present those aspects of the Newcastle use case which have been completed and so the first demonstration scenario. In order to do so, we follow the activities mentioned in Figure 2 above and explain the process of data and tools integration.

#### 3.1.2.1 A.N1 – Definition of different alternatives of urban planning **

In the Newcastle use case, each alternative corresponds to a separate model of the Newcastle case study area on which an end user is developing a proposed refit plan for a set of houses. The methods for producing such alternative maps have already been developed, but certain aspects such as aggregating the effects of multiple improvements to many houses have not yet been completed. During this first iteration of the demonstration scenario terrestrial imagery and vector maps were used to identify the individual models or areas of different alternatives for urban planning.

#### 3.1.2.2 A.N2 – Determination of geometry of buildings and urban environment

The determination of the geometry of 65 single family dwellings in the case study area has been conducted using a prototype version of the SAP tool defined in excel, using data from maps freely available in the UK (Mhalas et al, 2012). The prototype is designed on a GIS platform wherein aerial and terrestrial imagery and vector maps are imported and the geometry of the buildings is manually computed (Mhalas et al, 2012). This tool is implemented on the SEMANCO platform and will be fully functional once the model of the UK case study area is improved. This will enable more of the input data for the SAP calculations to be automatically derived from the model than is the case for the prototype version tool which uses open source maps.

#### 3.1.2.3 A.N3 – Determination of technical parameters of buildings

The basic method by which the SAP calculation drives the determination of the technical parameters of buildings is the manual inspection of open source street level photography. Certain additional details will be taken directly from the results of the LiDAR survey in order automate elements of this activity. The determination of the technical parameters of buildings has been manually conducted for 65 single family dwellings in the case study area using a prototype version of the SAP tool defined in excel, using data from imagery and maps freely available in the UK (Mhalas et al, 2012).

#### 3.1.2.4 A.N4 – Model the energy performance of individual buildings

Once all of the data above has been put in place, the SAP calculation tool calculates the energy performance, fuel costs, $CO_2$ emissions and other indicators for an individual dwelling. When available, this will be delivered to WP5 soon in order to visualize it through the 3D maps and the integrated platform. Again this activity has been conducted for 65 single family dwellings in the case study area using a prototype version of the SAP tool defined in excel. The geometrical and technical parameters of buildings from the earlier sections form the input for the various models constructed within the prototype (Mhalas et al, 2012).

#### 3.1.2.5 A.N5 – Calculation of operational costs (baseline)

This activity is produced as part of the outputs of the SAP calculation tool and as such has been covered above. The base line cost here is the predicted cost for an 'average' set of people to live in the individual dwelling for a year. There is a specific emphasis on space and water heating costs. The SAP rating itself strongly relates to these costs but is normalised in relation to the amount of floor space within the dwelling and put onto a scale roughly between 0 and 100. The calculation of operational costs has been conducted for 65 single family dwellings in the case study area using a prototype version of the SAP tool defined in excel, using data from maps freely available in the UK (Mhalas et al, 2012).

#### 3.1.2.6 A.N6 – Calculation of the potential benefits of energy efficient interventions

In this case a specific dwelling has been selected and the data resulting from its SAP evaluation produced. The tool then allows a full range of both fabric refits – e.g. improved insulation – and renewable electricity/heat interventions – such as solar PV – to be considered. The fact that the SAP calculation engine is used underneath allows the effects of the combinations of improvements to be taken into account.

#### 3.1.2.7 A.N7 – Decide on which energy efficiency interventions should be made

By presenting both the energy savings likely to arise from any such refits and various items relating to the economic results of installing the improvements concerned the improvements tool allows users to select which set of refits they consider optimal for each given property. The economic data includes not only the differences made to individual fuel bills but also such items as government subsidies.

#### 3.1.2.8 A.N8 – Calculation of energy savings and $CO_2$ emissions for each scenario **

Once the user has decided which set of refits should be applied to a given dwelling in this specific improvement scenario they can choose to store this data. The SAP calculation tool is then run again and the new results are stored. The estimated costs of the refit are also stored.

Since both the original and refitted values are stored it is then possible to aggregate the effects of the proposed refits for multiple buildings within the model.

#### 3.1.2.9 A.N9 – Multi criteria comparison of different scenarios

In this case each scenario is taken to be the fitting of one particular sort of improvement to a single dwelling. Different improvement alternatives will be compared using a multi criteria tool, which provides decision support to allow the user to consider qualitative aspects when deciding which improvement should be made. This activity has not been implemented yet since the tool requires an improvement of its user interface to be fully operative.

#### 3.1.2.10 A.N12 – Visualization of socio-economic and energy related characteristics of the urban environment

Databases containing LLSOA boundary data have been delivered, and they can be visualized through the integrated platform (3D map). This information is useful to identify levels of fuel poverty at the neighbourhood level. Also, it is possible to visualize outputs of SAP calculations in terms of properties with high, mid and low range SAP values.

### 3.1.3 Outcomes of first implementation round

Since the delay in the production of the three dimensional model anticipated as being completed in AN2 has been delayed, it has not yet been possible to directly calculate baseline data points within the Newcastle case using the SEMANCO platform. What has however been completed is the production of a tool which will allow for the fast and efficient generation of this baseline data. Indeed the ability of this tool to accurately generate such data has already been evaluated. A report on this process can be found in (Mhalas et al, 2012). This was done by using sets of houses in the case study area for which certain elements of the baseline data had been generated by onsite visits of engineers and were so known to be accurate. The tool and approach, described in *D5.1 Building extraction and classification tools*, were then used to generate the baseline data and the results compared.

The results of this comparison are presented in Table B-1, Appendix B. This calibration was originally conducted with a prototype version of the tool defined in excel. This table shows the SAP calculations carried out on over sixty houses in the UK case study are using the prototype SAP tool compared to those carried out manually by sites visits. The manual calculations were conducted by visits to properties by the social housing provider in the Newcastle case study area- Your Homes Newcastle. In this way, it was possible to validate the outcomes of the prototype version of the tool against the results of manual site visits.

When the three dimensional model for the Newcastle case study area is produced it will be possible to quickly populate the baseline data for it using the SAP calculation tool. The social housing provider in the case study supported this evaluation by providing the data and taking part in the assessment of the tool and is very interested in the wider application of the tool in later iterations of the demonstration scenario.

## 3.2 Evaluation of implementation

As mentioned in section 3.1, the first implementation round has been successful in setting the basis to measure the baseline energy efficiency performance of existing, single dwellings. Table C-1 to Table C-3, Appendix C, contains a detailed description of the status of the implementation of the Newcastle case study area. These tables list each activity, the purpose of activity, the current state of its implementation and degree of fulfilment and finally the obstacles that might be expected to be encountered in completing the task.

We have also delivered several data sources that have been modelled and can be visualized through the 3D maps (i.e. LLSOA level data of Index of multiple deprivation, income domain score of the indices of deprivation, total number of household within the LLSOA and number of household which are in fuel poor conditions) (More information can be found in Sicilia, 2013).

## 3.3 Feedback to technological development

Due to the way in which the development of the work for the Newcastle use case has progresses, the major tools involved have already been integrated into the SEMANCO combined platform and the overall flow of work that they support decided on. A full description of how this is done will be presented in deliverables, D5.1, 5.3 and 5.4. There is however no current need to redefine the activities concerned.

*Table 1. Feedback to technological development*

| *Activities* | *Description* | *Update Activity forms.* | *Location in SEMANCO platform* |
|---|---|---|---|
| **A.N1 – Energy performance alternatives definition **** | Each alternative corresponds to a separate model of the Newcastle case study area on which an end user is developing a proposed refit plan for a set of houses | Detailed description of the process to define alternatives. Identifying potential and most common refit alternatives. | See description. This activity can potentially involve both producing new baseline measurements for previously unmeasured houses and the results of interventions. |
| **A.N3 – Determination of technical parameters of buildings** | Application of SAP calculation tool. | | **Baseline** |
| **A.N4 – Model the energy performance of individual buildings** | Application of SAP calculation tool | This activity form will be updated by including the calculation of operational costs | **Baseline** |
| **A.N5 – Calculation of baseline operational costs (yearly fuel bills for buildings)** | Application of SAP calculation tool | Since SAP tool also calculates operational costs, we will consider merging this activity with the previous one in a single activity form. | **Baseline** – all of the three previous activities combine to produce usable baseline energy efficiency data for a single dwelling. |
| **A.N6 – Calculation of potential benefits of energy efficient interventions** | Combination of refit and SAP tools. | Detailed description of the full range of fabric refits and renewable energy intervention. | **Intervention** |
| **A.N7 – Decide on which energy efficient interventions should be made** | Application of refit tool | | **Intervention** |
| **A.N8 – Calculate the combined effect of these interventions (energy performance and CO2 emissions) **** | Aggregation of individual building performances at neighbourhood and city levels | Previously called Activity A6, this form should be updated according to the new requirements | **Intervention** – this and tasks A.N6 and A.N7 combine to cover the generation of proposed interventions and the calculation of their ultimate overall effects. |
| **A.N9 – Multicriteria comparison of different scenarios** | Comparison of alternatives according to the set of multidimensional performance indicators | The corresponding activity form will be updated after receiving feedback about user interface. | **Intervention –** this task pertains to the overall comparison of various potential interventions. |

The remaining feedback to the technological development therefore takes two forms. The first is the refinement of the prototype interfaces in response to user feedback. This process is currently ongoing and the finalised interfaces will be described in D5.4. The second will be the provision of a more detailed and accurate model using the results of the LiDAR survey which will potentially provide the ability to automatically provide certain elements of the data currently manually generated from current maps. A detailed discussion of these matters will be provided in *D5.1 Building extraction and classification tools*.

## 3.4 Issues to be demonstrated for second implementation round

The two principle items to be addressed during the second implementation round for Newcastle are improving the baseline model and incorporating user feedback into the design of the tools which have already been implemented in prototype form during the first round of implementation. The following table describe the issues to be implemented in the next implementation round.

*Table 2. Activities and issues to be demonstrated in the second implementation round*

| ***Activities*** | ***Issues to be demonstrated*** |
|---|---|
| **A.N9.- Multicriteria comparison of different alternatives** | During second implementation round multicriteria tool will be improved based upon users' feedback regarding its interface. |
| **A.N10.- Total energy demand and demand distribution** | Looking forwards to the third implementation round it is anticipated that one major area of work will be the aggregation of the results of refits applied to single buildings at higher levels, and methods for comparing such results |
| **A.N11.- Determine $CO_2$ emissions and energy savings in each alternative or measure** | |

# 4 THE NORTH HARBOUR CASE STUDY

## 4.1 Demonstration scenario

The main objective of this demonstration scenario is to *determine the optimal combination of measures regarding sustainable energy supply and energy savings, with the lowest possible costs, in a greenfield planning situation*. The immediate goal of moving towards a $CO_2$ friendly urban development has been set by the CPH City and Port Development. The longer term aim is a $CO_2$ neutral or negative neighbourhood.

The **aim of the first implementation round** is *to determine the energy demand and cost impacts of a range of different levels of building energy performance*. The output of this step serves as an input to step 2 (comparison of alternatives) as well as a baseline calculation (buildings designed according to Danish minimum standards of 2010).

The second implementation round is concerned with the analysis of production costs, carbon emissions and supply potential for different energy supply technologies in order to select the most suitable one.

### 4.1.1 Use case, activities and data flows

In the following Figure 4 the activities from Use Case for this demonstration scenario are listed.

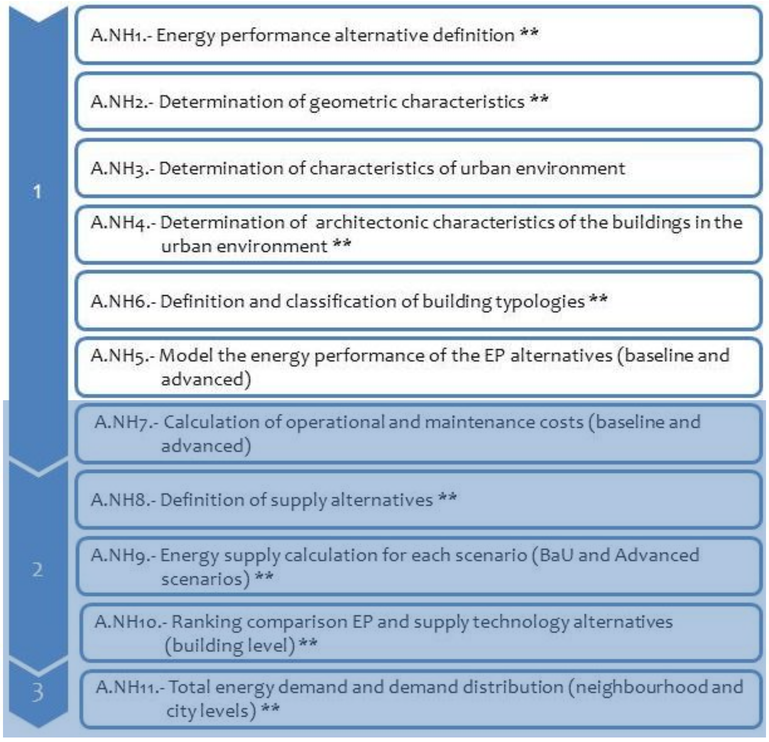


*Figure 4. Flow of activities of the North Harbour demonstration scenario.*
*** Activities whose activity forms should be created*

Some new activities have been used during the first implementation round, which will be described in detail through the standardized activity forms to be delivered at the beginning of the second implementation round.

Since the elaboration of *D8.1 Implementation plan*, some adjustments were needed in the planned data flow in order to be fully applicable in this first implementation round. A new data flow diagram has been elaborated, in order to show the actual data flow in the first round of the North Harbour demonstration scenario (See Figure 5).

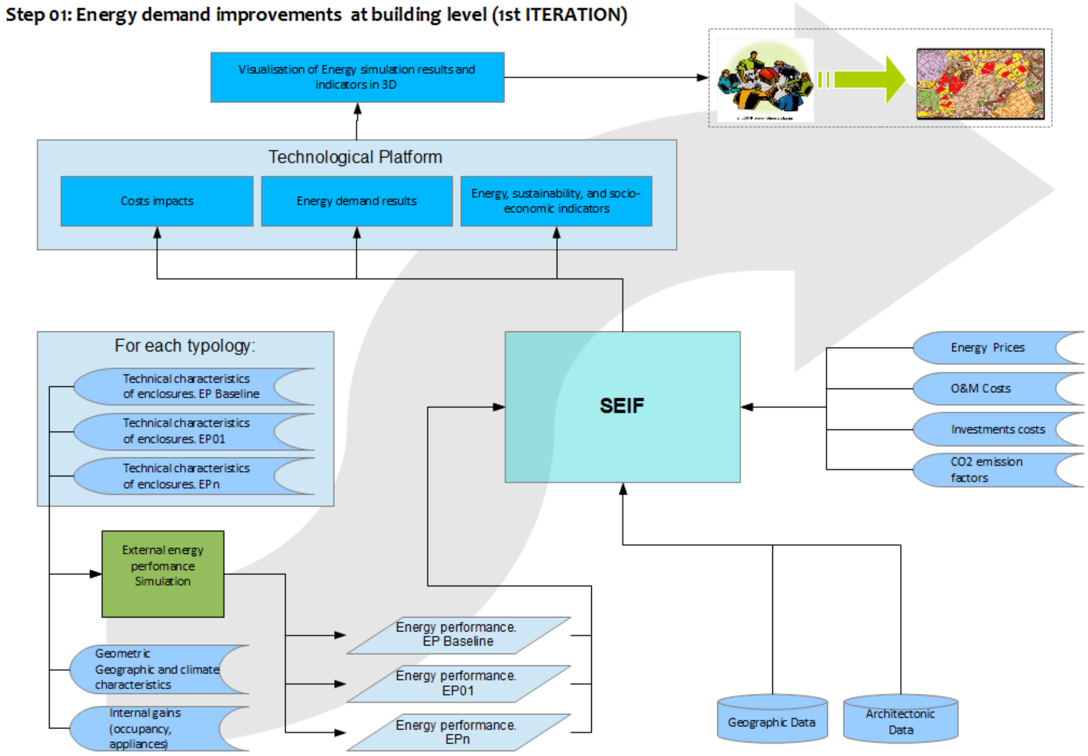


*Figure 5. Data flow in the activities of the North Harbour demonstration scenario (updated)*

The main difference between the original presented in *D8.1 Implementation plan* and the new data flow diagram presented here is that the typologies and the specific energy demands for buildings are carried out outside the integrated platform. Once the typologies and their specific energy demands are defined, they will be stored in the SEIF.

An Excel-based tool that calculates energy demand and $CO_2$ emissions at building level within a given typology (building use and age class) has been developed. This tool serves as a guide for the first implementation round and covers most of its planned activities.

## 4.1.2 Implementation process

### 4.1.2.1 A.NH1 – Energy performance alternatives definition**

The first task is to define some energy performance alternatives for building typologies. These alternatives are based on different measures for energy saving in buildings. The expected specific energy demands of the alternatives determine their corresponding energy performance.

This activity included the determination of the baseline: the expected specific energy demand of alternatives. It remains to evaluate the energy performance of alternatives with varying degrees of insulation and to calculate their additional investment costs.

### 4.1.2.2 A.NH2 – Determination of geometric characteristics**

The geometric characteristics for the North Harbour demonstration scenario are extracted from 3D Maps based on the architectural 3D model of the urban area. The data is crucial for determination of the gross floor area. This activity is under development and it is expected to be implemented in the pilot tool soon.

#### 4.1.2.3 A.NH3 – Determination of characteristics of urban environment

Ortho photos and related GIS data of the North Harbour area and its surroundings have been delivered and implemented in 3D Maps.

#### 4.1.2.4 A.NH4 – Determination of architectonic characteristics of the buildings in the urban environment**

This activity is very closely related to *A.NH2 Determination of geometric characteristics*. Since that activity is expected to cover A.NH4 in the second round, the decisions as to whether to merge both activities remains pending.

#### 4.1.2.5 A.NH6 – Definition and classification of building typologies**

The building typologies used in the demonstration scenario are based on the standard tables developed in *D.3.3 Guidelines for structuring contextual data* with an added temporal scale for the baseline energy performance. As the North Harbour project is in a greenfield planning situation in its early planning stages, no buildings or infrastructure have yet been completed. Four building typologies covering dwellings and offices are used to specify the planned final layout of the urban area.

#### 4.1.2.6 A.NH5 – Model the energy performance of the EP alternatives (baseline and advanced)

The simulation of the energy performance of buildings divided into four age classes have been carried out for the baseline. The energy performances are based on existing and future expected requirements in the national building code with user/occupants behaviour taken into account. Calculations were done by using the developed Excel-tool.

#### 4.1.2.7 A.NH7 – Calculation of operational and maintenance costs (baseline and advanced)

Data covering these costs is available, but it has not been processed in the first implementation round. This work is expected to be carried out in the second round.

### 4.1.3 Outcomes of first implementation round

The main outputs are presented in Table B-2 and Table B-3, Appendix B. There, the reader will find the specific energy demands for the four typologies of buildings and the expected (i.e. calculated) energy performance and $CO_2$ emissions of the target urban area. The calculations have considered the increase in the built area in North Harbour from 2013 to 2035. The results are summarized in Figure 6.

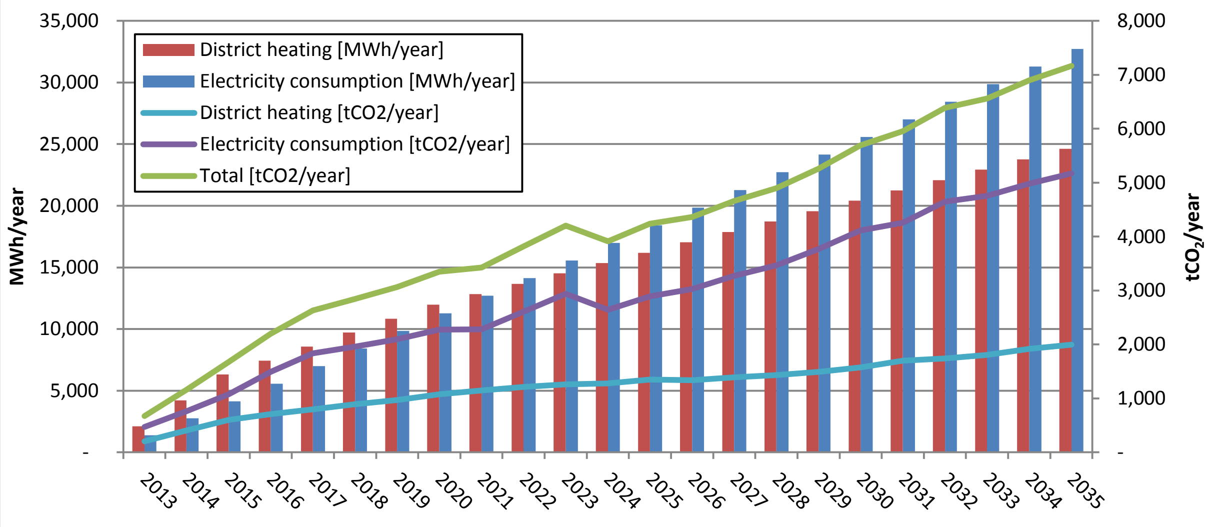


*Figure 6. Projections of energy consumption and $CO_2$ emissions in the North Harbour urban area*

## 4.2 Evaluation of implementation

As mentioned in section 4.1, the aim of the first implementation round is *to determine the energy demand and cost impacts of a range of different levels of building energy performance*. In general, the first implementation round has met this objective to a medium extent due to the fact that cost impacts are yet to be determined. The cost calculations will be carried out in the second implementation round.

Table C-4 and Table C-5 of Appendix C contain a detailed description of the status of implementation in North Harbour. As mentioned there, the first implementation round has been carried out using an excel-tool developed for the North Harbour case study. Also, $CO_2$ emissions related to energy demand have been calculated, which was originally planned to be conducted during the second implementation round. As well, some missing data of the 3D model, which produce inaccurate geometric representation of the buildings, will be delivered in the second implementation round.

## 4.3 Feedback to technological development

The following Table 3 describes the activities implemented during the first implementation round, a general description of the requirements, an evaluation of whether the corresponding Activity forms require an update or not and the location of those requirements within the integrated platform.

*Table 3. Feedback to technological development*

| *Activities* | *Description* | *Update Activity forms.* | *Location in SEMANCO platform* |
|---|---|---|---|
| **A.NH1.- Energy performance alternative definition** | The energy performance (EP) alternatives are loaded into SEIF according to the building typologies and age class of building. Default values will be available for the North Harbour with the opportunity for the user to edit them. When the user assign building use and construction year to a building, the baseline EP is assigned to the building. The EP levels are later on used to benchmark the energy performance of the demonstration scenario as a whole. | Energy performance alternatives are defined as the degree of insulation and the associated added cost. A baseline EP and EP alternatives with various degree of insulation are developed for the demonstrations scenario. This activity will have its corresponding activity form updated during the second implementation round. | Intervention<br>At current state this activity is mostly carried out outside the framework of SEMANCO. Specific for the demonstration scenario data are uploaded to the SEIF platform. |
| **A.NH2.- Determination of geometric characteristics** | Data on the geometric characteristics of the North Harbour project are retrieved from 3D maps (e.g. BuildingId, Length_m, Width_m, Height_m, GroundFloorArea_m2, Volume_m3, UTM_X, UTM_Y).<br>There are still some flaws and errors with the architectural 3d model which is integrated in the 3D Maps. | This activity will have its corresponding activity form updated during the second implementation round. | Intervention<br>The user should have the possibility to modify data of buildings. When the user have assigned year of construction for at selected building the EP is assigned automatically and the building energy demand is calculated. |
| **A.NH3.- Determination of characteristics of urban environment** | Geometry of buildings, orthophotos and structural plans are already included in 3D maps in order to determine the urban environment. | Minor updates are needed. | The geometry of buildings and urban environment is already defined in 3maps. |
| **A.NH4.- Determination of architectonic characteristics of the buildings in the urban environment** | This activity is covered by "A.NH2 - Determination of geometric characteristics" | During the second implementation round it will be determined whether the existence of this activity is justified. | |
| **A.NH6.- Definition and classification of building typologies** | Definition and classification of building typologies are defined outside the SEMANCO framework for the North Harbour demonstration. It is the combination of EP, age class and building use. | This is a new activity form and will be elaborated in the second implementation round. | The user assigns year of construction and building use for at selected building, which match the corresponding building typology on which energy demand is based on. |

| *Activities* | *Description* | *Update Activity forms.* | *Location in SEMANCO platform* |
|---|---|---|---|
| **A.NH5.- Model the energy performance of the EP alternatives (baseline and advanced)** | To calculate the energy performance of buildings. The user assigns the year of construction and building use. | This activity form should be updated with detailed information on the calculation of some performance indicators: Specifically, intensive indicators of energy demand at urban scale. The Activity form will include the necessary information to incorporate the Excel-tool | This should be visualized through 3D maps and the user should have the opportunity to download/extract the calculated data from SEIF or process the data in an interfaced LEAP model. Calculated indicators (e.g. Energy demand for final energy uses, $CO_2$-emissions and reduction compared to baseline) will be delivered to WP4 and WP5 in order to visualize them in 3D maps. |
| **A.NH7.- Calculation of operational and maintenance costs (baseline and advanced)** | Calculation of operational and maintenance costs are calculated according to the energy consumption, fuel mix and energy supply technologies | This activity form has not been developed yet and has been postponed to the second implementation round. | The calculations will be carried out in the excel model developed and then integrated in the SEMANCO platform. . The user should have the opportunity to choose a given energy supply technology, whereas the corresponding costs are calculated in the interfaced excel model. |
| **A.NH12.- Calculation of $CO_2$ emissions buildings and urban area** | $CO_2$ emissions are calculated according to the energy consumption and the energy mix. Projections on emission factors should be implemented in SEIF in order to show the temporal development in emissions. | This activity form should be updated in order to include the formulas and calculation procedure of $CO_2$ emissions | This should be visualized through 3D maps and the user should have the opportunity to download/extract the calculated data from SEIF or process the data in an interfaced LEAP model. |

## 4.4 Issues to be demonstrated for second implementation round

The following Table 4 presents the activities of the second implementation round, including the pending activities of the first round.

*Table 4. Activities and issues to be demonstrated related to the Excel-tool developed and the technological platform in the second implementation round.*

| *Activities* | *Issues to be demonstrated* |
|---|---|
| **A.NH7.- Calculation of operational and maintenance costs (baseline and advanced)** | Data are available as indicators, but have to be put into tables that relates to the Standard tables. Also it is needed to describe the calculation steps. |
| **A.NH8.- Definition of supply alternatives** | A basic energy supply technology catalogue has already been identified in the Excel-tool. This catalogue with different supply technologies has to be further developed, demonstrated in the Excel-tool and implemented in the technological platform. |
| **A.NH9.- Energy supply calculation for each scenario** | To apply the energy supply catalogue (incl. data) in the calculation of different scenarios and visualized in the technological platform. |

| | |
|---|---|
| **A.NH10.- Ranking comparison EP and supply technologies alternatives** | To calculate different EP and supply technologies alternatives in different scenarios and rank these according to cost-effectiveness. Visualization of scenarios and alternatives in the technological platform. |
| **A.NH11.- Total energy demand and demand distribution** | Besides baseline EP, EP levels with varying insulation degree have to be defined. This is done in a table and acts as an input to SEIF. |

*Table 5. Activities and issues to be demonstrated related to 3D-maps and the technological platform in the second implementation round.*

| ***Activities*** | ***Issues to be demonstrated*** |
|---|---|
| **A.NH2.- Determination of geometric characteristics** | Extracting building and area characteristics from 3D-model.<br>To develop a tool to extract information of selected buildings in an urban area (e.g. BuildingId, Length_m, Width_m, Height_m, GroundFloorArea_m2, Volume_m3, UTM_X, UTM_Y) |
| **Visualization of energy simulations and indicators in 3D in the technological platform** | To visualize different alternatives in different scenarios at a temporal scale in the technological platform.<br>In order to do so, we will deliver tables with the calculated indicators |

# 5 THE MANRESA CASE STUDY

## 5.1 Demonstration scenario

The focus and main objective of this demonstration scenario, in its first implementation round, is to *calculate the baseline of the study area*, which consists of a group of buildings that existed previous the implementation of the Barreras Plan, which was aimed at demolishing old buildings and to construct a new one for social housing: *Quatre Cantons* building. In the second implementation round, it is expected to develop a set of alternative urban plans and compare them against the baseline and against each other. The comparison will be based on the set of performance indicators.

### 5.1.1 Use case, activities and data flows

The use case implemented in Manresa encompassed the activities presented in Figure 7.

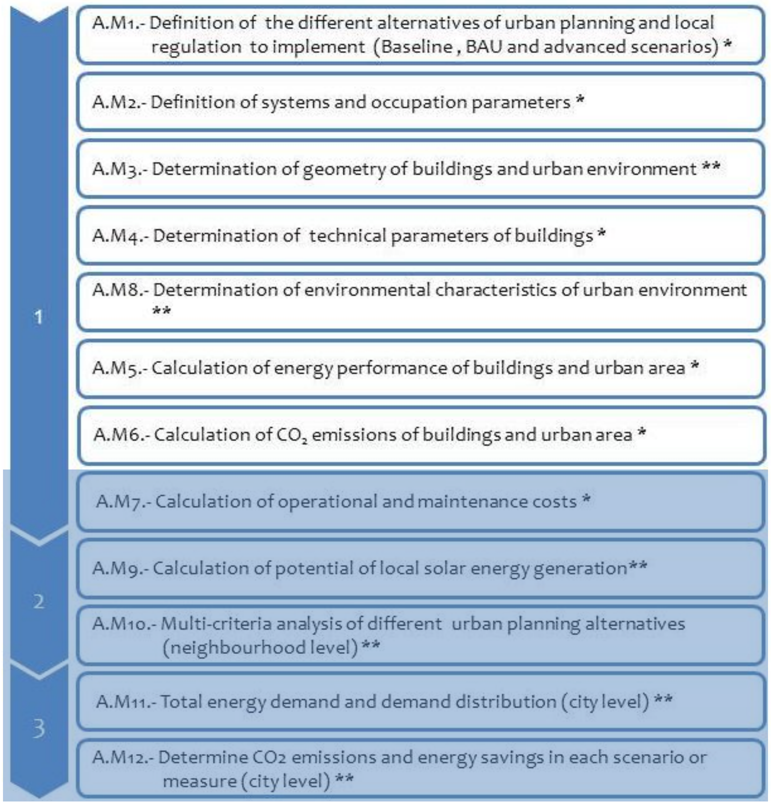


*Figure 7. Flows of activities in the Manresa demonstration scenario.*
** Activities whose activity forms should be updated; ** Activities whose activity forms should be created*

For this first implementation round, we had to update the sequence of activities planned in *D8.1 Implementation plan*. Also, the first activity only considers how to define the baseline situation for the first implementation round. This update entails to also redefine most of the activity forms included in the first implementation round. Activity forms, which currently explain in a very broad sense each of the corresponding activities, will include the step-by-step procedures to be delivered to the technological development.

In order to perform those activities, we follow the flow of information showed in Figure 8, which is an updated version of the flow chart presented in *D8.1 Implementation plan*. This scheme considered to have SEIF already implemented. In the case of the first implementation round, domain experts and people in charge of implementation play the role of SEIF. In doing so, we perform the procedure described in the following section.

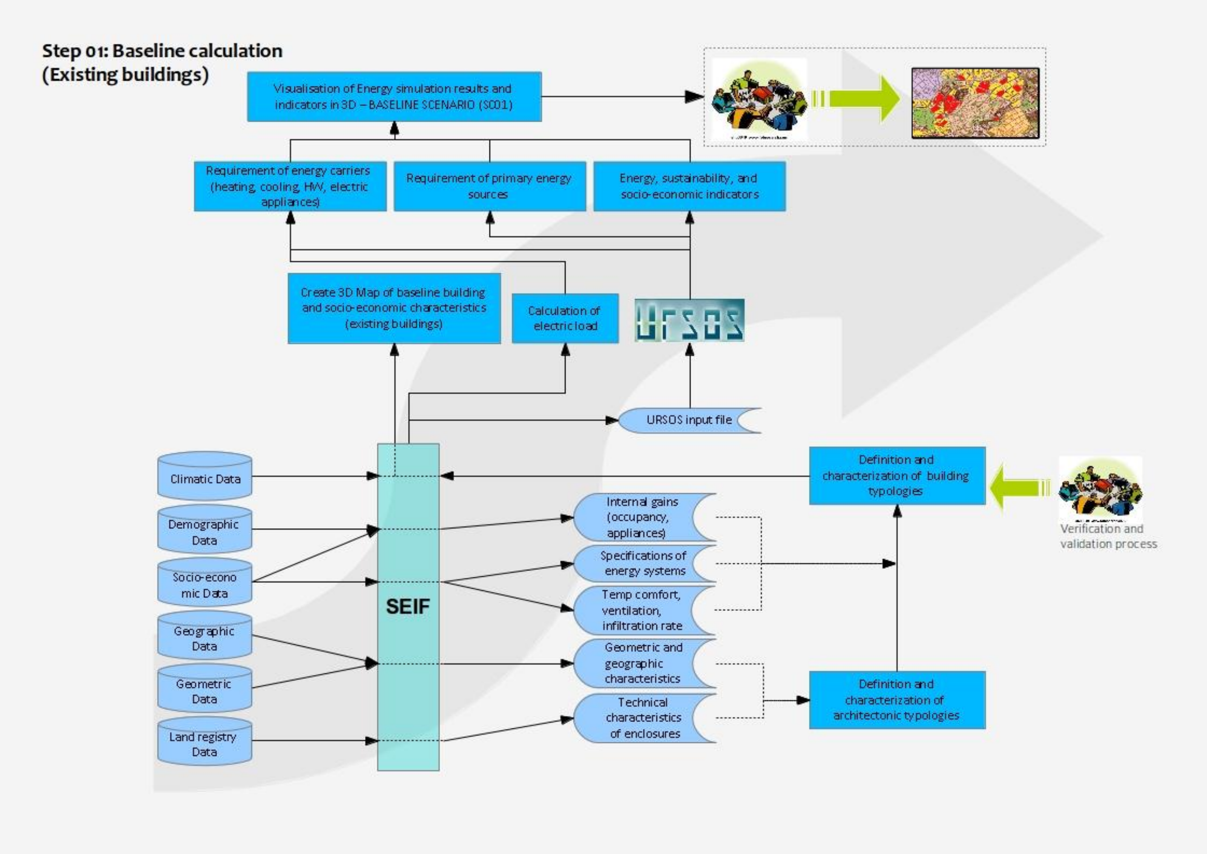


*Figure 8. Data flow in the activities of the Manresa demonstration scenario*

### 5.1.2 Implementation process

The following sections present the first round of the Manresa demonstration scenario. In order to do so, we follow the order of activities described in Figure 7 in order to explain the process of integrating data and tools.

#### 5.1.2.1 A.M1 – Definition of different alternatives of urban planning *

In the first implementation round, only the definition and calculation of the baseline scenario are considered. Figure 9 presents a snapshot of a CAD software with the buildings of the baseline, as they were in 1997.

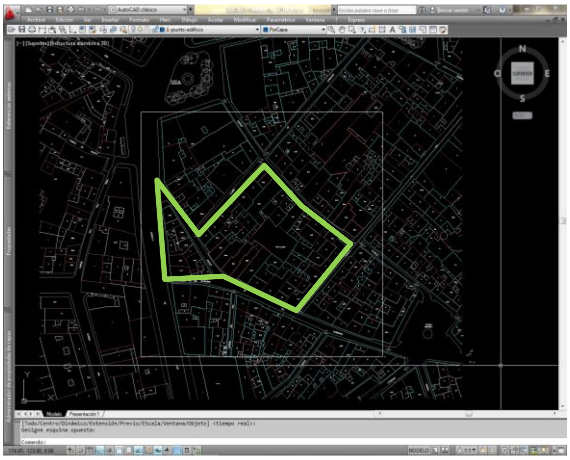

*Figure 9. Baseline of target urban area: Quatre Cantons, Manresa*

*Figure 10. Current state of target urban area: Quatre Cantons, Manresa*

Figure 10 shows an orthophoto of the current state of Quatre Cantons and the green line delimits the target urban area, which is the focus of first and second implementation rounds.

#### 5.1.2.2 A.M2 – Definition of system and occupation parameters *

Occupancy parameters can be divided in three categories. Firstly, there are parameters related to **internal gains**: the degree of occupancy of the building, the electric appliances and the number of inhabitants. Secondly, there are parameters related to **building systems** such as energy carriers and efficiencies of heating, cooling and domestic hot water systems. Thirdly, there are parameters related to **living conditions**, such as comfort temperatures in winter and summer and ventilation rates.

##### *5.1.2.2.1 Internal heat gains*

Internal heat gains have two components: those due to human metabolism and those that are product of households' equipment.

The former depends on the number of inhabitants and their time spent at household. The number of inhabitants of the building is obtained from the census of Manresa. Then, we consider that a person is at home an average of 16 hours/day (=5.860 hours/year) and produces a heat load of about 1,9 kWh/day[11].

Household equipment produces an internal heat load according to their type and the installed power. Households' equipment is determined according to the socio-economic situation of the household (or neighbourhood) income[12]. This relation between income and heat gains depends on two aspects. On the one hand, it depends on the heat gains produced from different electric appliances, whose average values are derived from IDAE (2011) (See also Hendron & Engebrecht, 2009; ASHRAE, 2005). On the other side, it depends on the number and type of electric appliances present in the household, which is derived from IDAE (2011) and IDESCAT (2009)

Total heat load (i.e. internal gains due to human metabolism and home appliances) is divided by the total surface of occupied flats. The last is obtained by crossing data from the census and the land registry.

##### *5.1.2.2.2 Building systems*

In Spain, and specifically in Catalonia, most of the buildings are connected to the natural gas network. Therefore, we assume that domestic hot water and range is fuelled by natural gas. However, for very old buildings we need to assume that heating and cooling systems are fuelled with electricity. The efficiencies of those systems are determined according to the year of construction of the building. This information is obtained from the databases of the Spanish software for energy certification (CE3).

##### *5.1.2.2.3 Living conditions*

As in the case of home appliances in the household, we assign different comfort condition according to the level of income of the household. We assume rich household to have higher comfort temperatures in winter and lower temperatures in summer, due to their ability of afford better heating and cooling systems. [13] As mentioned before, we assigned income levels

[11] These values are derived from ASHRAE (2005) (Fundamentals) and Hendron & Engebrecht (2010).

[12] This is a preliminary and very general assumption. However, this assignment can be updated based on expert knowledge of the city. In the future, one can carry out a socio-economic survey and to update income levels across buildings and neighbourhoods. Also, we can collect information on heating and cooling systems.

[13] This is a preliminary and general assumption which will need to be proved later on either by bibliographic

to neighbourhoods. Then, we assigned comfort temperatures to different income levels.

#### 5.1.2.3 A.M3 – Determination of geometry of buildings and urban environment **

These data were retrieved from Manresa GIS files. In order to do so, geographic information was imported to a computer-aided design (CAD) application. From here, it was possible to obtain the coordinates of the urban plots and of the building footprints to be incorporated to Ursos software.

From the same database (Manresa's GIS), we obtained the number of storeys of the buildings. Then, the height of the buildings is derived by assuming a height of about 3 meters for each floor.

#### 5.1.2.4 A.M4 – Determination of technical parameters of buildings *

Technical parameters of buildings encompass U-values of enclosures and windows, percentage of windows in each enclosure, transmittances, solar absorption factor, among other. We assigned their value according to the age of construction of each building, which is retrieved from the land registry. This assumption is based on the fact that the construction of buildings in different periods is regulated by different technical codes; which establish different requirement levels[14].

However, one of the main disadvantages of this assumption is that we do not consider building refurbishments which have already been performed. This information is not available in data bases (e.g. land registry) and the only way to assign more accurate values is on the basis of direct inspection of the building (or by means of image analysis).

#### 5.1.2.5 A.M8 – Determination of environmental characteristics of the urban environment **

This category of data encompasses climatic and solar irradiance data, which are obtained from the Manresa weather station of the Catalan government.

#### 5.1.2.6 A.M5 – Calculate the energy performance of buildings and urban area *

With all these data introduced to URSOS, we proceed to calculate the energy performance of the buildings. URSOS calculates the energy demand for heating and cooling. In the first implementation round, we consider that electricity consumption from electric appliances is proportional to household income. Therefore, this value is constant for all households of the same neighbourhood.

Then, it took place the aggregation of information in order to obtain the energy performance of the target urban area.

#### 5.1.2.7 A.M6 – Calculation of $CO_2$ emissions of buildings and urban area *

This activity considers calculating the $CO_2$ emissions of the buildings and the urban are according to final energy uses. In order to do so, we obtain the demand of heating and cooling from URSOS calculations. Then, we assume a certain rate of electricity consumption per square meter and according to the income of the neighbourhood, to finally calculate $CO_2$ emissions according to the Spanish energy mix.

#### 5.1.2.8 A.M7 – Calculation of operational and maintenance costs (baseline) *

We didn't carry out this activity due to the lack of data. We are currently collecting operational and maintenance costs of buildings in order to include these indicators for the

support or on analyses of available data.

[14] Data is derived from IDAE (2012).

second implementation round.

### 5.1.3 Outcomes of first implementation round

The aim of the first implementation round was to calculate the baseline of the target urban area (see Figure 9 and Figure 10); that is, the energy performance of the buildings previous the construction of *Quatre Cantons* building. The results of the calculations are presented in Appendix B, section B.3. There, Table B-4 presents the energy demand for heating and cooling of the baseline buildings. The first two columns of that table present the energy demand for heating and cooling, in absolute terms. The third column presents the conditioned surface in each building. With that information, we calculate the energy demand per unit of surface required in each building (see also Figure *11*).

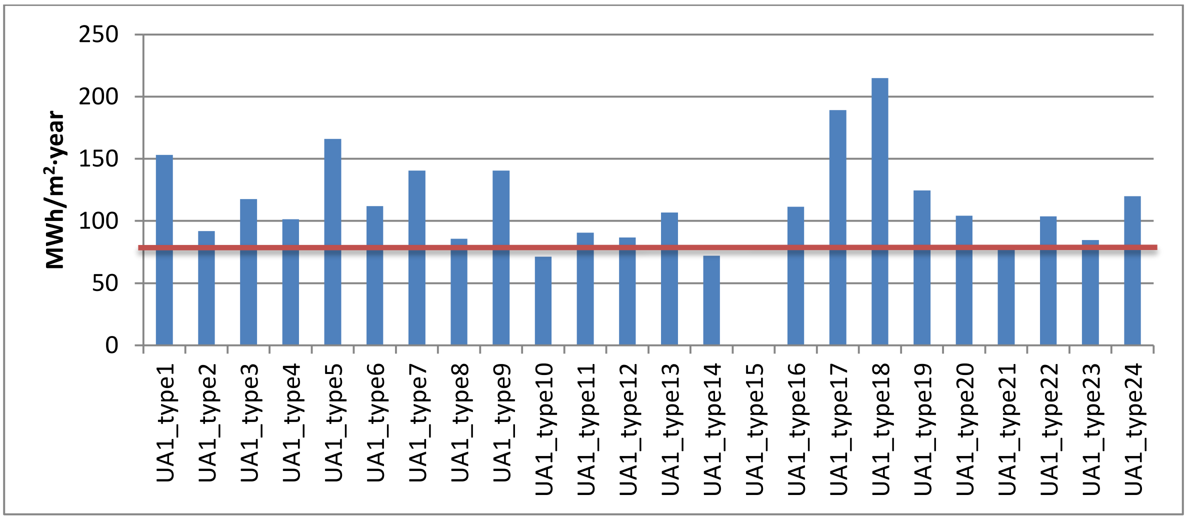


Figure 11. Heating demand per building (red line indicates the mean heating demand per square meter per year in the target built environment)

This last indicator is very useful to characterize the energy metabolism of each building, since it gives the pace or the intensity of energy demand for heating and cooling. Using this sort of indicator, we can identify buildings that are above the average values of the urban area. Here, we identify three buildings that present high rates of energy demand for heating purposes and four buildings with high rates of energy demand for cooling purposes. In other words, and assuming that the calculation parameters are correctly valued, we can identify hot spots of low energy efficiency and look for potential improvements.[15] Also, Table B-5 presents calculated $CO_2$ emissions from gas and electricity consumption in each building.

## 5.2 Evaluation of first implementation round

As showed in Table C-4 and Table C-5, Appendix C, the first implementation round has been highly successful in the Manresa case study. Most of the planned activities for the first implementation round were carried out. The energy demand for heating and cooling purposes has been calculated as well as $CO_2$ emissions of target buildings. It remains to calculate operational costs and the set of urban planning indicators. In order to do so, partners in charge of implementation have to deliver a detailed explanation about how to do it during the second implementation round.

As mentioned in the tables of Appendix C, some socio-economic data at neighbourhood level (e.g. population densities and dependency ratio) was delivered with certain delay, so that

[15] For instance, we can propose to change windows, which are modeled by using the corresponding (and improved) U-values in the calculation.

information is not available for visualization purposes. Due to those delays, the Manresa 3D map is only able to show the geometry of the city.

## 5.3 Feedback to technological development

The following Table 6 presents the main requirements that arise from this first implementation round.

*Table 6. Feedback to technological development*

| *Activities* | *Description* | *Update Activity forms.* | *Location in SEMANCO platform* |
|---|---|---|---|
| **A.M1. Definition of different alternatives of urban planning and local regulations** | Ursos will be incorporated within the integrated platform. Then, we will use the urban tool to define urban planning alternatives and SEIF will produce the input file to be used by the Ursos calculation engine. | Explain in more detail the way of defining alternatives. Use mock-up of integrated platform.<br>For instance, describe how to assign technical building parameters. | **Intervention**<br>We need to specify a working area (i.e. are containing the set of target buildings) before starting an intervention. |
| **A.M2. Definition of system and occupation parameters** | • **Internal gains**: depend on the degree of occupancy of the building, the electric appliances and the number of inhabitants.<br>• **Building systems**: energy carriers and efficiencies of heating, cooling and domestic hot water systems.<br>• **Living conditions:** comfort temperatures in winter and summer and ventilation rates. | Update activity form with a step-by-step procedure of data retrieving (indicating data sources)<br>Also, describe in detail embedded tools to calculate internal heat gains and the queries to filter data from data sources. | **Baseline** & **Intervention**<br>The process of assigning occupation and system parameters occurs automatically (SEIF). However, the user should have the possibility to modify data of buildings.<br>There is the need to also have a Building table in the BASELINE section, in order to change parameters of the baseline.<br>Currently, there is Building table in the INTERVENTION section, but it remains to define the form to update building parameters (for one or multiple buildings |
| **A.M3. Determination of geometry of buildings and urban environment** | Geometry of buildings and urban environment is already included in 3D maps. However, it remains to define how to transform this information to an Ursos input.<br>Also, we need to define some parameters to calculate urban planning indicators. | Previously, it considered to define the characteristics of urban environment (climatic and geometric).<br>Now, Activity M3 considers defining geometric characteristics of buildings and urban environment.<br>Therefore, Activity form needs to be updated accordingly<br>One important issue to have in mind is the facts that Ursos uses simplify geometric models of buildings, while 3D maps are based on real geometry of buildings defined in the city's GIS. | The geometry of buildings and urban environment is already defined in 3maps. |

| *Activities* | *Description* | *Update Activity forms.* | *Location in SEMANCO platform* |
|---|---|---|---|
| **A.M4. Determination of technical parameters of buildings** | Technical parameters of buildings encompass U-values of enclosures and windows, percentage of windows in each enclosure, transmittances, solar absorption factor, among other, which are defined according to the age of construction of each building that is retrieved from the land registry. | This activity form needs to indicate in more detail the process of determining technical building parameters | As in Activity 2, there is the need to indicate (by means of the mock-ups) how to change or modify buildings parameters, both in the BASELINE and in the INTERVENTION sections of the integrated platform |
| **A.M8. Determination of environmental characteristics of urban environment** | Environmental characteristics encompass climate, solar irradiance and geographic data | This is a new activity form. It considers the determination of climatic information as well as the horizon profile. | This process is automatic. SEIF determined the values according to the location (i.e. city), and retrieve data from specific data sources. |
| **A.M5. Calculation of energy performance of buildings and urban area** | Ursos will be incorporated within the integrated platform. Therefore, we will use the calculation engine to carry out this activity. | This activity form should be updated with detailed information on the calculation of some performance indicators: Specifically, intensive indicators of energy demand at urban scale.<br>Also, it should be updated in order to explain the calculation of the set of already defined indicators (e.g. electricity consumption). | In both, the BASELINE and INTERVENTION sections, we have to confirm the set of performance indicators to be visualized. |
| **A.M6. Calculation of $CO_2$ emissions of buildings and urban area** | $CO_2$ emissions are calculated according to the energy consumption and the energy mix. | This activity form should be updated in order to include the formulas and calculation procedure of $CO_2$ emissions | This indicator should be showed in both, the BASELINE and INTERVENTION sections |
| **A.M7.- Calculation of operational and maintenance costs** | Cost will be calculated according to average operational and maintenance costs per square meter of a building. | This activity form needs to indicate in more detail the process of determining cost rates and the calculation process | This indicator should be showed in the INTERVENTION sections. When comparing different alternatives of urban planning. The main indicators will be cost of intervention and the internal rate of return. |

## 5.4 Issues to be demonstrated for second implementation round

Partners in charge of this implementation round have accessed and integrated data, entered data to calculation models and calculated the performance indicators without using neither SEIF nor the integrated platform. Their work has been oriented to identify technological requirements rather than demonstrating integrated tools. Therefore, the second implementation round will be focused on demonstrating that functionalities of the integrated platform meet the requirements identified in this first round.

In the second implementation round some alternative urban plans will be created and compared against the baseline. Then, we will perform the same activities than in the first implementation round in order to calculate the energy performance of those alternative urban plans. Specific to the second implementation round are the calculation of potential solar energy generation and the multicriteria comparison between alternatives and the baseline (See Figure 7).

*Table 7. Visualization and Data modelling issues. Second implementation round*

| ***Activities*** | ***Issues to be demonstrated*** |
|---|---|
| **A.M1. Definition of different alternatives of urban planning and local regulations** | To create alternatives through the interface defined in URSOS, in combination with 2D CAD maps |
| **A.M2. Definition of system and occupation parameters** | To integrate data from different sources through SEIF<br>To generate input file for calculation methods (i.e. URSOS) |
| **A.M3. Determination of geometry of buildings and urban environment** | To visualize socio-economical and urban environment parameters (i.e. urban planning indicators) |
| | To generate geometric building model as an input of the calculation method (i.e. URSOS) |
| **A.M4. Determination of technical parameters of buildings** | To check whether the level of accuracy in defining technical parameters is enough to compare alternative urban plans by means of simplified modelling. |
| **A.M8. Determination of environmental characteristics of urban environment** | To retrieve climatic data from online meteorological data bases and to determine the horizon profile automatically |

*Table 8. Calculation issues. Second implementation round*

| ***Activities*** | ***Issues to be demonstrated*** |
|---|---|
| **A.M5. Calculation of energy performance of buildings and urban area** | To calculate requirements of energy carriers according to final energy uses, for the different alternatives (with URSOS software). Electricity consumption from electric devices used within the household will be determined by using a preliminary version of the tools developed within Task 5.2 (data mining). |
| **A.M6.- Calculation of $CO_2$ emissions of buildings and urban area** | To calculate $CO_2$ emissions according to final energy uses |
| **A.M7.- Calculation of operational and maintenance costs** | To calculate energy costs of investment and maintenance of. To calculate preliminary results of the multi-criteria and multi-dimension analysis to the calculated scenarios |
| **A.M9.- Calculation of potential solar energy generation** | One of the outcomes of URSOS is the solar irradiance on walls. Based on this information, we will develop a simplified method to calculate solar energy generation. |
| **A.M10.- Multicriteria comparison of different urban planning alternatives** | To compare different alternatives according to the set of performance indicators. This will be done by applying the multicriteria algorithm already incorporated to in the integrated platform. |
| **A.M15.- Calculate urban planning indicators (for the integrated platform)** | To calculate population density, built surface, occupancy, buildability and other socio-economic and environmental indicators to be included in the integrated platform. |

# 6 COMMON DEVELOPMENT

The SEMANCO project is aimed at designing, implementing and evaluating a semantic-based energy information framework and a suite of tools to support energy efficient urban planning. The suite of tools will be embedded in a web-based platform, which will enable users to integrate data and tools in order to pursue some specific objectives regarding energy efficient urban planning. In other words, the platform is expected to perform the functions of a decision support tool.

As discussed in *D2.3 Impact verification*, our ability to make precise and yet relevant statements about a system diminishes as the complexity of the system increases (Zadeh, 1973). This issue has important consequences in the development of the SEMANCO integrated platform. For instance, when choosing adequate tools to simulate the energy performance of buildings, we have to decide between simplified or detailed energy modelling methods[16]. Usually, a detailed method is more time consuming in their application due to the bigger amount of required information, and the increasing time necessary to collect data and to enter it to the model. These requirements of time and information increases when the aim is to model the energy performance of urban areas (e.g. neighbourhood or city), and the modelling process would become unmanageable even if the amount of considered buildings are few. Since the SEMANCO platform is aimed at supporting decision making related to energy efficient interventions at urban level, simplified models better suit the requirements of the platform.

On the other hand, within the field of building energy simulations, it is well known that the outcomes of energy modelling are usually different than real energy performances. Calibration of the model (i.e. to adjust some parameters of the model in order to produce reliable results) is one way of making the results of calculations closer to real energy performances. However, this needs to have access to the real energy consumption of the same buildings that are being modelled. Another possibility is to compare the outcomes of energy modelling with some reference values; for instance with expected values of energy consumption according to certain building typologies. This issue is very important if the SEMANCO integrated platform is expected to produce reliable results to support decision making in the field of energy efficient urban planning.

In this regard, a preliminary baseline for the set of performance indicators in the three case studies is presented. This baseline of performance indicators would enable subsequent analysis and exploitation of the available data in each case study and to ensure comparability between sites and with other projects.

As the reader can see in Appendix B, Table B-1 to Table B-5, the three demonstration scenarios present the following similarities and differences:

- Heating demand and $CO_2$ emissions have been calculated across the three demonstration scenarios.

[16] The former requires entering general characteristics of the building or urban area to be modelled: street layout, the basic shape of the buildings (footprint, height and shape), surface and coefficients of thermal transfer of enclosures (walls, windows, roof) and climatic data. Detailed models, on the other side, require more precise information about the type and size of windows, doors, woodwork, among others. A simplified model would be more suitable to, for instance, optimize energy demand of a group of buildings (i.e. to find the configuration of the urban area with less energy consumption in relation with other evaluated alternatives). In the same line, the use of detailed model is closer to the definition of a building project, which would be subject of some energy efficiency requirements according to the law (i.e. technical code)

- Electricity consumption from electric devices actually used within the home is estimated in the three demonstration scenarios.
- Energy demand for domestic hot water has been calculated in the case of Newcastle and North Harbour.
- Operational costs are calculated only in the Newcastle case. These are expressed through the SAP rating, which strongly relates to these costs but is normalised in relation to the amount of floor space within the dwelling and put onto a scale roughly between 0 and 100.

Electricity consumption from devices used within the household is a result of estimations in the three demonstration scenarios. Basically, all cases use a technical coefficient (i.e. electricity consumption per square meter) that is multiplied by the total floor area to calculate the total amount of electricity consumption. In the case of North Harbour, this technical coefficient takes two different values depending on the type of building (residential or office). Then, the calculated electricity consumption will be used to define the energy supply system (in second and third implementation round). In the case of Manresa, the value of electricity consumption per square meter is defined according to the income of the household and, at this stage of implementation, it considers only residential buildings. Electricity consumption is then used to calculate internal heat gains and the demand of energy for heating and cooling. In the case of Newcastle, the calculation of electricity consumption is similar than in the Manresa case, but using different calculation procedures (i.e. formulas). However, these figures are also used to determine the energy requirements for heating. The difference with the Manresa demonstration scenario is that SAP also calculates electricity consumption from lighting and the central heating pump.

In general terms, it can be said that the estimations of electricity consumption from devices used within the household are very rough. These estimations depend on one parameter in each case; for instance, the type of building in North Harbour or the household income in Manresa. One way of improving this issue is to use the tools and services developed within *Task 5.2 Energy analysis, and optimization and strategic decision tools*. For instance, the estimation of electricity consumption might rely upon several parameters – e.g. household income, number of inhabitants, orientation of building, level of education, etc. – by using data mining techniques.

During the second implementation round, partners responsible of demonstration scenario will look for real data either in official statistics or based on expert knowledge in order to define a set of benchmarks for each of the indicators of energy performance.

Finally, Table 9 presents a preliminary comparison of the set of indicators used in the different contexts. According to the information presented in the table, indicators related to energy demand and $CO_2$ emissions are very similar across case studies. Economic issues are considered from the supply side in the North Harbour demonstration scenario, and from the consumption perspective in the other two cases. Not all case studies deal with energy certification issues and there is still a lack of cross-cutting quality of life indicators across cases, with few exception of Newcastle.

*Table 9. Comparison of sets of performance indicators across case studies*

| ***Type*** | ***General comments*** | ***Extensive/Intensive*** | ***Apprise multiple scales*** |
|---|---|---|---|
| Energy demand | While the Newcastle case study considers the total amount of energy demand (excluding electrical appliances use), Manresa and North Harbour explicitly differentiate energy demand for electricity, cooling and heating.<br>Additionally, the case of Manresa indicates the total primary energy consumption. | The three cases can easily calculate absolute energy demand (and consumption) and energy demand per built square meters. | All cases are able to calculate energy demand at building and urban scales.<br>It remains the issue of calculating energy demand according to different land or building uses |
| $CO_2$ emissions | Newcastle and Manresa cases indicate the total amount of $CO_2$ emissions, in absolute terms and per square meters. The North Harbour case differentiates between $CO_2$ emissions produced from heating, cooling and electricity (which can be also performed in the case of Manresa, but it is still under development). | All cases have the possibility of calculating $CO_2$ emissions in absolute terms and per square meters, even though some of them do not mention it explicitly.<br>In the case of Newcastle and Manresa, calculation is done with SAP and URSOS respectively. The calculation methods assess the energy consumption per building, but as we know the built surface, we can obtain their energy performance per square meter.<br>In the North Harbour case, energy consumption per square meter is already given, by the technical coefficient used for the calculations benchmarks previously presented. | All cases are able to calculate emissions at building and urban scales. The last, would be a result of aggregating the individual energy performance of buildings within the target urban area.<br>It remains the issue of calculating emissions according to different land or building uses. |
| Economic issues | In the case of Newcastle and Manresa, they consider calculating the investment cost of performing energy related improvement. Also, these cases consider the issue of profitability, either calculating the internal rate of return or the lifetime cost/gain balance. Both cases also consider calculating changes in the energy bill compared to the baseline.<br>In the case of North Harbour, the indicators are related to the costs to produce and supply energy services (i.e. heating, cooling, electricity, domestic hot water) to different EP alternatives<br>North Harbour would be able to calculate energy cost from the consumer point of view. | Both in Newcastle and Manresa, the cost of *energy consumption* is calculated in absolute terms. However, they can easily calculate energy cost per square meter.<br>In the North Harbour case the perspective changes: it is calculated the cost of *supply energy*. | Investment costs and rate of return are related to the specific improvement action.<br>On the other hand, the cost of energy consumption can easily be calculated at urban levels, from the calculations at building level.<br>It remains the issue of calculating cost of energy consumption according to different land or building uses. |
| Energy certification | Both, Newcastle and North Harbour consider the assessment of whether a specific building complies with national energy standards. | Not applicable | At building level |

| ***Type*** | ***General comments*** | ***Extensive/Intensive*** | ***Apprise multiple scales*** |
|---|---|---|---|
| Socio-economic | Only the Newcastle case considers the calculation of socio-economic indicators such as energy poverty and multiple deprivation levels.<br>Other cases will consider including quality of life indicators in the forthcoming implementation rounds. | Not applicable | Calculated at building and city level |

# 7 CONCLUSIONS

## 7.1 Contribution to overall picture

In *Task 8.2 Implementation*, the use cases and their corresponding activities described in *D8.1Implementation plan* have been implemented in demonstration scenarios in each of the three case studies: Newcastle, North Harbour and Manresa. This implementation has been carried out while the tools and integrated platform are still under development. In this context, the purpose of the implementation has been to verify the feasibility of the procedures which have been performed with the available tools. As a result, in this document it is presented the shortcomings in previous descriptions of activities and defines their necessary refinements. The document also includes the feedback to technological development, which have to be delivered in the form of new or updated activity forms at the beginning of the second implementation round. In order to do so, the report deals with the following issues:

1. State the objectives of each demonstration scenario (i.e. the objective of the implemented use case and the corresponding activities)
2. Describe the activities already performed in real scenarios today, either with existing or prototype tools, by users, stakeholders or domain experts
3. Evaluate whether we have been successful in implementing those activities and in meeting the objectives of the demonstration scenario

In summary, it has been assessed how far the some of the tools being developed could, in their current state, address the identified problems. Based on that evaluation, feedback to technological development is provided in order to update or incorporate, to the integrated platform, the functionalities required to perform the activities.

*Task 8.2 Implementation* encompasses actions to involve local actors and stakeholders and collecting data and information to document the process. At this stage of the project development, most of the activities of this first implementation round have been performed by domain experts (i.e. the gathering and integration of data, the input of data to simulation models and the calculation of performance indicators). Since the first prototype of the integrated platform will become operative during the second implementation round, actions to involve local actors and stakeholders will take place during that implementation round.

In *Task 8.3 Intermediate report on implementation*, the partners responsible of each demonstration scenario will demonstrate and validate the decision support tools within the SEMANCO integrated platform. Also, in Task 8.3 partners in charge of implementation will develop a more comprehensive common information database structure with all necessary specifications. This means, to provide data ranges, types, benchmarking values and the potential minimum and maximum values of the set of performance indicators. The aim is to enable subsequent analysis and exploitation of the available data in each case study and to ensure comparability between sites and with other projects. However, in this document it is presented a preliminary assessment of the similarities and differences on the set of performance indicators across case studies (See Table 9). In general, there is still a lack of cross-cutting quality of life indicators, with few exception of Newcastle.

## 7.2 Impact on other WPs and Tasks

Task 8.2 and Deliverable 8.2 have the following impacts on the other work packages and tasks:

- This first implementation round has entailed actions involving the local actors and stakeholders and collecting data and information to document the process. Since WP6 frames the relationships between the project development and actors and users, interaction with actors and users may lead to confusion about the role of WP6 and WP8. They are strongly related, but differ in the degree of detail in framing the issue of carbon reduction. On the one side, D6.1 has to do with context (legislation, scales, stakeholders) and with identifying and specifying the range of use cases, assuring that the tools developed are applicable beyond the functionalities implemented here. On the other side, D8.2 has to do with implementation of specific use cases in the field of energy efficient urban planning, with the determination of the scope of the implemented tools (functionalities and purposes) and with the feedback to the technological development (WP5).

- D8.2 also has an important impact on the technological development of the project. After this first implementation round, involved partners have been able to provide feedback for tools and integrated platform in generic terms to WP5. Also, we have been able to provide information in more precise terms; that is, to check whether we have to update the corresponding activity forms or to add new ones. Those are the basis for the development of the integrated and embedded tools within the SEMANCO platform.
- Moreover, after this first implementation, we have been able to identify missing data to be modelled within WP3 and the potential existence of additional concepts to be included in the ontologies developed in WP4.
- Electricity consumption from electric devices used within the household has been estimated in a very a simple way (i.e. based upon only one parameter). In the second and third iteration, it is expected to use the tools developed within Task 5.2 (i.e. data mining) in order to improve these estimations by considering several socio-economic and structural parameters (in at least one demonstration scenario). In turns, implementation will also provide feedback to the development of Task 5.2.

## 7.3 Contribution to demonstration

The work presented in this deliverable continues with the work started in D8.1 to demonstrate the capacities of the SEMANCO tools to support decision making in energy efficient urban planning. Table 10 presents the contribution of both deliverables to the different demonstration phases:

*Table 10. Contribution of D8.1 to the demonstration phases*

| ***Tasks in the demonstration phases*** | ***Contribution of Deliverable 8.1*** | ***Contribution of Deliverable 8.2*** |
|---|---|---|
| The automated identification and classification of buildings for energy analysis within a geographic area | Description of existing databases, technical requirements, and objectives of an automated classification of buildings are defined for the different demonstration scenarios | Use of existing databases (e.g. cadastre and GIS of the city) to identify buildings (demolished, replaced, existing and planned)<br>Definition of procedures to classify buildings according to age categories and household income. |
| The identification and visualisation of 'energy use hot spots' to support the effective targeting of urban energy efficiency and renewable energy interventions | Not applicable | Assessment and comparison of energy performance of buildings by means of applying simulation software packages calculation procedures)<br>Visualization of calculation outcomes in 3D maps<br>Visualization of energy performance at urban level (e.g. energy related LLSOA data – energy poverty) |
| Assessment of the potential of different technical and social interventions and strategies to reduce $CO_2$ emissions at different geographic scales; | Definition of the methodology of calculation and flow chart to define and calculate interventions and strategies to reduce $CO_2$ emissions considered within each demonstration scenario<br>Recognition of the complexities entailed by the definition of the analytical scales and preliminary definition of micro, meso and macro scales, and by the definition of a common use case | Calculation of baseline in two cases (Newcastle and Manresa). This allows the analysis of pros and cons of the applied methodology.<br>Assessment and comparison of different technical interventions (North Harbour). This allows to<br>First attempt to calculate indicators at different scales. |
| Optimisation or trade-offs between conflicting social, economic, political and environmental constraints within planning and design practice to support stakeholder decision making; | Description of the international, national and local policy frameworks and local urban planning schemes, which frame (or constrain) the urban planning practices in demonstration scenario. | Calculation of a set of performance indicators |
| Extracting guidelines to apply to other areas and projects, providing planning authorities (local, national and European) with appropriate indicators for monitoring and reporting that can be used to establish future planning strategies; | Not applicable | First implementation round provide preliminary insights in a learning process. After the following implementation rounds, we will be able to derive guidelines to apply to other areas and projects |
| Predicting future demand following demographic and economic changes by identifying patterns of growth and sustainable urban developments which reduce energy consumption | Definition of the methodology for baseline calculation of energy consumption and $CO_2$ emissions in each demonstration scenario. The performance of the final demonstration scenarios – developed with the support of the methods and tools developed in SEMANCO – will be compared against those baselines. | Calculation of baseline to further assess and compare future scenarios, under a set of appropriate indicators. Those scenarios (i.e. urban planning alternatives) will consider demographic and economic changes. |

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# 9 GLOSSARY

**Data** means **energy-related open data**

**Methods** refer to the rules used to calculate the energy performance of buildings and places

**Tools** used to assess the energy performance of buildings and places and to support decision-making in urban planning

**Actors** are stakeholders in the urban planning process; they will not necessarily use tools

**Users** are individuals who will be using the tools to calculate/simulate/visualise the energy performance of buildings and places

**Integrated platform.** The SEMANCO integrated on-line platform provides access to data, tools and services developed in the project that can be used by different stakeholders involved in the design and implementation of actions aimed at reducing carbon emissions at the urban scale. The platform provides an integrated access to semantically modeled data –building typological data and urban data– required by the tools and services. The platform contains three kinds of tools:

- Embedded which are intrinsic to the platform and developed specifically in the project. An example is SAP.
- Interfaced which are existing tools with an interface built in the project to interact with other tools and services from the platform such as URSOS.
- External which are existing tools using exported data from the platform to work with the data. An example is LEAP.

Both together the data and tools enable a set of services provided by the platform such as the following:

- treat carbon reduction problems holistically by encompassing the multiple dimensions involved,
- facilitate access to energy related information by exposing existing energy related data to the Internet using semantic technologies,
- analyze heterogeneous and distributed energy related data using data mining of data distributed in heterogeneous services,
- visualize consumptions at the urban level and benchmarking consumption levels, and provide appropriate energy indicators and the methodologies to calculate them.

The platform includes two environments: visualization and intervention. In **visualization** any kind of users can explore –visualizing, filtering, comparing– the energy performance baseline for a city by means of the 3D Maps technology. In **intervention**, registered users have access to the tools and services to update the baseline and to create new interventions (new policies, plans…) to be compared with the baseline.

**Demonstration scenario** is the implementation of a use case in real world scenarios. A **use case** is made up of a series of **activities**, which are specific actions which have to be performed to meet the objective of the use case; usually, a strategic goal regarding carbon reduction in urban settings.

**Energy efficient intervention** refers to any policy or plan aimed at improving the energy and $CO_2$ emissions performance of buildings and urban areas.

**Baseline** refers to the performance of a building or urban area in its preliminary or current state. That is, before any intervention. It is the main yardstick with which to compare alternatives.

# 10 APPENDICES

## Appendix A. Table of indicators

### A.1. Newcastle

*Table A-1. Indicators and calculation methods Newcastle*

| Type | Unit | Calculation method | Input needed | Obs. | Implementation round | Benchmark description |
|---|---|---|---|---|---|---|
| Total predicted yearly energy demand for a single dwelling | kWh/Dwelling·Year | Output of SAP | See Activity Template 5 | | 1st | The energy predicted to use to run a given single dwelling for a year. This includes space and water heating and a minor element of energy usage for some items such as lighting. However it also explicitly *excludes* consideration of the electricity used by appliances. |
| Total predicted CO2 emissions for a single dwelling | Kg/Dwelling·Year | Output of SAP | See Activity Template 5 | | 1st | As above but converted to CO2 production. SAP has internal values for the CO2 production from a kWh of electricity or gas. |
| Normalised CO2 emissions for a single dwelling | Kg/Total·m2 | Output of SAP | See Activity Template 5 | | 1st | As above but normalised for the total floor area of the dwelling. However this should *not* be considered as a per square meter measurement. It is still a per dwelling measurement. |
| SAP (National Rating) | [-] | National Calculation Method | See Activity Template 5 | | 1st | This is a single, effectively unit less, number normally lying between ~40 and 100.<br>It most closely reflects the predicted cost of running a given dwelling for a year, but is normalised in various ways.<br>It is this figure which is the legal UK benchmark and comparable across different dwellings. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Upfront install cost of proposed improvements | £/Dwelling·Year | 5.3 tool. Some improvements have a fixed, estimated, cost. Some scale with features of the dwelling. | See Activity Template 7 | | 2nd | The total upfront installation cost of a proposed set of improvements. |
| SAP improvement for a set of proposed improvements | [-] | 5.1/5.3 tools combined. | See Activity Template 7 | | 2nd | The SAP value is recalculated using the dwellings parameters, modified by the proposed improvements. |
| Yearly CO2 improvement for a set of proposed improvements | Kg/Dwelling·Year | 5.1/5.3 tools combined. | See Activity Template 7 | | 2nd | As above but recalculating total CO2 consumption instead of SAP. |
| Yearly net energy use improvement for a set of proposed improvements | kWh/Dwelling·Year | 5.1/5.3 tools combined. | See Activity Template 7 | | 2nd | As above but recalculating total energy consumption instead of SAP. |
| Annual Savings on energy bill | £/Dwelling·Year | 5.1/5.3 tools combined. | See Activity Template 7 | | 2nd | As above but the difference in the predicted energy bills from the improvements. |
| Total predicted lifetime cost loss/gain balance | £/Dwelling | 5.1/5.3 tools combined, predicted energy price inflation, UK tariff rates etc | See Activity Template 7 | | 2nd | The predicted monetary gain/loss judged over the lifetime of these improvements (20 years). Includes predicted energy price inflation and various UK government incentives. |
| Index of multiple deprivation (Neighbourhood level) | N | Income/ housing/ crime and living environment scores and ranking from the index of multiple deprivation | IMD Scale | | 1st | IMD will enable us to identify the level of deprivation within the neighbourhood area compared with the municipality. Examining each of the indicators in this way will also help us to appreciate which of the multidimensional issues are particular prevalent in the area. |
| Index of multiple deprivation (City Level) | N | Income/ housing/ crime and living environment scores and ranking from the index of multiple deprivation | IMD Scale | | 1st | IMD will enable us to identify the level of deprivation within the city area compared with other cities. Examining each of the indicators in this way will also help us to appreciate which of the multidimensional issues are particular prevalent in the city. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Percentage of households population with access to energy services (final energy use) | % | Percentage of households with access to energy services. (final energy use) | Data taken from National Housing Stock Surveys | | 1st | This information will allow us to assess which primary heating fuel is being used by households within a specified area. |
| Number and Percentage of Households in Fuel Poverty. | N and % | Number and Percentage of Households in Fuel Poverty | Data taken from DECC. Fuel Poverty Statistics | | 1st | Local levels of fuel poverty may be compared (visualised) with regional/ national levels |

## A.2. North Harbour

*Table A-2. Indicators and calculation methods*

| Type | Unit | Calculation method | Input needed | Observations | Implementation round | Benchmark description |
|---|---|---|---|---|---|---|
| ***Energy demand for final energy uses*** | | | | | | |
| Electricity consumption | kWh/($m^2$·year) | The indicator is calculated from the following formula: kWh/$m^2$ = total consumption of kWh / total number of $m^2$ (differentiating between households and office buildings) | The annual consumption of electricity for buildings and total number of square meters | What is the expected final electricity use of a scenario in kWh per square meter? | 1st | Average final energy consumption for appliances and systems according to national statistics could be used to set the benchmark. However, new appliances and systems for new and existing buildings should have the energy label A, A+ and A++ or simply be Best Available Technology (BAT). |
| Heating demand | kWh/($m^2$·year) | The indicator is calculated from the following formula: kWh/$m^2$ = total consumption of kWh / total number of $m^2$ (differentiating between households and office buildings) | The annual consumption of heating for buildings and total number of square meters | What is the expected final heat use of a scenario in kWh per square meter? | 1st | Average final energy consumption for heating according to national building codes could be used to set the benchmark. |
| Cooling demand | kWh/($m^2$·year) | The indicator is calculated from the following formula: kWh/$m^2$ = total consumption of kWh / total number of $m^2$ (differentiating between households and office buildings) | The annual consumption of cooling for buildings and total number of square meters | What is the expected final use of cooling in a scenario in kWh per square meter? | 1st | Average final energy consumption for cooling systems according to Best Available Technology (BAT) for instance ground water cooling, absorption cooling, seawater cooling, energy efficient air conditioning units etc. |
| ***$CO_2$ emissions and reduction compared to baseline[17]*** | | | | | | |

[17] Indicators from this category are related to the supply side. They are needed to calculate the performance of the urban environment: CO2-factor x Energy consumption related to urban area

| Type | Unit | Calculation method | Input needed | Observations | Implementation round | Benchmark description |
|---|---|---|---|---|---|---|
| $CO_2$ emissions from the electricity supply | $tCO_2e/MWh$ | The indicator is calculated using the values from the following formula: Average $CO_2$e-factor for electricity ($gCO_2e/kWh$) = (Electricity consumption in city district (kWh) * $CO_2$e-factor electricity-grid ($gCO_2e/kWh$) + Electricity production in city district (kWh)* $CO_2$ -factor city electricity ($gCO_2e/kWh$))/ (Electricity consumption in city district (kWh) + Electricity production in city district (kWh)) | Input needed is $CO_2$e-factors for electricity produced, the total electricity produced and total electricity consumed, all within the city district, along with $CO_2$ e-factors for electricity produced outside the city district. | What is the average $CO_2$ emission coefficient for electricity expected to be in the city district? | | A target for reduction of GHGs for the city district as a geographic area is established. The benchmark value for the $CO_2$ factor for electricity is determined through the choice of instruments (energy efficiency, renewable energies.) that can contribute to the realisation of the target. The $CO_2$ factor will be documented through scenario analyses, welfare economics, corporate economics etc. |
| $CO_2$ emissions from the heat supply | $tCO_2e/MWh$ | The indicator is calculated using the values from the following formula: average $CO_2$ -factor for heat ($gCO_2e/kWh$) = (heat supply from grid (kWh) * $CO_2$ -factor heat-grid ($gCO_2e/kWh$) + Heat production in city district (kWh)* CO2 factor city heating ($gCO_2e/kWh$))/ (heat supply from grid (kWh) + Heat production in city district (kWh)) | Input needed is $CO_2$ emission-factors for heat produced, the total heat produced and total heat consumed, all within the city district, along with CO2emission-factors for heat produced outside the city district. | What is the average $CO_2$ emission coefficient for heating expected to be in the city district? | | A target for reduction of GHGs for the city district as a geographic area is established. The benchmark value for the $CO_2$ factor for heat supply is determined through the choice of instruments (energy efficiency, renewable energy etc.) that can contribute to the realisation of the target. The $CO_2$ factor will be documented through scenario analyses, welfare economics, corporate economics etc. |
| $CO_2$ emissions from the cooling supply | $tCO_2e/MWh$ | The indicator is calculated using the values from the following formula: average $CO_2$ -factor for cooling ($gCO_2e/kWh$) = (cooling supply from grid (kWh) * $CO_2$ -factor cooling-grid ($gCO_2e/kWh$) + cooling production in city district (kWh)* CO2 factor city cooling ($gCO_2e/kWh$))/ (cooling supply from grid (kWh) + cooling production in city district (kWh)) | Input needed is $CO_2$ emission-factors for cooling produced, the total cooling produced and total cooling consumed, all within the city district, along with CO2emission-factors for cooling produced outside the city district. | What is the average $CO_2$ emission coefficient for cooling expected to be in the city district? | | A target for reduction of GHGs for the city district as a geographic area is established. The benchmark value for the $CO_2$ factor for cooling supply is determined through the choice of instruments (energy efficiency, renewable energy etc.) that can contribute to the realisation of the target. The $CO_2$ factor will be documented through scenario analyses, welfare economics, corporate economics etc. |

| Type | Unit | Calculation method | Input needed | Observations | Implementation round | Benchmark description |
|---|---|---|---|---|---|---|
| ***Energy simulations in buildings*** | | | | | | |
| Energy standards for buildings | - | Energy standards for the specific country/ region. Zero-emissions standards, plus energy standards, etc. | Information about building type, square metre and building energy consumption | Which energy standards do new buildings have to comply with in the city district? | | Choice of energy standard for new buildings is based on welfare economic calculations, social aspects, building plan aspects and expectations to technology development. |
| ***Cost/Economics*** | | | | | | |
| Electricity cost | €/kWh | The costs of implementation of electricity supply based on renewable energy (e.g. windmills, biomass plants etc.) is determined in relation to the expected ambition level for $CO_2$ -targets. The price per kWh for the chosen electricity supply solution is calculated on the basis of the combined investment costs, net present value of the operating costs over a 20 year period, including subsidies in the period in relation to the expected production. | The total cost of supplying electricity (investments, running costs, profit margin, etc.) and the total amount of electricity produced. | What price per kWh is expected for the electricity supply solution, including locale electricity plants? | | The electricity price should be attractive compared to the market price. |

| Type | Unit | Calculation method | Input needed | Observations | Implementation round | Benchmark description |
|---|---|---|---|---|---|---|
| Cost of heat supply | €/kWh | The price per kWh for the chosen heat supply solution is calculated on the basis of the combined investment costs, net present value of the operating costs over a 20 year period, including subsidies in the period in relation to the expected production. Efficient heat supply solutions could be: Conversion from natural gas to district heating. CHP based on biomass, Low temperature areas, Efficient utilisation of the temperatures in the district heating grid. | The total cost of supplying heat (investments, running costs, profit margin, etc.) and the total amount of heat produced from different sources. | What price per kWh is expected for the cooling supply solution, including local cooling plants? | | The heat price should be attractive compared to the market price. |
| Cost of cooling supply | €/kWh | The price per kWh for the chosen cooling supply solution is calculated on the basis of the combined investment costs, net present value of the operating costs over a 20 year period, including subsidies in the period in relation to the expected production. Efficient cooling supply solutions could be: ground water cooling, absorption cooling, seawater cooling, energy efficient air conditioning units etc. | The total cost of supplying cooling (investments, running costs, profit margin, etc.) and the total amount of cooling produced from different sources. | What price per kWh is expected for the cooling supply solution, including local cooling plants? | | The cooling price should be attractive compared to the market price. |

## A.3. Manresa

*Table A-3. Indicators and calculation methods Manresa*

| Type | Unit | Calculation method | Input needed | Observations | Implementation round | Benchmark description |
|---|---|---|---|---|---|---|
| Energy demand for heating | kWh/($m^2$·year) | Output from URSOS | Input parameters of URSOS (see template of Activity 5) | | $1^{st}$ – $2^{nd}$ | National building technical code |
| Energy demand for cooling | kWh/($m^2$·year) | Output from URSOS | Input parameters of URSOS (see template of Activity 5) | | $1^{st}$ – $2^{nd}$ | National building technical code |
| Electricity consumption | kWh/($m^2$·year) | Calculated with embedded tool | - Installed power capacity at home (according to socio-economic conditions)<br>- Use rate of electric appliances<br>- Percentage of electric heating and cooling systems | | $1^{st}$ – $2^{nd}$ | National building technical code<br>National Energy Efficiency Directive |
| Primary energy consumption | kWh/year | Calculated with embedded tool | | Should differentiate type of primary energy source | $1^{st}$ – $2^{nd}$ | |
| $CO_2$ emissions | $TCO_2/m^2$ | Electricity consumption * $CO_2$ emission factors of energy mix + Natural gas consumption * emission factor natural gas + Liquid fuels consumption * emission factor liquid fuels | Installed capacity (according to income)<br>Utilization factor (technical coefficient defined by expert domain) | Electricity consumption is calculated as Installed power capacity of building * utilization factor + energy demand for heating and cooling covered with electric systems. | $1^{st}$ – $2^{nd}$ | National Energy Efficiency Directive |

| **Type** | **Unit** | **Calculation method** | **Input needed** | **Observations** | **Implementation round** | **Benchmark description** |
|---|---|---|---|---|---|---|
| Cost of investment | € | Rate of demolishing cost * demolished surface + Rate of construction cost * constructed area + Rate of urbanization cost * Urbanized area | Rate of demolishing, construction and urbanization costs<br>Demolished, constructed and urbanized area | Rates of demolishing, urbanizing and constructing are expressed by $m^2$.<br>There will be 3 levels of construction costs: High, medium and low standard (with decreasing values)<br>Two types of urbanization costs: streets and squares | $2^{nd}$ | Cost of money |
| Internal Rate of Return | % | $\Sigma [C_i /(1+IRR)^n] = 0$<br><br>Where,<br>$C_i$:= cash flow of the period *I*<br>n:= number of periods | Price of land<br>Investment (previous indicator)<br>Renting prices<br>Neighbourhood coefficient of income<br>Maintenance costs of buildings | In case of selling houses:<br>Price of houses = Land price + Investment + Profit (15-20%)<br>Land prices is an input from the user<br>In case of renting<br>Renting prices: 5,5 €/$m^2$ * neighbourhood coefficient<br>(Neighbourhood coefficient: Defined by expert domain)<br>Depreciation of construction investment: 2,5%/year<br>Maintenance costs: Defined by expert domain | $2^{nd}$ | Cost of money |
| Solar electricity potential | kWh/year | Simplify method that calculate potential of solar electricity from solar radiation on walls and roofs | Solar radiation in each wall | Only walls with a minimum threshold of solar radiation will be considered | $2^{nd}$ | N/A |

# Appendix B. Outcomes from demonstration scenarios

## B.1. Newcastle

*Table B-1. Primary energy demand and SAP rating, Newcastle. Validations results.*

| **Location** | | **Primary Energy (kWh/m2)** | | | **SAP Rating** | | |
|---|---|---|---|---|---|---|---|
| ***No.*** | ***Post Code*** | ***Prototype*** | ***YHN**** | ***% Diff.*** | ***Prototype*** | ***YHN**** | ***% Diff.*** |
| 31 | NE4 7JU | 166.86 | 159.50 | 4.41% | 75 | 72 | 3.44% |
| 35 | NE4 7JU | 204.08 | 194.24 | 4.82% | 70 | 67 | 4.27% |
| 40 | NE4 7DR | 252.47 | 258.53 | -2.40% | 61 | 60 | 1.57% |
| 4 | NE4 6HZ | 233.38 | 216.35 | 7.30% | 68 | 66 | 3.55% |
| 9 | NE4 7DR | 265.25 | 243.09 | 8.35% | 50 | 50 | 0.08% |
| 1 | NE4 7DR | 240.94 | 219.80 | 8.77% | 60 | 57 | 4.36% |
| 3 | NE4 7DR | 240.94 | 217.56 | 9.70% | 66 | 60 | 8.72% |
| 5 | NE4 7DR | 238.22 | 222.62 | 6.55% | 62 | 60 | 3.11% |
| 11 | NE4 7DR | 238.22 | 244.82 | -2.77% | 56 | 61 | -9.03% |
| 34 | NE4 7HP | 167.31 | 159.58 | 4.62% | 75 | 71 | 4.93% |
| 52 | NE4 7HP | 172.16 | 175.73 | -2.08% | 72 | 75 | -4.63% |
| 18 | NE4 6JA | 172.19 | 190.52 | -10.65% | 67 | 70 | -4.76% |
| 20 | NE4 6JA | 170.69 | 198.21 | -16.12% | 65 | 71 | -8.61% |
| 14 | NE4 6EU | 231.61 | 204.35 | 11.77% | 65 | 61 | 5.89% |
| 68 | NE4 6HX | 142.22 | 144.15 | -1.36% | 73 | 75 | -2.16% |
| 13 | NE4 7HJ | 219.66 | 234.72 | -6.85% | 59 | 64 | -7.58% |
| 205 | NE4 6RZ | 219.56 | 187.80 | 14.47% | 72 | 64 | 10.93% |
| 203 | NE4 6RZ | 136.04 | 142.24 | -4.56% | 67 | 73 | -8.16% |
| 23 | NE4 7HJ | 219.66 | 245.39 | -11.71% | 61 | 64 | -4.99% |
| 13 | NE4 6EQ | 204.08 | 174.59 | 14.45% | 73 | 67 | 8.10% |
| 21 | NE4 6EQ | 205.09 | 208.48 | -1.65% | 71 | 75 | -6.28% |
| 10 | NE4 7EB | 214.66 | 243.84 | -13.59% | 60 | 64 | -6.40% |
| 115 | NE4 6RL | 198.67 | 176.89 | 10.97% | 68 | 64 | 6.01% |
| 113 | NE4 6RL | 198.67 | 183.54 | 7.62% | 67 | 66 | 2.09% |
| 107 | NE4 6RL | 198.67 | 195.07 | 1.81% | 66 | 65 | 0.84% |
| 105 | NE4 6RL | 198.67 | 184.81 | 6.98% | 66 | 65 | 0.84% |
| 103 | NE4 6RL | 198.67 | 182.32 | 8.23% | 68 | 65 | 3.89% |
| 101 | NE4 6RL | 198.67 | 190.27 | 4.23% | 65 | 65 | 0.03% |
| 159 | NE4 6RZ | 174.47 | 183.77 | -5.33% | 70 | 71 | -1.43% |
| 3 | NE4 6RE | 177.32 | 181.88 | -2.57% | 70 | 68 | 3.33% |
| 33 | NE4 6RG | 183.31 | 191.95 | -4.71% | 62 | 65 | -4.45% |
| 31 | NE4 6RG | 183.31 | 174.69 | 4.70% | 72 | 69 | 4.13% |
| 14 | NE4 6RJ | 241.68 | 228.17 | 5.59% | 64 | 63 | 1.62% |
| 30 | NE4 6ET | 237.00 | 221.81 | 6.41% | 62 | 61 | 2.24% |
| 35 | NE4 7HR | 183.76 | 166.94 | 9.15% | 72 | 69 | 4.78% |
| 54 | NE4 6HT | 189.71 | 212.08 | -11.79% | 64 | 68 | -6.18% |
| 66 | NE4 6HT | 146.43 | 152.02 | -3.82% | 75 | 74 | 1.44% |
| 5 | NE4 7HS | 176.06 | 170.16 | 3.35% | 74 | 70 | 5.52% |
| 38 | NE4 7DS | 226.67 | 232.29 | -2.48% | 60 | 63 | -4.95% |
| 15 | NE4 7HS | 235.86 | 227.43 | 3.57% | 65 | 62 | 4.50% |

| **Location** | | **Primary Energy (kWh/m2)** | | | **SAP Rating** | | |
|---|---|---|---|---|---|---|---|
| ***No.*** | ***Post Code*** | ***Prototype*** | ***YHN**** | ***% Diff.*** | ***Prototype*** | ***YHN**** | ***% Diff.*** |
| 7 | NE4 7DT | 273.36 | 264.03 | 3.41% | 56 | 56 | -0.59% |
| 24 | NE4 7DT | 240.44 | 249.79 | -3.89% | 58 | 61 | -5.08% |
| 22 | NE4 7DT | 218.32 | 211.73 | 3.02% | 68 | 64 | 5.31% |
| 19 | NE4 7DT | 264.60 | 250.76 | 5.23% | 59 | 56 | 5.71% |
| 71 | NE4 6RS | 182.62 | 156.11 | 14.52% | 73 | 65 | 11.13% |
| 48 | NE4 6RS | 164.11 | 163.91 | 0.12% | 70 | 69 | 1.58% |
| 85 | NE4 6RL | 171.28 | 174.98 | -2.16% | 72 | 71 | 1.68% |
| 57 | NE4 6RS | 159.93 | 152.72 | 4.51% | 76 | 73 | 4.25% |
| 47 | NE4 6RS | 164.11 | 147.86 | 9.90% | 77 | 72 | 6.55% |
| 35 | NE4 6RS | 294.51 | 277.50 | 5.77% | 55 | 55 | 0.80% |
| 46 | NE4 6RP | 224.13 | 227.19 | -1.36% | 63 | 63 | 0.36% |
| 48 | NE4 6RP | 173.08 | 177.50 | -2.56% | 68 | 70 | -3.61% |
| 62 | NE4 6RP | 224.13 | 233.60 | -4.22% | 62 | 63 | -2.39% |
| 18 | NE4 6RP | 175.00 | 177.40 | -1.37% | 68 | 70 | -2.43% |
| 20 | NE4 6RP | 175.00 | 184.74 | -5.57% | 68 | 69 | -2.10% |
| 26 | NE4 6RQ | 245.12 | 248.48 | -1.37% | 57 | 60 | -5.76% |
| 54 | NE4 6RQ | 316.24 | 293.11 | 7.31% | 49 | 49 | -0.06% |
| 43 | NE4 6RQ | 230.21 | 241.88 | -5.07% | 60 | 62 | -2.67% |
| 57 | NE4 6RQ | 253.15 | 263.92 | -4.25% | 53 | 58 | -9.35% |
| 160 | NE4 7JT | 201.62 | 199.69 | 0.96% | 66 | 67 | -2.10% |
| 150 | NE4 7JT | 210.94 | 194.93 | 7.59% | 74 | 68 | 7.88% |
| 152 | NE4 7JT | 210.94 | 225.68 | -6.99% | 60 | 65 | -8.68% |
| 156 | NE4 7JT | 156.87 | 154.70 | 1.38% | 76 | 73 | 4.02% |

(*) YHN stands for Your Homes Newcastle, the social housing provider in the Newcastle case study area.

## B.2. North Harbour

*Table B-2. Specific energy demands for the North Harbour demonstration scenario*

| **Age class** | **2010-2015** | **2016-2020** | **2021-2030** | **2030<** |
|---|---|---|---|---|
| Heat demand, kWh/($m^2$ GFA·year) | | | | |
| Residential | | | | |
| Single-family_house | 29,88 | 12,405 | 8,44 | 8,44 |
| Apartment_block | 29,88 | 12,405 | 8,44 | 8,44 |
| Office | | | | |
| Computer_centre | 32,16 | 12,885 | 5,852 | 5,852 |
| Stand-by Duty | 32,16 | 12,885 | 5,852 | 5,852 |
| Hot water demand, kWh/($m^2$ GFA·year) | | | | |
| Residential | | | | |
| Single-family_house | 13,1 | 13,1 | 13,1 | 13,1 |
| Apartment_block | 13,1 | 13,1 | 13,1 | 13,1 |
| Office | | | | |
| Computer_centre | 5,2 | 5,2 | 5,2 | 5,2 |
| Stand-by Duty | 5,2 | 5,2 | 5,2 | 5,2 |
| Elec. demand, kWh/($m^2$·year) | | | | |
| Residential | | | | |
| Single-family_house | 22 | 22 | 22 | 22 |
| Apartment_block | 22 | 22 | 22 | 22 |
| Office | | | | |
| Computer_centre | 30 | 32 | 32 | 32 |
| Stand-by Duty | 30 | 32 | 32 | 32 |
| Cooling demand, kWh/($m^2$·year) | | | | |
| Residential | | | | |
| Single-family_house | 0 | 0 | 0 | 0 |
| Apartment_block | 0 | 0 | 0 | 0 |
| Office | | | | |
| Computer_centre | 21 | 17 | 17 | 16 |
| Stand-by Duty | 21 | 17 | 17 | 16 |

*Table B-3. Baseline indicators for the North Harbour demonstration scenario*

| | Unit | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conditioned space** | | | | | | | | | | | | | | | | | | | | | | | | |
| Apartment_block | $m^2$ | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 | 25.000 |
| computer_centre | $m^2$ | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 | 27.500 |
| ***Total*** | ***$m^2$*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** | ***52.500*** |
| Demand | | | | | | | | | | | | | | | | | | | | | | | | |
| Heat | | | | | | | | | | | | | | | | | | | | | | | | |
| Apartment_block | MWh/year | 747 | 1.494 | 2.241 | 2.551 | 2.861 | 3.171 | 3.482 | 3.792 | 4.003 | 4.214 | 4.425 | 4.636 | 4.847 | 5.058 | 5.269 | 5.480 | 5.691 | 5.902 | 6.113 | 6.324 | 6.535 | 6.746 | 6.957 |
| computer_centre | MWh/year | 884 | 1.769 | 2.653 | 3.008 | 3.362 | 3.716 | 4.071 | 4.425 | 4.586 | 4.747 | 4.908 | 5.069 | 5.230 | 5.390 | 5.551 | 5.712 | 5.873 | 6.034 | 6.195 | 6.356 | 6.517 | 6.678 | 6.839 |
| Hot water | | | | | | | | | | | | | | | | | | | | | | | | |
| Apartment_block | MWh/year | 328 | 655 | 983 | 1.310 | 1.638 | 1.965 | 2.293 | 2.620 | 2.948 | 3.275 | 3.603 | 3.930 | 4.258 | 4.585 | 4.913 | 5.240 | 5.568 | 5.895 | 6.223 | 6.550 | 6.878 | 7.205 | 7.533 |
| computer_centre | MWh/year | 143 | 286 | 429 | 572 | 715 | 858 | 1.001 | 1.144 | 1.287 | 1.430 | 1.573 | 1.716 | 1.859 | 2.002 | 2.145 | 2.288 | 2.431 | 2.574 | 2.717 | 2.860 | 3.003 | 3.146 | 3.289 |
| ***Total heat demand*** | ***MWh/year*** | ***2.102*** | ***4.204*** | ***6.306*** | ***7.441*** | ***8.576*** | ***9.711*** | ***10.846*** | ***11.981*** | ***12.823*** | ***13.665*** | ***14.508*** | ***15.350*** | ***16.193*** | ***17.035*** | ***17.878*** | ***18.720*** | ***19.562*** | ***20.405*** | ***21.247*** | ***22.090*** | ***22.932*** | ***23.775*** | ***24.617*** |
| Electricity for appliances etc. | | | | | | | | | | | | | | | | | | | | | | | | |
| Apartment_block | MWh/year | 550 | 1.100 | 1.650 | 2.200 | 2.750 | 3.300 | 3.850 | 4.400 | 4.950 | 5.500 | 6.050 | 6.600 | 7.150 | 7.700 | 8.250 | 8.800 | 9.350 | 9.900 | 10.450 | 11.000 | 11.550 | 12.100 | 12.650 |
| computer_centre | MWh/year | 825 | 1.650 | 2.475 | 3.355 | 4.235 | 5.115 | 5.995 | 6.875 | 7.755 | 8.635 | 9.515 | 10.395 | 11.275 | 12.155 | 13.035 | 13.915 | 14.795 | 15.675 | 16.555 | 17.435 | 18.315 | 19.195 | 20.075 |
| ***Total electricity demand*** | ***MWh/year*** | ***1.375*** | ***2.750*** | ***4.125*** | ***5.555*** | ***6.985*** | ***8.415*** | ***9.845*** | ***11.275*** | ***12.705*** | ***14.135*** | ***15.565*** | ***16.995*** | ***18.425*** | ***19.855*** | ***21.285*** | ***22.715*** | ***24.145*** | ***25.575*** | ***27.005*** | ***28.435*** | ***29.865*** | ***31.295*** | ***32.725*** |
| **Supply** | | | | | | | | | | | | | | | | | | | | | | | | |
| District heating | | 2.102 | 4.204 | 6.306 | 7.441 | 8.576 | 9.711 | 10.846 | 11.981 | 12.823 | 13.665 | 14.508 | 15.350 | 16.193 | 17.035 | 17.878 | 18.720 | 19.562 | 20.405 | 21.247 | 22.090 | 22.932 | 23.775 | 24.617 |
| **Final consumption** | | | | | | | | | | | | | | | | | | | | | | | | |
| Electricity consumption | [MWh/year] | 1.375 | 2.750 | 4.125 | 5.555 | 6.985 | 8.415 | 9.845 | 11.275 | 12.705 | 14.135 | 15.565 | 16.995 | 18.425 | 19.855 | 21.285 | 22.715 | 24.145 | 25.575 | 27.005 | 28.435 | 29.865 | 31.295 | 32.725 |
| District heating | [MWh/year] | 2.102 | 4.204 | 6.306 | 7.441 | 8.576 | 9.711 | 10.846 | 11.981 | 12.823 | 13.665 | 14.508 | 15.350 | 16.193 | 17.035 | 17.878 | 18.720 | 19.562 | 20.405 | 21.247 | 22.090 | 22.932 | 23.775 | 24.617 |
| **Emissions** | | | | | | | | | | | | | | | | | | | | | | | | |
| Electricity consumption | [t$CO_2$/year] | 469 | 758 | 1.073 | 1.492 | 1.833 | 1.957 | 2.095 | 2.272 | 2.280 | 2.607 | 2.939 | 2.640 | 2.891 | 3.028 | 3.273 | 3.469 | 3.770 | 4.117 | 4.256 | 4.649 | 4.758 | 4.979 | 5.173 |
| District heating | [t$CO_2$/year] | 202 | 402 | 600 | 706 | 795 | 889 | 969 | 1.075 | 1.144 | 1.211 | 1.262 | 1.274 | 1.349 | 1.336 | 1.387 | 1.429 | 1.490 | 1.575 | 1.701 | 1.739 | 1.804 | 1.921 | 1.993 |
| ***Total*** | ***[t$CO_2$/year]*** | ***672*** | ***1.160*** | ***1.673*** | ***2.198*** | ***2.628*** | ***2.846*** | ***3.064*** | ***3.347*** | ***3.423*** | ***3.818*** | ***4.201*** | ***3.915*** | ***4.240*** | ***4.364*** | ***4.660*** | ***4.899*** | ***5.260*** | ***5.692*** | ***5.957*** | ***6.387*** | ***6.562*** | ***6.899*** | ***7.166*** |

## B.3. Manresa


*Figure B 1. Codes of the buildings in the target urban area*

*Table B-4. Energy demand for heating and cooling. Baseline of Quatre Cantons urban area, Manresa*

| Building code | Heating demand [MWh/year] | Cooling demand [MWh/year] | Conditioned surface [m2] | Heating demand (Intensive) [KWh/(m2·year)] | Cooling demand (Intensive) [KWh/(m2·year)] |
|---|---|---|---|---|---|
| UA1_type1 | 29,14 | 0 | 190,3 | 153,1 | 0,0 |
| UA1_type2 | 24,69 | 0 | 269,0 | 91,8 | 0,0 |
| UA1_type3 | 54,33 | 0 | 462,3 | 117,5 | 0,0 |
| UA1_type4 | 30,91 | 0 | 304,8 | 101,4 | 0,0 |
| UA1_type5 | 54,7 | 0 | 329,7 | 165,9 | 0,0 |
| UA1_type6 | 47,34 | 0 | 422,8 | 112,0 | 0,0 |
| UA1_type7 | 46,11 | 0 | 328,3 | 140,5 | 0,0 |
| UA1_type8 | 21,94 | 0 | 256,4 | 85,6 | 0,0 |
| UA1_type9 | 61,29 | 0 | 436,4 | 140,4 | 0,0 |
| UA1_type10 | 51,31 | 0 | 720,5 | 71,2 | 0,0 |
| UA1_type11 | 56,88 | 0 | 628,1 | 90,6 | 0,0 |
| UA1_type12 | 59,57 | 0 | 686,8 | 86,7 | 0,0 |
| UA1_type13 | 18,75 | 0 | 175,4 | 106,9 | 0,0 |
| UA1_type14 | 36,67 | 0 | 508,9 | 72,1 | 0,0 |
| UA1_type15 | 0 | 0 | 322,3 | 0,0 | 0,0 |
| UA1_type16 | 48,84 | 0 | 438,5 | 111,4 | 0,0 |
| UA1_type17 | 53,22 | 0 | 281,5 | 189,0 | 0,0 |
| UA1_type18 | 42,92 | 0 | 199,8 | 214,8 | 0,0 |
| UA1_type19 | 24,68 | 0 | 198,1 | 124,6 | 0,0 |
| UA1_type20 | 25,44 | 0 | 244,0 | 104,3 | 0,0 |

| Building code | Heating demand [MWh/year] | Cooling demand [MWh/year] | Conditioned surface [m2] | Heating demand (Intensive) [KWh/(m2·year)] | Cooling demand (Intensive) [KWh/(m2·year)] |
|---|---|---|---|---|---|
| UA1_type21 | 17,79 | 0 | 230,4 | 77,2 | 0,0 |
| UA1_type22 | 13,57 | 0 | 130,9 | 103,7 | 0,0 |
| UA1_type23 | 21,78 | 0 | 257,3 | 84,7 | 0,0 |
| UA1_type24 | 56,88 | 0 | 474,5 | 119,9 | 0,0 |
| **Urban area** | **898,75** | **0** | **8.497,1** | **105,8** | **0,0** |

*Table B-5. $CO_2$ emissions from gas and electricity consumption. Baseline of Quatre Cantons urban area, Manresa*

| Building code | Heating demand [MWh/year] | Electricity consumption [MWh/year] | CO2 emissions heating [tCO2/year] | CO2 emissions electricity [tCO2/year] | CO2 emissions [tCO2/year] |
|---|---|---|---|---|---|
| UA1_type1 | 29,14 | 3,68 | 7,0 | 1,5 | 8,5 |
| UA1_type2 | 24,69 | 5,20 | 5,9 | 2,1 | 8,0 |
| UA1_type3 | 54,33 | 8,94 | 13,0 | 3,6 | 16,6 |
| UA1_type4 | 30,91 | 5,90 | 7,4 | 2,4 | 9,8 |
| UA1_type5 | 54,7 | 6,38 | 13,1 | 2,6 | 15,7 |
| UA1_type6 | 47,34 | 8,18 | 11,4 | 3,3 | 14,6 |
| UA1_type7 | 46,11 | 6,35 | 11,1 | 2,5 | 13,6 |
| UA1_type8 | 21,94 | 4,96 | 5,3 | 2,0 | 7,2 |
| UA1_type9 | 61,29 | 8,44 | 14,7 | 3,4 | 18,1 |
| UA1_type10 | 51,31 | 13,94 | 12,3 | 5,6 | 17,9 |
| UA1_type11 | 56,88 | 12,15 | 13,7 | 4,9 | 18,5 |
| UA1_type12 | 59,57 | 13,29 | 14,3 | 5,3 | 19,6 |
| UA1_type13 | 18,75 | 3,39 | 4,5 | 1,4 | 5,9 |
| UA1_type14 | 36,67 | 9,84 | 8,8 | 3,9 | 12,7 |
| UA1_type15 | 0 | 6,24 | 0,0 | 2,5 | 2,5 |
| UA1_type16 | 48,84 | 8,48 | 11,7 | 3,4 | 15,1 |
| UA1_type17 | 53,22 | 5,45 | 12,8 | 2,2 | 15,0 |
| UA1_type18 | 42,92 | 3,87 | 10,3 | 1,5 | 11,8 |
| UA1_type19 | 24,68 | 3,83 | 5,9 | 1,5 | 7,5 |
| UA1_type20 | 25,44 | 4,72 | 6,1 | 1,9 | 10.1.1 8,0 |
| UA1_type21 | 17,79 | 4,46 | 4,3 | 1,8 | 6,1 |
| UA1_type22 | 13,57 | 2,53 | 3,3 | 1,0 | 4,3 |
| UA1_type23 | 21,78 | 4,98 | 5,2 | 2,0 | 7,2 |
| UA1_type24 | 56,88 | 9,18 | 13,7 | 3,7 | 17,3 |
| **Urban area** | **898,75** | **164,4** | **215,7** | **65,8** | **281,5** |

# Appendix C. Evaluation tables

- **Evaluation scale**
  - Very high – Implementation was able to fully perform the expected task
  - High – Implementation was able to perform most of the expected task
  - Medium – About half of the expected task was carried out
  - Low – Only a small portion of the expected task was carried out
  - None – Expected task was not carried out at all.
  - N/A – it is expected to be performed in next implementation rounds

## C.1. Newcastle

*Table C-1. Data modelling issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| Activities | Aims | Current state of implementation | Degree of fulfilment | Drawbacks and obstacles |
|---|---|---|---|---|
| **A.N1.- Energy performance alternatives definition** | The ability to create and consider alternatives for a major refit of an area of housing in Newcastle | The individual tools relating to both defining the baseline and the potential improvements to this baseline are implemented and integrated in the overall platform. | High | The area level aggregation of the results of improvements has yet to be implemented.<br>No inherent major obstacles to this are expected. |
| **A.N2.- Determination of geometry of buildings and the urban environment** | To generate 3D maps of Newcastle and the urban area, with visualization of socio-economical and urban environment parameters | The creation of a 3D map which would support automated collection of building data of the Newcastle case study area was found to be impossible with the existing data and consequently a LiDAR survey was commissioned. | Medium | The LiDAR survey was finally fully commissioned in Autumn of last but was delayed until arriving this Spring. |
| | To automatically generate geometric building model as an input of the calculation method. | While the SAP tool does not require geometric information beyond that which the user can measure there is an aspiration that this data can be provided automatically to simply the user’s task. | Low | The LiDAR survey was finally fully commissioned in Autumn of last but was delayed until arriving this Spring. |
| **A.N3.- Determination of the technical parameters of buildings** | To generate input values for the SAP tool to calculate the baseline energy consumption of an existing dwelling | The basic method for proceeding with this is the use of publically available street level imagery and manual interpretation.<br>The interface for inputting the values to the SAP tool has been implemented and integrated into the overall platform | Very high | The potential for interface changes due to user feedback remains. As one round of feedback/changes has already been completed, further major updates are not now currently expected. |

*Table C-2. Visualization issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| **Activities** | **Aims** | **Current state of implementation** | **Degree of fulfilment** | **Drawbacks and obstacles** |
|---|---|---|---|---|
| **A.N12 Visualization of socio-economic and energy related characteristics of the urban environment** | How socio-economic and energy information at the neighbourhood level can be visualised on the GIS Platform 3D Maps<br>SEIF will provide access to databases containing LLSOA boundary data and socio-economic data which will be used to identify and visualise levels of fuel poverty at the neighbourhood level | This can already be done using the current version of the platform – certain indicators can be selected and the relevant LLSOA areas are colour coded to indicate their value.<br>In addition a bubble with detailed information can be shown | High | The currently used set of indicators is not felt to be entirely ideal.<br><br>The NEA is preparing some information about how the presentation of fuel poverty indicators can be improved. |
| | Visualize output of SAP calculations in terms of high low and mid-range properties in the case study area | The dynamic colour coding of houses in response to the SAP values allocated to them by the SAP tool has been implemented within 3D maps | High | See the following section on mapping. |

*Table C-3. Calculation issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| **Activities** | **Aims** | **Current state of implementation** | **Degree of fulfilment** | **Drawbacks and obstacles** |
|---|---|---|---|---|
| **A.N4.- Model the energy performance of individual buildings.** | The SAP estimation tool developed as part of WP5 task 5.1 is used to calculate the energy performance of an individual building. | As above – the SAP tool is now running in software and fully integrated to the overall platform.<br>This tool gives values for both energy and $CO_2$ consumption. | Very high | |
| **A.N5.- Calculation of baseline operational costs** | This data is produced as an output of the SAP tool referenced above | As above | Very high | |

| Activities | Aims | Current state of implementation | Degree of fulfilment | Drawbacks and obstacles |
|---|---|---|---|---|
| **A.N6.- Calculation of the potential benefits of energy efficiency interventions** | A tool has been developed with complements the SAP tool by taking its output as input and using this to calculate the effects of various possible energy efficiency interventions for a given dwelling. This includes both fabric improvements (insulation) and renewable electricity/heat generation such as solar PV panels. | The tool for calculating the effects and costs of the improvements has been implemented and integrated with both the SAP tool and the overall integrated platform.<br>The interface of this tool is still in draft form and as such subject to revision due to user feedback. | High | The aggregation of the effects of the improvements attached to multiple houses to allow the consideration of the combined effect of the refit has yet to be completed. This task however lies within implementation round three. |
| **A.N7.- Decide on which energy efficiency measures should be made** | This uses both the output the tool mentioned above and the output of various economic data relating to each set of interventions.<br>In addition a multi criteria decision support tool has been produced which aids users in making such decisions. | All of the tools have been implemented and are ready to be integrated into the overall platform.<br>As above, certain interface changes arising from user feedback are expected, especially in relation to the economic indicators shown and the detail of the multi criteria tool. | High | |
| **A.N8.- Calculate the combined effect of these interventions (Cost and energy use)** | In addition to the changes to the energy efficiency of the dwelling, the tool mentioned above calculates both an estimated installation cost for the improvements.<br>In addition it considers various other financial aspects such as the relevant government subsidies. | As above. | High | As above. |
| **A.N9.- Multicriteria comparison of different alternatives** | To compare the energy performance alternatives under the set of performance indicators | The prototype tool is already implemented, but certain interface changes arising from user feedback are expected. | Low | |

## C.2. North Harbour

*Table C-4. Data modelling issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| Activities | Aims | Current state of implementation | Degree of fulfilment | Drawbacks and obstacles |
|---|---|---|---|---|
| **A.NH1.- Energy performance alternative definition** | To create a combination of energy performance with 3D maps of the area | An excel model that shows the calculation method has been elaborated. As soon as the architectural 3d model is harmonized with 3d to a satisfactory level, this process is straight forward. | Medium | Some flaws and issues in the 3d model of the North Harbour project have been detected; which gave inaccurate geometric data of the buildings. Agency9 are working on a workaround with the 3d model. |
| **A.NH2.- Determination of geometric characteristics** | Integration of the 3D model of the urban area in SEIF and in the integrated platform. | Under development | Low | |
| **A.NH3.- Determination of characteristics of urban environment** | Geometry of buildings, orthophotos and structural plans are included in 3D maps | Data already included in current 3D maps | High | |
| **A.NH4.- Determination of architectonic characteristics of the buildings in the urban environment** | Integration of information about urban environment. | In next implementation round we will consider whether to integrate this activity with A.NH2.<br>Whether to consider shadows in the calculation of the energy performance of buildings is a key issue upon which to base the decision. | N/A | |
| **A.NH6.- Definition and classification of building typologies** | Ability to classify buildings and assign technical parameters and/or a benchmark of energy performance. | We have defined a preliminary classification of buildings, based on the use of the building (dwellings or offices). | High | |

*Table C-5. Calculation issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| Activities | Aims | Current state of implementation | Degree of fulfilment | Drawbacks and obstacles |
|---|---|---|---|---|
| **A.NH5.- Model the energy performance of the EP alternatives (baseline and advanced)** | To calculate the building performance level via the simulation software IES. | Energy performance calculation is done in the tool. An excel based model that shows the calculation method has been elaborated for that purpose. | High | Same as "Creation of alternatives" |
| **A.NH7.- Calculation of operational and maintenance costs (baseline and advanced)** | First version of a cost benefit module to compare cost and energy savings for various energy performance levels, based on RETSCREEN software | Data are available, but have not been implemented yet. | Low | |
| **A.NH12.- Calculation of $CO_2$ emissions buildings and urban area** | To calculate $CO_2$ emissions according to final energy uses with IES and/or first version of module, for the different scenarios | So far this have been done in the excel based model. The calculation methods are to be implemented in the tool. This process is under its way. | High | |

## C.3. Manresa

*Table C-6. Data modelling issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| Activities | Aims | Current state of implementation | Degree of fulfillment | Drawbacks and obstacles |
|---|---|---|---|---|
| **A.M1. Definition of different alternatives of urban planning and local regulations** | To create alternatives through the interface defined in URSOS, in combination with 2D CAD maps | First implementation round only considers the calculation of the base line.<br>The only possibility now is to draw the urban area through the URSOS interface. | High | We were able to define the socio-economic and technical characteristics in the baseline. |
| **A.M2. Definition of system and occupation parameters** | To integrate data from different sources in a preliminary database of the area (i.e. technical parameters, occupancy) | We have delivered data tables that assign values to system and occupation parameters according to socio-economic information and to the age of the building. | High | The process of populating those tables with technical parameters implies a series of assumptions. Therefore, it remains to check whether the level of accuracy in defining those technical parameters is enough to compare alternative urban plans by means of simplified modeling. |
| **A.M3. Determination of geometry of buildings and urban environment** | To generate 3D maps of Manresa and the urban area. | 3D map of Manresa has been already generated<br>It remains pending the visualization of both outcomes from calculation and other socio-economic information | High | We've been able to provide data about population and dependency rates at neighbourhood level. With this information it is possible to calculate and visualize population densities at neighbourhood level. But it remains the need to provide additional information to calculate other urban planning indicators. |
| | To generate geometric building model as an input of the calculation method (i.e. URSOS) | Geometry of buildings and urban environment has been retrieved from Manresa's GIS in order to incorporate this information to URSOS. | High | This process has bee highly time consuming and needed to simplify geometries in order to be recognized by URSOS.<br>It remains to define how to retrieve data from Manresa GIS to input Ursos. Since GIS has the original geometry of buildings and not the simplified one. |
| **A.M4. Determination of technical parameters of buildings** | To generate the building typologies of the area, based on their age , uses and technical parameters (from legislation at this age) | We have created and delivered data tables that assign values to the calculation parameters according to age of construction of the building and their use. | High | The process of populating those tables with technical parameters implies a series of assumptions. Therefore, it remains to check whether the level of accuracy in defining those technical parameters is enough to compare alternative urban plans by means of |

| | | | | |
|---|---|---|---|---|
| | | | | simplified modeling. |
| **A.M8. Determination of environmental characteristics of urban environment** | To integrate climatic data in a preliminary database of the area | We have provided data tables with climatic data of Manresa city. | High | It remains to identify and access data sources with updated daily or monthly information |

*Table C-7. Visualization issues (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| **Activities** | **Aims** | **Current state of implementation** | **Degree of fulfillment** | **Drawbacks and obstacles** |
|---|---|---|---|---|
| **A.M15.- Calculate urban planning indicators (for the integrated platform)** | Visualization of socio-economical and urban environment parameters in 3D maps. | Data about population and dependency ratio has been delivered. It remains to process data (e.g. calculate population densities) and visualize them in 3D maps | None | Late delivery of data |

*Table C-8. Calculation issues. (Evaluation of Degree of fulfilment range from Very low, Low, Medium, High to Very high)*

| **Activities** | **Aims** | **Current state of implementation** | **Degree of fulfillment** | **Drawbacks and obstacles** |
|---|---|---|---|---|
| **A.M5. Calculation of energy performance of buildings and urban area** | To generate input variables for calculation methods (i.e. URSOS) | URSOS has not been integrated yet. Therefore, this requirement is expected to be met in the second implementation round | N/A | |
| | To calculate requirements of energy carriers according to final energy uses, for the different alternatives (with URSOS software). Base line scenario, BAU scenario, and one advanced scenario will be calculated. Only Energy efficiency measures will be calculated | First implementation round has performed only the calculation of baseline scenario. | Medium | There are some indicators that were not calculated. And that require the development of some specific embedded tools. |

| | | | | |
|---|---|---|---|---|
| **A.M6.- Calculation of $CO_2$ emissions of buildings and urban area** | To calculate $CO_2$ emissions according to final energy uses (with URSOS and Spanish energy mix) | $CO_2$ emissions of baseline have not been calculated. | None | Still missing the calculation of electricity consumption. Currently, we can make an assumption of electricity consumption based on the income of families and the installed power capacity. |
| **A.M7.- Calculation of operational and maintenance costs** | To calculate energy costs of investment and maintenance of energy efficiency measures with RETSCREEN software. To calculate preliminary results of the multi-criteria and multi-dimension analysis to the calculated scenarios | No alternative has been developed yet. Baseline only considers the calculation of maintenance costs and, probably, energy bill. | N/A | |