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SEMANCO Semantic Tools for Carbon Reduction in Urban Planning

SEMANCO

Deliverable 6.1
Stakeholder requirements analysis

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PP	Restricted to other program participants (including the Commission Services)	
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Deliverable Administration & Summary					
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Editor	Tracey Crosbie, Michael Crilly (UoT)				
DoW	**Task description** Building on the scenario description of each of the case studies conducted in T2.1 an analysis will be conducted utilising soft systems IT development methodologies to identify the problems to be solved by the tools developed in WP5. The first stage of this task will involve requirements capture that will include interviews and workshops with the stakeholders to support the identification of the central problems to be address within the functionality of the tools at the neighbourhood, municipal and regional scale. The requirements capture and analysis will be framed by current carbon reduction interventions and practical barriers to uptake. For example, municipalities in all of the case study sites have signed up the Covenant of Mayors therefore it is envisaged that the requirements capture will be situated within local authorities' commitment to submit Sustainable Energy Action Plans (SEAPs) within the years 2011 and 2012. In this way the application of the tools beyond those in case studies will be considered at the very outset of the requirements capture. **Deliverable description** Stakeholder requirements analysis: This deliverable will take the form of a report which will build on the scenario description of each of the case studies presented in D2.1.It will present the requirements captured by T6.1 using soft systems methodologies to identify the problems within the case studies to be ameliorated by the tools developed in WP5.				
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EXECUTIVE SUMMARY

This report presents the research conducted in Task 6.1 *Defining the problem domain and scope of the tools within the case study scenarios*. As such, it summarises the findings from the stakeholder[1] requirements capture conducted during the first eighteen months of the project. The outcomes of this exercise are the identification, specification and validation of a range of Use Cases applicable to Denmark, Spain and the UK. The Use Cases are described in the form of a detailed specification for the practical application of the ICT tools by a range of stakeholders.

The requirements capture drew on Soft Systems Methods of data collection and analysis. As a starting point a set of complex rich pictures were drawn to describe three different case study areas in Copenhagen, Manresa and Newcastle upon Tyne. These rich pictures were used to summarise the scope of stakeholders involved in urban planning, the policies, processes, funding, conflicts, and spatial context in which decisions are made regarding the role of urban planning in the reduction of CO_2 emissions.

A common framework for integrating the responses and findings from the separate case studies is described. A summary of the analysis of semi-structured interviews, conversations and workshops undertaken with a range of stakeholders following this framework is presented. Appropriate stakeholders were identified through their specific involvement in case study planning projects in Copenhagen, Manresa and Newcastle upon Tyne; and through their professional support work linked to these projects to provide a broad and unbiased scope of views. These included stakeholders that are active project partners in the development and use of the ICT tools.

At the strategic scale and in the earliest stages of project development stakeholders were interested in demand reduction through efficiency measures (achieved through targeted retrofitting or the application of construction standards / codes for new development) and the supply and distribution of renewable or community based energy. However, the stakeholder requirements focused on the practical functions of the tools as additional and / or complementary to existing tools used within their organisations.

The key issues identifies are:

- Speed and cost in the use of ICT tools are significant, and often limiting, factors in their use in practical applications. If SEMANCO tools can provide increased speed and cost savings when compared to current mechanisms stakeholders will accept emission / energy estimations and simplified calculation methods.
- Speed and costs saving have the most significance at the earliest stages in project development, and as such, the greatest potential for the practical application for the SEMANCO tools is at project initiation and business justification stages.
- More sophisticated integration with project costs and potential savings would provide effective and beneficial tools for project initiation and business planning. This is due to the increasing importance and bias towards fiscal indicators within the ever increasing number of completing, imposed and self-defined, Key Performance Indicators[2] (KPIs) considered by stakeholders.

[1] Following Deliverable 2.1 (Gamboa et al 2012) this report makes a distinction between 'Actors' and 'Users'. 'Actors' are Stakeholders in the urban planning process, but will not necessary use the tools developed in the project. While 'Users', as the name suggests, are the envisaged users of the tools under development in WP5.

[2] Key performance indicators (KPIs) are measures of different aspects of organisational performance (AusIndustry 1995) that enable selected issues or conditions to be monitored over time for the purposes of evaluating progress towards or away from a desired direction (Hart 1999).

- Quality in data sources, collection, input and integration methods have to be understandable and trusted if any decision-support tool is to be effective in providing convincing evidence for decision-making at the early stages of regeneration projects.
- There is more interest in the provision of an 'expert-tool' than the development of an open-source web platform. Stakeholders largely see themselves working with technical support for data-management and interpretation of outputs rather than relying on training to support themselves as users.
- It is important that the tools can provide a trusted and reliable baseline figure for CO_2 emissions and energy consumption. This was the starting point for longer term monitoring and improvements as well as the comparison basis for consideration of different options for development and / or intervention.
- The tools must be flexible and able to adapt to different locations and projects as well as being able to adapt to changes in stakeholders organisations strategic goals.

The issues outlined above have informed the specifications for the decision-support tools and the scope of such tools. Recommendations are also made regarding the potential functionality of the tools, in terms of flexibility and adaptability, to extend the scope of the initial Use Cases. This is a necessary response to the dynamic nature of the policies and standards as well some significant externalities impacting on individual projects. It also demonstrates the ability of additional semantic tools to be added to the Semantic Energy Information Framework (SEIF) which lies at the heart of the SEMANCO platform to facilitate the integration of multiple data sources.

These stakeholder requirements provide the outline specification for the initial Use Cases in each of the individual case study areas within the wider and dynamic policy context.

1 INTRODUCTION

1.1 Purpose and target group

As described in the DoW the work presented in this report builds on the description of each of the case studies conducted in Task 2.1 *Case Study Design* **to conduct an analysis utilising soft systems IT development methodologies to identify the problems to be solved by the tools developed in WP5 Integrated Tools.** As such, the work presented in this report builds on the information supplied in SEMANCO Deliverable 2.1 (Gamboa *et al*, 2012) to:

- Identify the specific real world problems to be addressed in each case study area;
- Show how the work conducted for Task 6.1 has ensured that the Use Case Methodology described in SEMANCO Deliverable 1.8 *Project Methodology* (Madrazo *et al*, 2012) is informed by the requirements of 'Users'[3] and 'Actors'[4];
- Illustrate how the requirements capture conducted as part of T6.1 ensures that the energy modelling and simulation tools[5] can be effectively integrated with the tools developed in WP5 fit with Actor and User requirements;
- Illustrates how the requirements capture and analysis is framed by current interventions, such as Sustainable Energy Action Plans (SEAPs) of the Local Authorities in each Case Study areas.

This deliverable also illustrates how Soft Systems Methodologies (Checkland & Scholes, 1990; Checkland & Poulter, 2006) are integrated within the methodology developed within the SEMANCO project described in Deliverable 1.8 (Madrazo *et al*, 2012).

1.2 Contribution of partners

This report was largely structured, written and edited by researchers at UoT. Researchers at UoT wrote the executive summary, chapters 1, 2, 3, 6 and 7 and edited the written contributions received from RAMBOLL for chapter 4 and CIMNE and FORUM for chapter 5. FUNITEC provided useful comments on successive drafts of the report and RAMBOLL, CIMNE and FORUM supported the analysis of the data presented in chapter 6. Chapters 3, 4 and 5 concern the requirements capture undertaken by RAMBOLL in Denmark, UoT and NEA in the UK and CIMNE and FORUM in Spain. Chapter 6 sets out the common range of stakeholder requirements identified in each of the case study areas derived from the application of a common methodology for data gathering and integrating the findings developed by researchers at UoT supported by the NEA.

1.3 Relations to other activities in the project

The work presented in this report builds on the Case Study Descriptions presented in Deliverable 2.1 *Report of the case studies and analysis* (Gamboa *et al*, 2012).As such, it adds to the literature and desk-based practice review undertaken as part of Deliverable 2.1. It does so by presenting a review of the decision support tools currently used by stakeholders at different scales of operation and stages of intervention. The work presented in this report also shows how the requirements capture exercise was informed by Deliverable 2.2 *Strategies and*

[3] Users are individuals who will be using the tools to calculate/simulate/visualise the energy performance of buildings and places (Gamboa *et al* 2012).
[4] Actors are decision-makers in the urban planning and regeneration process; they will not necessarily use tools (Gamboa *et al* 2012) but will make decisions informed by the evidence and analysis the tools provide.
[5] Tools used to assess the energy performance of buildings and places and to support decision-making in urban planning (Gamboa *et al* 2012).

Indicators for Monitoring CO_2 Emissions (Niwaz *et al*, 2012). This report also identifies how the work conducted for Task 6.1 informed the Demonstration Scenarios presented in Deliverable 8.1 *Implementation Plan* (Cipriano, Gamboa & Cipriano, 2012) the tool development in WP5 and will underpin Task 7.4 *Exploitation Planning*.

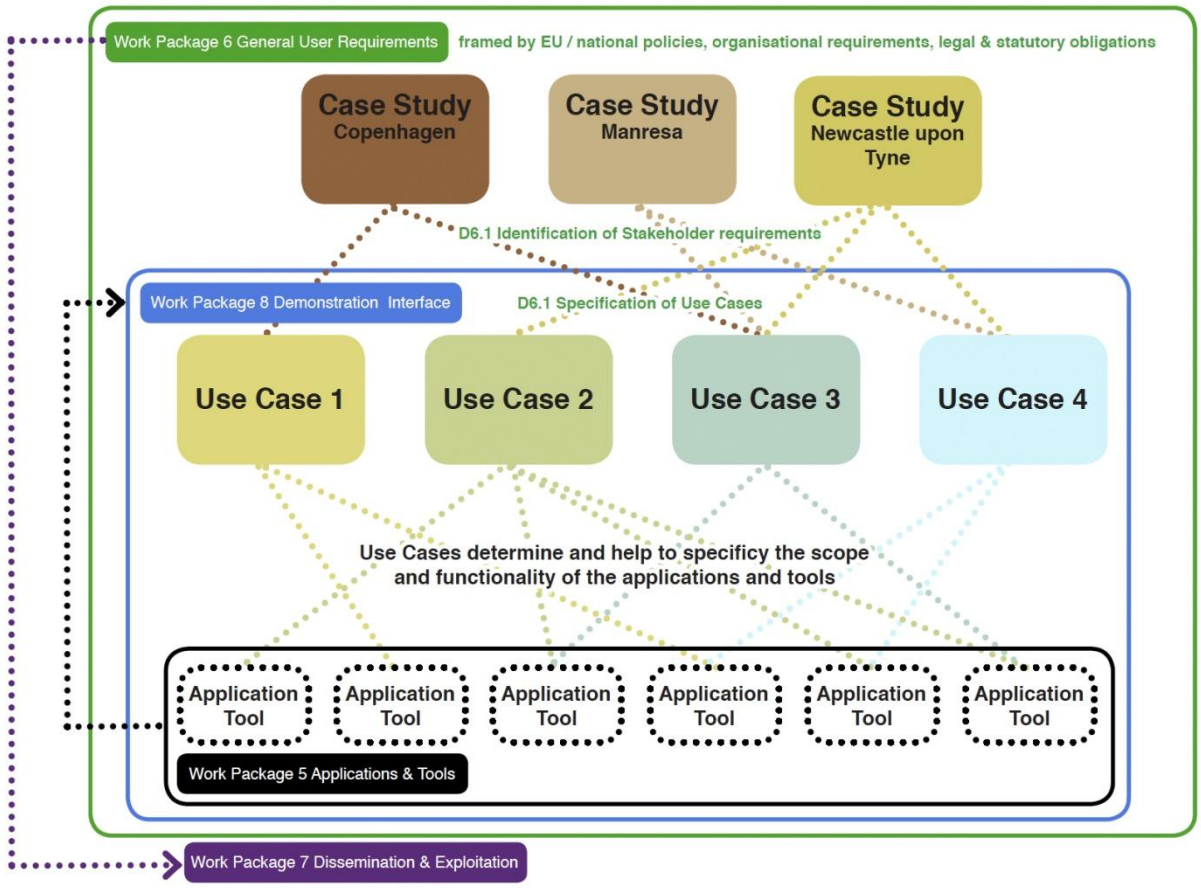

Figure 1. The relationship between Stakeholder requirements capture and other SEMANCO work packages

Figure 1 above, depicts the relationship between the activities undertaken as part of WP6 and other project tasks. Policy review and detailed case study evidence is used as the basis for the specification of a series of locality specific and transferable Use Cases. These specifications are the basis of the individual tool development and testing in practice. The findings presented in this report are germane to Task 7.4 *Exploitation Planning* and the development of the commercial exploitation and practical functionality of the prototype tools.

1.4 The structure of the report

The remainder of this report is split into five chapters. Chapter 2 describes the methodology used to capture knowledge about different 'Actors' and 'Users' perspectives and experiences at different stages in the project development and the issues they face in relation to CO_2 reduction in the Case Study areas. Chapters 3, 4 and 5 describe the application of this methodology for requirements capture in the UK, Danish and Spanish case studies. Chapter 6 discusses how the functionalities being built into the pilot tools were validated by explicitly checking them against stakeholder requirements. By way of conclusion Chapter 7 summarises the contribution of the work presented to the projects technical development and the demonstrations.

2 METHODOLOGY

2.1 Introduction

This chapter describes the methodology applied in the requirements capture with 'Actors' and 'Users' conducted by Task 6.1 *Defining the problem domain and scope of the tools within the case study scenarios*. As such it describes the approaches used to capture knowledge about different 'Actors' and 'Users' perspectives and the issues they face in relation to CO_2 reduction in the Case Study areas. It then goes on to discuss how these methods were used to translate this knowledge into the requirements to be built into the functionality of the tools underdevelopment in WP5. In doing so, this chapter explains how Soft Systems Methodologies (Checkland & Scholes, 1990; Checkland & Poulter, 2006) are integrated within the methodology developed within the SEMANCO project described in Deliverable 1.8 *Project Methodology* (Madrazo *et al*, 2012). Finally, this chapter describes the common procedural framework used to situate the requirements capture within the wider context and the data collection methods used.

2.2 Identifying specific real world problems

The methods used to identify the specific real world problems to be addressed in each case study area by the tools developed within the SEMANCO draw on the Multiview (Avison & Wood-Harper 1990; Avison *et al* 1998) approach as indicated in the DoW. In common with this approach the core question addressed in the requirements capture process, is, "**how are the tools and methods of analysing CO_2 reduction in urban design supposed to further the aims of 'Actors' and 'Users' within the three case study areas?".** This approach ensures that the requirements capture accounts for real-world applications situated within the wider dynamic political economic and social context.

The first technique used in Multiview is the development of a Rich Picture. This is a pictorial caricature of an organisation/ problem situation and is an invaluable tool for helping to explain what the problem situation is about. A Rich Picture is drawn at the pre-analysis stage, *before* you know clearly which parts of the situation should be regarded as process and which as structure. This picture is achieved by obtaining as much background information as possible from all sources that is interviews published materials and observation etc. **"***The picture should include elements of structure and process and the relationship between them (the climates). The picture should include both hard facts and soft facts. The latter includes subjective information about worries and interests. The social rolls of the people in the picture should be clear as should the role of the analysts and the rest of the actors: The picture should yield both the primary tasks of the situation and the issues which surround those tasks***"** (Avision & Wood-Harper, 1990).

The actual act of visualising and drawing the Rich Picture is an invaluable method of identifying the full scope of stakeholders involved in the problem situation and its organisational, statutory and spatial parameters. Therefore, as illustrated by earlier work, (Coelho *et al* 2009) it allows the complexity of urban planning and regeneration processes to be captured and supports comparative study (Horan, 2000).

2.3 Translating real world problems into systems requirements

Rich Pictures help everyone concerned to understand the nature of the human activity system that the tools being developed in SEMANCO are to serve. From the development of these Rich Pictures a set of questions that stakeholders want to address at different geographical scales and at different operational stages in the individual projects in each case study was developed. But getting an impression of the questions Actors want to address is going on is

not sufficient. Poor comprehension of what the tools are for and will do, often leads to an inadequate basis for future development and systems being developed according to specifications which are not aligned to the Actors and Users' needs. Multiview uses the technique of root definition (Checkl & Scholes, 1990) to solve this problem (Avison & Wood-Harper, 1990). However, within the SEMANCO project a specific Use Case Methodology was developed to derive the "*strategic goals regarding carbon reduction in urban settings and the methods and tools to achieve it (e.g. identification of buildings below/above benchmarks of energy consumption and CO_2 emissions in suburban areas). A Use Case is made up of a series of Activities, these are, specific actions which have to be performed to fulfil a Task within a Use Case: A Use Case brings together the data, tools and users required to address a particular question posed by stakeholders*" (Madrazo *et al* 2012).

To ensure the validity of the problems addressed by the Use Cases, beyond the case study areas, they were situated within a common procedural framework (see figure 2). This provides an overview of a typical project from inception through to delivery and management and is recognisable to all policy makers, designers and construction professionals. This approach is grounded in the idea of a 'common language' (RIBA, 2012) within the development and construction industry which enables different professions to place themselves, their discipline within the development process. Each Use Case identified has a particular relationship with one or more stages of work within this common procedural framework. This 'grounding' in a common framework provides a strategy for handling and organising the complex layered information (Easterby-Smith *et al* 1987, Glaser and Strauss 1967, Denzin 1972).

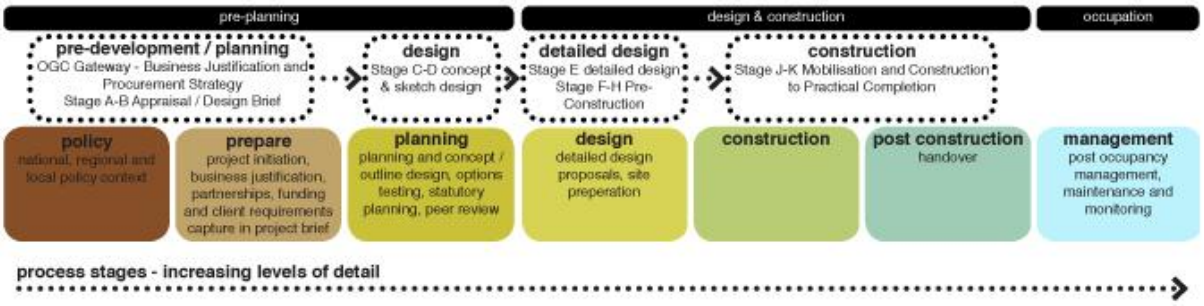

Figure 2. The use of a generic development process provides a procedural framework for mapping the stages of stakeholder involvement

2.4 Data collection methods

The procedural framework formed the basis of discussions and data collection using a variety of separate sources to capture and record stakeholder requirements. These include;

- A literature and desk based practice review of current tools and instruments to identify the tools available and make an initial assessment of how they are being used and barriers to their wider application.
- Semi-structured interviews. That is one-to-one conversations with opinion formers, policy makers and practitioners undertaken on and on-going basis from the beginning of the SEMANCO project.
- Focus groups. These included both informal group meeting and more formal workshops. Participants were drawn from existing local / regional contacts and people expressing an interest in the development of the decision-support tools via social media. They were used to record practical levels of awareness, user knowledge, and attitudes on the use of decision-support tools and instruments beyond the boundaries of the case studies. This was achieved by using open-ended questions to explore ideas and views. Attendance at the workshops and meetings are recorded within each of the individual case study records.

2.4.1 Framework for Semi-structured Interviews and Focus groups

In each case, the researcher followed a semi-structured approach with the use of open-ended questions as prompts in both the interviews and the focus group. These broadly followed the stages of work set out in the development framework and are in Table 1 below.

Table 1 Framework for Semi-structured Interviews and Focus groups

Policy and Preparation: Identification and contact with stakeholders responsible for policy development. Pre-planning stages from project initiation, business justification, partnerships and procurement strategy, policy and project brief
We are interested in understanding your role is identifying or initiating work on carbon reduction. What requirements or references have they made regarding policy (including energy, planning and corporate policies)? How has this informed the project through legal obligations, conditions attached to funding or similar? At what operational scale are these policy requirements? What are your key reasons, including policy or strategy requirements, for getting involved in work on carbon reduction? What requirements or provisions for supporting evidence are necessary to build a business case or justify project / investment? How are these requirements and expectations shared with other delivery partners and stakeholders – including the use of existing data and sharing / data management between partners? What existing tools and methodologies are used to support project initiation and development? How much consideration is there for the extended use of this information at later stages in the project process?
Planning: Project planning and design including concept / outline design, options testing, sketch design, statutory planning. Design: Detailed design proposals
We are interested in your role in project planning and initial design stages. What is the range of tools, models that are currently used (new build construction / retrofitting projects / 'soft' interventions and campaigns? What are the experiences of these tools – for both actors and technology / systems users within your organisation? What are the problems and barriers around use, data, accuracy, transferability and use / sharing of data sets, support / training required? Are these fit for current purpose / future changes and developments? How are they currently used and how could they be improved?
Construction and post construction: Handover
We are interested in the systems that are in place to review and / or test the actual performance of the fabric / elements and systems being installed. Issues of contractor skills training undertaken prior or during the construction. What are the working arrangements with sub-contractors – suppliers of systems and any diagnostic checks and testing of these systems undertaken prior to handover? Was there any use of individual systems design tools or models used as the basis for checks? What project management systems are in place regarding the programme and phasing of work, including practical views on any internal or externally accredited quality control systems being used? What is the role and responsibility of any project manager or clerk of works?
Management: Post occupancy management, maintenance and monitoring
We are interested in your views on the on-going management of the area / development with regard to energy efficiency. What is the level of awareness and application of the wider aspects of 'soft-landings' post occupation review and monitoring? What specific organisation requirements are there of post-occupancy monitoring and what is recorded / reviewed? Tenants' levels of satisfaction, thermal comfort, health, plus issues of control, reliability, upgrading (future-proofing) and flexibility? Explain the responsibility over the building / fabric and separate technical systems? How much consideration has there been in the linking of capital costs in the provision of the system(s) with running costs (billings, fuel supply, systems maintenance)? We are interested in your knowledge of the actual performance and energy uses, particularly any differences between 'modelled / predicted and actual energy use / affordability and carbon emissions. How existing communities / occupants (tenants and owners) are supported in carbon reduction and / or energy management activities? Have communities / occupants already been involved in any carbon reduction strategy? We are interested in understanding the current levels of technical knowledge and skills that are used to support partnership working between different stakeholders. What resources and technical support is provided for the development of community led networks and community groups? What training, if any, is provided and who is participating in both the delivery and learning?

This set of open-ended questions emerged from the development of the initial Rich Pictures. They were used to develop a set of Use Cases in more detail by identifying the strategic goals regarding carbon reduction in the individual case study areas and exploring the requirements

for additional functionality beyond currently available tools and instruments. This approach helped to assess the needs and requirements of Actors and Users at each of the case study site by determining;

- How the goal of the Use Case was relevant to the particular actors and users in each of the Case Studies to which it is applicable?
- How the Activities of the Use Case are relevant to particular actors and users in each of the Case Studies to which the Use Case is applicable?
- How the goal of the Use Case relates to the changing national /local policy frameworks identified as relevant to it? and;
- How the tools / methods identified in the Use Case are related to the needs and requirements of actors and related national or local policy frameworks?

To support stakeholders understanding of the goals and possible applications of the SEIF and associated tools, a number of different mock-ups and pilot tools were demonstrated to Users and Actors. This approach helped to further specify user requirements, validate the feasibility of Activities, and verify the need for the tools and methods provided by SEMANCO in the real-world settings.

To be consistent with the scoping methodology (Bourdieu, 2001) there is a rough 'target' set for 12-20 individual contacts for each case study which was exceeded in practice[6]. However it must be noted that this included several individuals within the same organisation but with differing professional skills and legal remits regarding carbon reduction, planning policy, design or management. The proposed number of contacts is intended to establish the broad scope of interest for the stakeholders, their current knowledge, use of decision-support systems, technical skills, and data input requirements and day-to-day involvement. This sample size is not intended to be representative of the weight of any particular issues but rather the most appropriate way of recording the scope of the issues without prejudice or bias. Within this 'target' stakeholder sample, a short record was retained of all discrete comments / statements and views relating to the different stages in the project.

The emphasis and extent of stakeholders contacted in each of the case studies varied in response to the extent of local engagement. In the UK case study area, while NEA was geographically located there, they held a largely advocacy role and were not directly responsible for physical interventions nor held any control over budget. As a result, more structured contact was needed with the public sector stakeholders in Newcastle upon Tyne who held these roles and responsibilities. In both the Danish and Spanish case studies, the principal stakeholders responsible for planning, development and management of change are also SEMANCO project partners. In this context, the records and Use Case specifications are based on a smaller number of more active partners.

[6] See Appendix B A2 Table 1 for a list of the participants.

3 REQUIREMENTS CAPTURE IN THE UK CASE STUDY

3.1 Introduction

This section discusses how the specific real world problems to be addressed in the UK case study area by the tools developed within the SEMANCO project were identified using the methodology described in chapter 2. As such, it describes how the research captured an understanding of different stakeholders'/ actors' perspectives and the issues they face in relation to the UK Case study. It then goes on to discuss how these methods were used to translate this knowledge into the requirements to be built into the functionality of the tools underdevelopment in WP5. Finally, it discusses the processes conducted to further specify user requirements, validate the feasibility of Activities and verify the need for the tools and methods provided by the tool development with the SEMANCO project in the real settings.

3.2 Identifying specific real world problems

3.2.1 Developing a Rich Picture of the problem situation in the UK

The problem situation expressed in the Rich Picture in Figure 3.1 is informed by policy documents, site visits, group meetings, face-to-face interviews[7] and the experiences of members of the SEMANCO team working at National Energy Action [NEA][8]. Reviews of international, national and local policies / interventions applicable to the UK Case Study area are presented in SEMANCO Deliverable 2.1 (see Gamboa *et al* 201, pp. 35- 44). However certain elements of the national and local policy frameworks and urban planning schemes being implemented by 'actors' in the UK case study are seeking to implement are highlighted to inform readers of the development of the Rich Picture presented in Figure 3.1. This is an important point to make, as policy developments within the UK case study are dynamic and have been subject to recent and radical changes. These changes are due to depression in the national economy, local property market, organisational restructuring (a factor which has been significant within the local authority) and changes to national Government and policy initiatives.

The refurbishment of the tower blocks, in the Riverside Dean was part of a large national programme of housing market renewal (HMR) targeted at several depressed housing markets within northern English conurbations. It was initiated due to many of the earlier 'bottom-up' regeneration programmes having limited impacts (Smulian, 2003). Initially, the KPIs within the HMR programme included the 'number of (housing) demolitions. This has been widely criticised and is now replaced by changing strategic KPIs (CLG 2011). However, the KPI relating to housing demolition was significant across the West End of Newcastle and impacted many other potential regeneration areas. The effect was the demolition of higher quality properties than the tower blocks that were renovated in Riverside Dean[9]. In addition, grant 'claw-back' conditions for demolitions has stultified regeneration in the adjacent sites for the short-to-medium term. The redevelopment of the tower blocks was initiated by staff from Your Homes Newcastle (YHN). Their role was as an Arm's Length Management Organisation (ALMO) dealing with property / asset management and tenant liaison on behalf of Newcastle City Council. In Newcastle, social housing remains in the ownership of the

[7] See Appendix B Table B1 for a list of the participants.
[8] The NEA have conducted studies into the implementation of Government policies to reduce fuel poverty and carbon emissions with those living the in the case study area (Lynch 2011).
[9] In practice, three immediately adjacent housing sites at Loadman Street and Elswick were subject to large-scale demolition, in part, as ownership of property in these locations was dominated by single social housing providers (*Home Housing* and the *Guinness Trust*) on at least two of the sites.

Council. This is an important distinction to make regarding ownership of the Riverside Dean flats; as in many other locations around the UK local authorities made the decision to transfer ownership and management responsibilities to separate legal entities to act as independent social housing providers.

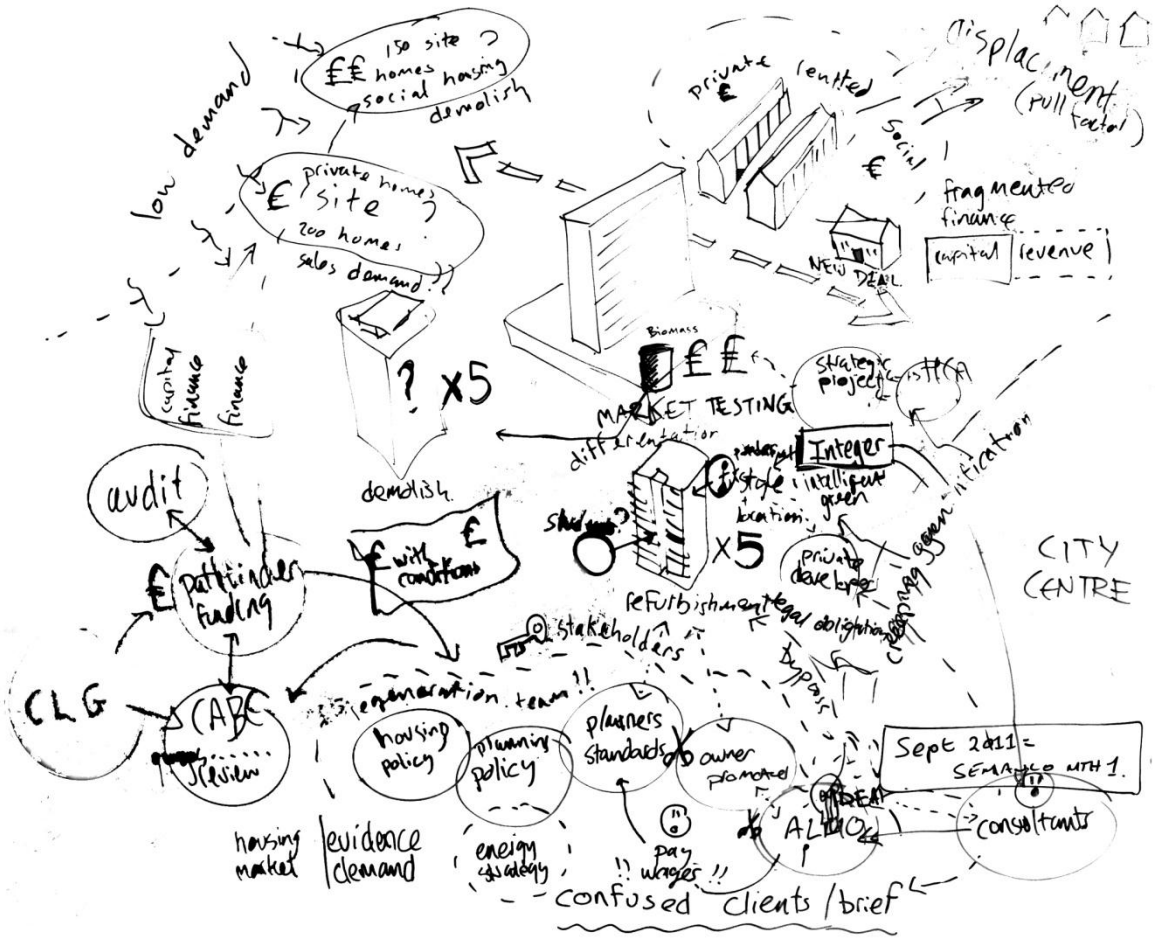

Figure 3. Rich picture of the redevelopment of the Riverside Dean

In effect YHN were one of several 'clients' interested in defining the successful project outcomes as part of the initial project brief. In this context, the decision to refurbish rather than demolish the tower blocks was centred on YHN; as the ALMO; having more incentive to retain an overall level of housing management through retention. This is because the potential outcome from any demolition would be a loss of rental income and the land ownership reverting to the City Council to dispose of as they thought fit, including for sale as a private housing development site. The decision to examine the energy efficiency and sustainability of the tower blocks was also initiated from YHN staff where there was an interest in knowledge transfer from best practice retrofitting towers gained through their membership and involvement in the Integer (2001) (Intelligent and Green) Research Partnership. The refurbishment of the tower blocks began as a project before the review of the local development framework (statutory plans) and the imposition of local sustainability standards. However, it was influenced and / or supported by a layered set of regional to local energy policies and strategies.

The strategic energy context, including the imposition of minimum statutory standards, was initially addressed through the realistic establishment of regional targets for the capacity for renewable energy technologies. At the regional scale, early stage definitions of regional sustainability and objectives had been set out (North East Assembly, 2002) as an attempt at

greater integration with a range of regional strategies[10]. However, since these targets were established through the mechanism of regional spatial strategies (RSS), the UK Coalition GGovernment has abolished the RSS and left many of these strategic decisions for the individual local municipalities to address. These local expectations are now set out in the more modest intentions in PolicyCS18: Climate Change (Newcastle City Council & Gateshead Council, 2011) which shows the local planning authority intention to enforce mandated national standards, (requiring evidence provided through a pre-assessment certificate from a qualified CSH assessor) and with a 'hierarchical' preference for connections to a decentralised energy supply and to work at providing renewable or low carbon energy through collective and / or municipal systems.

In this context, the Local Authority in the Case Study area, Newcastle City Council, has developed a SEAP, which sets out proposals to deliver 20% reduction in carbon emissions as part of its commitment to the Covenant of Mayors. One of the series of action plans to deliver carbon emission reductions in Newcastle, involves the development of community energy schemes using centralised gas or biomass combined heat and power units (Newcastle City Council 2008a, 2008b). Based on the work undertaken in a city-wide Energy Master Plan (NAREC, 2012), the municipality has been considering the promotion of a city wide district heating and cooling scheme which would link up the currently isolated local district heating systems across the city.

In conjunction with the consideration of large scale district heating & cooling, Newcastle City Council is also considering options for the installation of renewable energy generation (in particular solar photovoltaic panels (PV), solar thermal hot water systems, biomass heating and small scale wind), improved insulation and energy efficiency of all housing stock and buildings (NAREC, 2012). However, currently Newcastle City Council, as an asset management organisation, lacks the ability to make informed decisions about which of these approaches are most advantages in terms of cost and CO_2 reduction in particular instances.

In support of the implementation and enforcement of current and emerging policies on the reduction of carbon emissions, the North East Regional Assembly undertook the commissioning and promotion of a regional energy modelling tool 'CarbonMixer' with the aspiration that this could "…provide a common language for developers, planners and architects … allowing quick comparison of the sustainability of various developments" (NAREC, 2010). Yet, even though this was provided free to all local municipalities within the region, the eventual level of application and awareness was limited outside of the anticipated 'users' of this model – the energy consultants and commissioning groups.

3.2.2 Actors key problems

One of the expectations, as opposed to requirements, of undertaking housing market renewal and investment at the scale of Riverside Dean has been around identity and stigma. The image and reputation of the area to residents and to external investors / potential residents was expected to change due to the work undertaken. The high environmental specifications and the use of small scale CHP was an explicit elements of this re-branding of the estate.

At a strategic level, the importance of linking quality in residential development and area based regeneration was raised as part of the consideration of sustainable development (English Partnerships, 1999). This has led to the idea that high quality can be achieved at relatively high residential densities (Nathaniel Litchfield & Partners, 2001) becoming

[10] The scope of these different strategies included addressing and guiding investments, activity and management decisions through a series of 16 objectives supported by thematic indicators. Of particular relevance are the indicators for the installed capacity for energy production from renewable sources (potential / realised), travel provision and behaviour, election turnout, levels of local tenant participation with additional indicators for public health and safety.

embedded in the thinking about England's core cities (Northern Way, 2007). There was also a promotion of improved choice, quality and sustainability across the northern cities – significantly being of a sufficient scale to affect changes in perception in the housing market as well as built quality and relating to the challenge to improve the reputation of the Riverside Dean (previously called Cruddas Park) and the Inner West of Newcastle (Newcastle City Council, 2001). One mechanism for ensuring quality, alongside a more basic development quantum, was with the use of regional planning. More recent advice (Fairhurst, 2009) has considered values and costs over the longer term and explicitly included an assessment of long-term saving referred to as 'patient money' (effectively another way of referring to pay-back period).

The level of community involvement and empowerment in the long-term regeneration and management has been seen as an economically beneficial and 'transferable model' (Hayton, 1995) when there has been an historic focus on local job creation. So the potential benefits of undertaking the work to transform Riverside Dean would represent value for money through attracting a 'level of match funding' (DCLG, 2009) but undefined regarding whether this is capital or revenue.

The timing of the refurbishment work also resulted in changes to the initial project expectation and the decision to demolish five blocks, (half of the number of blocks on the estate). There was a private sector contractor undertaking the refurbishment work on behalf of YHN / City Council for the decanting and re-housing of the existing tenants who wished to remain in the area. However, significant efforts undertaken to procure a private sector development partner, to establish a joint venture or special purpose vehicle as a mechanism for delivery of private housing for sale within the remaining tower blocks proved to be unviable in the market at that time. Thus, a decision to demolish five of the blocks was taken on the grounds of low market demand. This decision had little influence from energy efficiency policies or considerations – even with YHN and the City Council being aware of the embodied energy in the stock and the sizing of the CHP to provide for ten refurbished blocks.

The process of the development of the rich picture identified (Figure 3) different, but related problems of these different Actors at each geographical scale. There was significant impact from the historical policy context and the legacy or otherwise from earlier regeneration activities in the West End of Newcastle upon Tyne. In this way, the research identified how the tools and methods of analysing CO_2 reduction in urban design are supposed to further the aims of the Actors in the UK case study area.

At the ***micro level*** [neighbourhood/building] the following issues were identified:

- The ALMO (responsible for operating) and the Local Authority (system owner) want to know how to optimise the underutilised district heating system that has been sized to provide heat / hot water for twice the number of units it is supplying and that has funding criteria to meet;
- The Local Authority wants to know how to utilise the land on which demolished tower blocks stood in a way which balances environmental, social and political aspirations, including the potential to continue addressing issues of poor image and stigma attached to the area and the dominance of social housing, by attracting private owner-occupiers;
- Local residents that do own their properties want to know the most cost effective methods of reducing their energy costs;
- YHN (as the major Registered Social Housing Provider in the area) wants to know how to target its resources to meet decent homes standards in their remaining units and reduce both fuel poverty and CO_2 emissions, including requirements for additional energy-

efficient work to the housing stock which has already undergone decent homes improvements;

- YHN and the Local Authority want to know how to revitalise the shopping centre in an area of low demand for retail / office space while reducing fuel poverty and CO_2 emissions.

At the ***meso level*** [City] the following issues were identified:

- The Local Authority wants to know how to target current initiatives' and resources to reduce fuel poverty and CO_2 emissions from existing privately rented and owner occupied housing stock as they are aware that this privately owned stock is typically poorer quality and energy performance standards that most social housing;
- The Local Authority wants to know how to revitalise the rundown areas of the city while meeting CO_2 reduction targets but within a cost effective manner within reducing public sector resources and more emphasis on using assets (such as vacant sites and properties) rather than providing grants to achieve this;
- The Local Authority wants to know how to integrate the district heating system with other local district heating systems across the city and test ideas for establishing a local municipal Energy Supply Company (ESCo);

At the ***macro level*** [Regional] the following issue was identified:

- How can National and Local Government target initiatives and policy be designed to reduce CO_2 emissions from housing stock and fuel poverty in a consistent manner while not creating a market disincentive for development and refurbishment in Newcastle?

3.3 Translating real world problems into systems requirements

3.3.1 Identifying the goals of the Use Cases

From the concerns facing Actors in the UK case study as described above, the following goals were identified during the initial development of Use Cases that are locally relevant and with transferability to other projects, sites, cities and regions:

- UC1-N Calculate the costs and CO_2 implications of the way Biomass district heating systems are used (see Appendix A Table A1).
- UC2-N Optimise single large building renovation in terms of cost and CO_2 emissions (See Appendix A2 Table A2).
- UC3-N Calculate the build cost, revenue liabilities and CO_2 implications of different options for the redevelopment of urban land and buildings at different specifications (See Appendix A Table A3).
- UC4-N Identify low-income (Fuel Poor) households living in energy intensive dwellings with a poor SAP (Domestic Energy Efficiency Rating). (See Appendix A Table A4).
- UC5-N Identify the CO_2 emissions of existing domestic stock and its CO_2 emission reduction potential. (See Appendix A Table A5).
- UC6-N Identify the relationship between energy demand reduction and provision of renewable energy in the financial viability and business planning for a municipal ESCo (See Appendix A Table A6).

3.3.2 Focusing the tool development

From the goals identified using the Rich Picture the following were selected to drive the tool

development in WP5 and the UK demonstration scenarios to be conducted as part of WP8.

- UC4-N Identify low income (Fuel Poor) households living in energy intensive dwellings with a poor SAP (Domestic Energy Efficiency Rating)
- UC5-N Identify the CO_2 emissions of existing housing and its CO_2 emission reduction potential.

These particular goals were selected because by providing the means to meet them at different geographical scales the tools developed within the SEMANCO project will be able to address the widest number of the Actors problems identified during the requirements capture. It is important to note that the development of the activities required to achieve the goals of the Use Cases were informed by the set of key questions relevant for strategies to plan, design and implement low-carbon urban development's identified in SEMANCO Deliverable 2.2 Strategies and Indicators for Monitoring CO_2 Emissions (Niwaz *et al*, 2012).

3.3.3 Contextualizing the Use Cases

To further ensure that the goals and the Activities of the Use Cases are applicable to the needs and requirements of stakeholders, their relevance to Actors, Users and national and local policy frameworks is explicitly identified as discussed below in sections 3.3.3.1 and 3.3.3.2 . This section explicitly illustrates how the reviews of the national international and local policies and interventions that applicable to the UK Case Study presented in SEMANCO Deliverable 2.1 (Gamboa *et al*, 2012) informed the requirements capture process (see Gamboa *et al* 2012, pp. 35-44).

3.3.3.1 Identify low income (fuel poor) households living in energy intensive dwellings with a poor SAP (Domestic Energy Efficiency Rating.

The activities involved in this use case are:

- Identify areas with the highest percentage of households in fuel poverty. This will be conducted using data at the Lower Layer Super Output Areas [LLSOA] level[11].
- Estimate the energy consumption and CO_2 emissions of the existing domestic dwellings. The Standard Assessment Procedure (SAP) which is the UK's national calculation methodology arising out of the Energy Performance in buildings Directive will be used to conduct this activity.

3.3.3.1.1 How is the goal of the use case and its activities relevant to Actors and Users?

This use case is particularly relevant to **City/ Local municipalities, registered social housing providers and utility companies as it can be used to supplement internal stock** databases and target the carbon reduction and fuel poverty interventions arising out of the national / local policy frameworks discussed below.

This use case is also relevant to Government policy lobbyists [Social enterprises / community interest companies, and third sector organisations] as it could provide a justification for the need for further Government intervention to reduce fuel poverty. As the information it provides could be used to highlight the poor quality of the housing in terms of energy performance in the poorer parts of towns, cities and regions. In doing so, it could also inform the development of future policies to alleviate fuel poverty and is therefore of interest to MPs and public health bodies. The latter are becoming increasingly concerned with the health effects of fuel poverty as indicated by the Housing Health and Safety Rating System for local authorities discussed below.

[11] Lower Layer Super Output Area [LLSOA]. England is divided into approximately 32,000 such areas, designed based on census results each to contain approximately 1500 residents.

This use case is also relevant to **Energy Consultants and analysts** as they will be the users of the tool conducting this analysis for utility companies social housing providers, Local Authorities, policy makers [MPs, Councillors, public heath bodies] and Government policy lobbyists [Social enterprises / community interest companies, and third sector organisations]. They may also have a role in the integration with stakeholders' own data sets with the SEMANCO tool and providing training and / or direct operation of the tools. There would be a function in analysing, visualising and communicating the results from the tool.

3.3.3.1.2 How is the goal of the use case related to national /local policy frameworks?

The UK Climate Change Act sets a legally binding target to reduce the UK's greenhouse gas emissions by 80% by 2050. Many UK Government policy frameworks and interventions have been introduced focusing on existing domestic properties as these are seen as offering a large potential to contribute to a reduction in CO_2 emissions due to the age and quality of much of the UK's housing stock. Many of these policies and interventions have a twofold aim: In that they not only aim to reduce CO_2 emissions but also to reduce the numbers of households that spend more than 10% of their income on their household energy bills and are deemed to be in Fuel Poverty. Therefore it is not surprising that the **UK Fuel Poverty Strategy** [the current approach of the UK Government to tackle fuel poverty] is also seen as supporting a reduction in CO_2 emissions from domestic properties.

The UK **Fuel Poverty Strategy** has policies to target the three main factors that influence fuel poverty – household energy efficiency, fuel prices and household income. In terms of increasing household energy efficiency it focuses primarily on practical measures and interventions. The most recent of these is enshrined in the **Energy Act 2011** which includes provisions for the new **'Green Deal',** which intends to reduce carbon emissions cost effectively by revolutionising the energy efficiency of British properties. From an economic standpoint, the Green Deal model is simple. In theory, Green Deal removes risks for the householder. The Green Deal provider installs the measures at no upfront cost to the homeowner or landlord. The costs of the measures, plus overhead costs, are then added to the household electricity bill in the form of a charge to be paid over a period of up to 25 years. It includes a Golden Rule that will shortly be enshrined in law that stipulates that the household must be better off as a result in that the savings on fuel consumed must be greater than the cost of the repayments.

Energy Company Obligation (ECO) is integrated with the Green Deal, to allow supplier subsidy and Green Deal Finance to come together into one seamless offer to the consumer to finance CO_2 reduction interventions in houses. This fits well with the **Carbon Emissions Reduction Target (CERT)**, which is a legal obligation on the six largest energy suppliers to achieve carbon dioxide emissions reductions by improving the energy efficiency of housing. The ECO also reflects the **Community Energy Savings Programme (CESP**) which obliges energy suppliers to provide 'whole house' energy saving solutions to domestic consumers in low-income areas.

Alleviating the problems faced by households in fuel poverty is also embedded in the **Housing Health and Safety Rating System (HHSRS)** tool designed for local authorities. This is a national risk-based evaluation tool to help local authorities identify and protect against potential risks and hazards to occupants from any deficiencies identified in dwellings. The HHSRS assesses categories of housing hazard, one of which is Excess Cold (a string indicator of fuel poverty). Each hazard has a weighting, which will help determine whether the property is rated as having Category 1 (serious) or Category 2 (other) hazard.

3.3.3.1.3 How the tools/methods identified in the Use Cases are related to the needs / requirements of actors and related national or local policy frameworks

For the majority of actors, there has been a focus on performance measurement in the form of

KPIs for most links with national and local policy frameworks. Observing the KPIs within the case study area in Newcastle also shows interesting links to many strategic regeneration aspirations and objectives around stimulating demand in the local and sub-regional housing market. One example being benchmarking measures that included information from the Cruddas Park area relating to property investment performance and returns, signifying the under-utilisation of property market and national measures (proxy KPIs) of investment (£ spent by public private sector) and levels of floor space by use and investment return by use (% pa / annual growth rate / change in % pa) (RCS Foundation, 2003).

In many ways, the constant referencing to appropriate KPIs and measurement is a straightforward reflection of national policy emphasis and the implicit dominance of this national policy when they are used to guide and ultimately measure and audit the expenditure of public funding from national initiatives.

The shift in emphasis towards addressing areas of low housing demand as it has become relevant to the case study area in the inner West End of Newcastle upon Tyne has led to a number of strategic assessments (see Llewelyn, Davies, & Yeang, 2007, p.26) using KPIs. These include cost metrics on affordability and property price increases and variations to understand how the housing stock in age, type and size matched current demand and specific aspects of 'measurable' housing quality. Measurement of quality included a SAP rating compared to regional and national average using data from the NeSS Data Exchange (ONS 2013) – albeit some concerns are that relatively good SAP ratings for property in Tyne and Wear is as much a reflection on the size of the property and a higher level of social housing where energy efficiency improvements have already been undertaken and which tend to be of higher quality than private property.

The scale of resolution for many indicators is at an LLSOA. This is a geographic hierarchy designed to improve the reporting of small area statistics in England and Wales. It is the lowest level at which open access socio-economic data is available in the UK. Below this scale there are difficulties around data protection and data privacy where it is possible to identify individuals through the data.

The UK's national calculation methodology [SAP] is the indicator used to measure the success of UK Government policies designed to improve the energy performance of the UK's housing stock. The Department of Energy and Climate Change (DECC) uses this methodology for assessing and comparing the energy and environmental performance of dwellings. In this way it provides the assessments of energy performance of houses required to underpin energy and environmental policy initiatives. As such, Social Housing providers are obliged to provide SAP assessments of their properties as a measure and as an additional set of input data requirements for undertaking the required Code for Sustainable Homes assessment for all of their new build dwellings. SAP (and integral DER and TER measurements) is undertaken at the household scale.

The Fuel poverty sub-regional statistics provide estimated fuel poverty levels at low levels of geography and are available for 2010. As such they are the most up-to-date geographically linked information available in relation to the number of households in fuel poverty.

3.3.3.2 Identify the CO_2 emissions of domestic dwelling stock and estimate its CO_2 emission reduction potential.

- Estimate the energy consumption and CO_2 emissions of existing domestic dwellings (used method/tool: SAP)
- Evaluate the applicability of energy efficiency and renewable energy interventions. This will use an approach called Multi-criteria Decision Analysis (MCDA) also known as `Multi-criteria Decision Aid' (MCA), `Multi-criteria Decision Making' (MCDM) and `Multiple Criteria Decision Methods' (MCDM).

3.3.3.2.1 How are the goal and Activities of the use case and its activities relevant to Actors?

The goal of this use case is also relevant to **City/ Local Councils, registered Social Housing providers and utility companies** as it can be used to target the carbon reduction interventions arising out of the national / local policy frameworks discussed above and support decisions related to which interventions are the most appropriate in different contexts.

It is not only in areas with high instances of fuel poverty that UK Government policy is seeking to improve the energy performance of existing housing stock. Currently in the UK there is a lack of comprehensive data in relation to the condition and energy performance of existing housing. This is particularly the case for privately owned housing stock, which makes up about 80 per cent of the UK housing stock. Social Housing providers often have this information about their existing stock, which makes up roughly the remaining 20 per cent of the UK's housing stock, as it is a regulatory requirement that they provide this information. However, this leaves Local Authorities and private individuals without the baseline information upon which to calculate the potential of different energy efficiency and renewable energy technologies to both reduce energy costs and CO_2 emissions. While registered Social Housing providers may have the base line information on the energy performance of the housing stock they manage, they lack a method of deciding which renewable energy / energy efficient interventions are optimum in terms of costs and CO_2 reduction. With several interventions available, varied investment options and multiple stakeholders involved, the decision making process becomes complex. To streamline this complex process, application of decision support system becomes necessary.

3.3.3.2.2 How is the goal of the use case related to national /local policy frameworks?

The UK Climate Change Act, Energy Act and the Green Deal are all relevant to the goal of this use case in the same way as they are relevant to the previous use case as discussed above. In the case of the goal of this use case Local Development Framework (LDF) (Office of the Deputy Prime Minister 2010) is also relevant. This requires local Governments to involve local community, utility providers, environmental groups and housing corporations amongst others in their appraisal and management process of the development of urban areas this points to the need for a decision support tool to allow these different stakeholders to take part in the decision making process.

As noted earlier the local authority has developed a SEAP, which sets out proposals to deliver the 20% reduction in carbon emissions as part of its commitment to the Covenant of Mayors. One of the series of action plans to deliver carbon emission reductions in Newcastle, involves the development of community energy schemes using centralised gas or biomass combined heat and power units (Newcastle City Council 2008a, 2008b). Based on the work undertaken in an Energy Master Plan (NAREC 2012) Newcastle City Council is considering the promotion of a city wide district heating and cooling scheme which would link up the currently isolated local district heating systems across the city. The City Council is also considering the installation of renewable energy generation (in particular solar PV, solar thermal hot water systems, biomass heating and small scale wind), improved insulation and energy efficiency of all housing stock and buildings (NAREC 2012). However currently Newcastle City Council lacks the ability to make informed decisions about which of these approaches are most advantages in terms of cost and CO_2 reduction in particular instances.

3.3.3.2.3 How the tools/methods identified in the Use Case related to the needs /requirements of actors and related national or local policy frameworks

As mentioned for the previous use case discussed the UK's national calculation methodology [SAP] is the indicator used to measure the success of UK Government policies designed to improve the energy performance of the UK's housing stock and is reference within the statutory Building Regulations for Energy Conservation (Part L). The DECC uses this

methodology for assessing and comparing the energy and environmental performance of dwellings. Therefore it provides a method of calculating the base line energy performance of existing housing, which is the only metric recognised by both nation and local Government. The stakeholder workshops have reinforced the relevance and importance of SAP [12] as it the most referenced metric within statutory planning, and as such is often calculated at a much earlier policy stage in the development process than would be the case if it was considered purely a requirement for Building Regulations.

An MCDA approach is suitable to evaluate the applicability of energy efficiency and renewable energy interventions as it helps to:

- structure frameworks for decision making;
- trade-offs multiple sets of criteria;
- consider alternative options;
- support evaluation consistency in risk/uncertainty;
- generate common interest from stakeholders‘ priorities and facilitates negotiation.

[12] SAP alongside BREDEM-12 for other non-residential uses.

4 REQUIREMENTS CAPTURE IN THE DANISH CASE STUDY

4.1 Introduction

This section discusses how the specific real world problems to be addressed in the Danish case study area by the tools developed within the SEMANCO project were identified using the methodology described in chapter 2. As such it describes how the research captured an understanding of different users / actors perspectives and the issues that they face in relation to the Danish Case study. It then goes on to discuss how these methods were used to translate this knowledge into the requirements to be built into the functionality of the tools under development in WP5. Finally this chapter discusses the processes conducted to further specify user requirements, validate the feasibility of Activities and verify the need for the tools and methods provided by the tool development with the SEMANCO project in the real settings.

4.2 Identifying specific real world problems

4.2.1 Developing the Rich Picture of the problem situation in Denmark

The problem situation expressed in the Rich Picture in Figure 4 is informed by policy documents, and meetings held with key stakeholders (users and actors) to present the objectives of the SEMANCO project and try to understand their priorities and capture their requirements related to tools[13]. It must also be highlighted that the Rich Picture is also informed by RAMBOLL's longstanding relationship with the key stakeholders involved in developing a sustainable energy strategy for the North Harbour Case study. These are CPH City & Port Development, the Municipality of Copenhagen and Copenhagen Energy (see Table 2 below). It was also informed by the reviews of international, national and local policies / interventions applicable to the Danish Case Study area presented in SEMANCO Deliverable 2.1 (see Gamboa *et al* 2012)

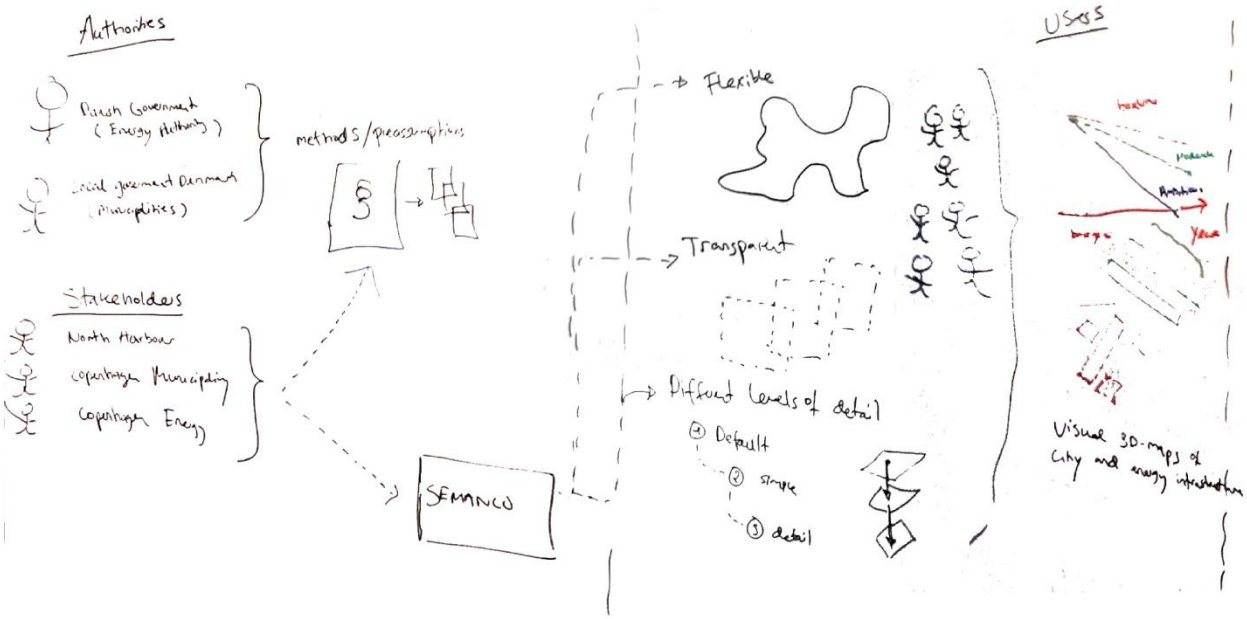

Figure 4. Rich Picture of the Danish Case Study

[13] See Appendix B Table B1 for a list of the participants.

Table 2 Defined role of stakeholders in the Danish Case Study area.

Actor/User	**Scale of action**	**Role**
CPH City & Port Development	Responsible for preparation of land use regulation, and land preparation within the new city district	Key stakeholder Land owner and developer
Municipality of Copenhagen	Responsible for the approval of master plans and land use codes within the municipality	Local authority/ potential user of the tool Defines certain minimum requirements Overseeing implementation of neighbourhood, municipal and regional (city-wide) strategic housing plans
Copenhagen Energy	Action on a local scale, within the new city district	Energy supplier/potential user of the tool Assessment of: Cost-benefit of varying urban layout, varying energy intensities, varying energy supply schemes and varying implementation schedules

Denmark is one of the few Counties to have a national policy framework for architecture, with explicit policies on promoting energy efficiency and sustainable design (Government of Denmark 2007), with an interest in the case study, seeking to learn lessons on sustainable planning from a small number of exemplar regeneration projects and to inform the development of national planning frameworks, or indeed, used as a trans-national exemplar project (Nordic Council of Ministers 2012). In this regard, the main objectives or key problems for the actors is the creation of an exemplar scheme that can 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.

Another group of actors at municipal or regional level will be local Governments and signatories of the Covenant of Mayors, which have to carry out different analysis to be able to submit a Sustainable Energy Action Plan (SEAP) covering their geographical area.

In the Danish context these types of analysis are carried out by consultants for municipalities using a combination of tools and spread sheet models.

One of these tools is a CO_2-calculator developed by the Local Government and the Ministry of Energy and Climate in Denmark for the 98 municipalities. The CO_2-calculator is free to use for the municipalities and is primarily used to map the CO_2-emissions from the main CO_2-emitting sectors: Energy, Industry, Transport and Agriculture. In case of SEMANCO only the energy consumption related to Energy and Industry sectors are relevant.

The CO_2-calculator operates on 3 different Tier levels requiring different details in data input. Hence, Tier 1 requires the least level of data input and Tier 3 the most. The reasoning behind this flexibility is primarily to ensure that most municipalities (actors/users) are able to use the calculator considering the barriers in collecting the necessary data. The definition of Tier-levels is in compliance with IPCC-guidelines (Intergovernmental Panel on Climate Change).

The CO_2-calculator[14] also has incorporated a measures catalogue covering CO_2-reduction measures (e.g. energy savings in buildings, diffusion of renewable energy technologies) in all major sectors. It can export data as xml-files.

14 The CO_2-calculator can be downloaded by users from this website: https://www2.miljoeportal.dk/Co2beregner/publish.htm

The CO_2-calculator however does not make any future projections. Since many municipalities have signed the Covenant of Mayors and committed themselves to a 20 per cent reduction in CO_2-emissions in 2020 it is necessary to forecast CO_2-emissions in a so called baseline scenario showing the expected development towards 2020 with already decided and implemented measures. This projection can be made in a simple Excel-model or in a scenario model (e.g. LEAP). So in the Danish context it will often be necessary to combine models and tools in order to make the analysis required by actors/users.

In this context the Rich Picture in Figure 4 illustrates the issues surrounding the North Harbour from 3 different perspectives:

- Actors-perspective (in this case mainly authorities, utilities and city developers)
- Users-perspective (in this case mainly experts/consultants)
- Technological platform-perspective (in this case mainly requirements for the user interface, data input, flexibility etc.)

The emphasis is on the processes and methodologies that are appropriate from each of these perspectives. Ensuring these multiple perspectives are considered in the development of the technical platform is an important part of the SEMANCO project.

Some of the key priorities and requirements identified during the development of the Rich Picture which was derived from discussions with stakeholders are outlined below[15]:

- The tools and techniques developed as part of the SEMANCO project should support the Danish Government authorised model of socio-economic calculation.
- The SEMANCO tools should support the Danish Government and Local Government Denmark (interest group and member authority of Danish municipalities) authorised model of municipal CO_2 emission inventory.
- The analysis approaches should be transparent and flexible whenever there are relevant alternatives (e.g. methods of calculations, choice of data and presumptions).
- The SEMANCO tools should be able to make calculations at different levels of detail (e.g. perhaps 3 levels). Level 1 could be default. Copenhagen Energy understood the particular relevance of this and how it could provide cost-effective and accurate support for demonstrating compliance with the local planning codes at the initial stages of design and planning detail. This could become more sophisticated as detail is added and analysis is undertaken around the impact of different design and phasing choices.
- The SEMANCO tools should be able to produce simple visual maps and graphs that could be presented for decisions makers (e.g. politicians, planners etc.). This requires the potential tools to be clear and transparent around the methodology and the quality of the input data used. Similarly, visualisation of the outputs to a non-technical (actor) audience with the support of technical experts (consultants / users) where there are inevitable limitations over staff resources, availability and levels of technical skills.
- The project partners had an expectation to make better use of their existing GIS resources. For example, through the integration of building energy models with maps of heat networks, and infrastructure; where possible providing information on physical dimensions and constraints; as a user of the tools.
- From a business perspective, there is an application in assessing the potential impacts

[15] See Appendix B A2 Table 1 for a list of the participants.

on changes to community or district heating systems (for example, in variations to temperatures, pressure and grid insulation). Typically these are time specific and would thus have considerations for energy storage.

- Resolving some of the competing pressures between a viable business for the supply of energy in a policy context of increasingly stringent and ambitious requirements for the energy performance of new development. The energy supply company needs to understand how the anticipated new construction standards will impact on new business models for district energy.
- Strategic economic assessment of scheme costs; both construction and operational / management costs, pay-back periods; will remain one of the most critical concerns for all of the case study partners. The scope of the economic assessment should cover the cost of building in energy efficiency (additional costs to building fabric standards above statutory minimum). The CPA is interested in the potential for an automated system that can inform the preliminary design (provide an assessment of energy and heat loads and demands) of a new community energy system. Ultimately this could be enhanced by supporting the design and costs for a spatial network.
- Where possible there should be close involvement and collaboration with the Ministry of Climate and Energy, given the potential significance of the North Harbour development as a national exemplar for sustainable urban development. There would be benefits for accuracy and use of appropriate methods for modelling building energy consumption and CO_2 emissions.

4.2.2 Actors key problems

At the ***meso level*** [Urban] the following issue was identified:

- Actors in urban development projects, in this case CPH City & Port Development, want to determine the optimal combination of measures regarding sustainable energy supply and energy savings, with the lowest possible costs. For the North Harbour case study the goal of becoming a CO_2 friendly urban development area has been set by the CPH City and Port Development. The longer-term aim is a CO_2-neutral or negative neighbourhood.
- CPH City & Port Development requires that measures towards reaching CO_2 neutrality are divided into two 'general energy' related categories; demand measures and supply measures.
- CPH City & Port Development want to create and demonstrate a CO_2 friendly/negative urban district, several energy demand measures and energy supply options have to be benchmarked and analysed, so that the optimal combination can be determined on the basis of socio-economic, financial and CO_2 emissions criteria.

At the ***macro level*** [municipal and regional] the following issues were identified:

- Regional municipalities need to be able to map greenhouse gasses (CO_2, CH_4, N_2O) in the geographical area of the Municipality.
- Regional municipalities require a base year scenario model which benchmarks greenhouse gasses.
- Regional municipalities need to be able to forecast and monitor greenhouse gas emissions in a baseline scenario
- Regional and local municipalities need the ability to calculate the effects of different CO_2-reducing measures in the scenario model

- Regional and local municipalities need the ability to develop CO_2-reduction scenarios based on the chosen measures (e.g. Energy Savings, Renewable Energy Supply)
- Regional and local municipalities need to be able to compare and benchmark against energy and climate change targets (e.g. SEAP)

4.3 Translating real world problems into systems requirements

4.3.1 Identifying the goals of the Use Cases

From the concerns facing actors and users in the Danish case study as described above the following goals were identified during the initial development of Use Cases:

- UC1-C. To calculate costs of production of energy (electricity, heating and cooling) for a variety of production technologies for both individual and district energy systems based on conventional as well as renewable energy sources (see Appendix A Table A7);
- UC2-C. To calculate the costs of energy saving measures (e.g. window replacement, improved insulation, energy efficient electric appliances and systems, smart grid etc.) (see Appendix A Table A8);
- UC3-C. To calculate impacts of alternative energy supply and demand options on CO_2 reduction, final energy consumption and primary energy consumption. (see Appendix A Table A9);
- UC4-C. To map potentials of local energy sources (e.g. conventional and renewable energy sources) (see Appendix A Table A10).

4.3.2 Focusing the tool development

The goals identified using the Rich Picture, were integrated into a single overarching Use Case to drive the tool development in WP5 and the Danish demonstration scenarios to be conducted as part of WP8. The goal of this is to calculate the energy consumption, CO_2 emissions, costs and /or socio-economic benefits of an urban plan for a new development. In the Copenhagen North Harbour project, this initial understanding of an appropriate, and staged, methodology for assessing energy performance and supply options was initially described as in Figure 5.

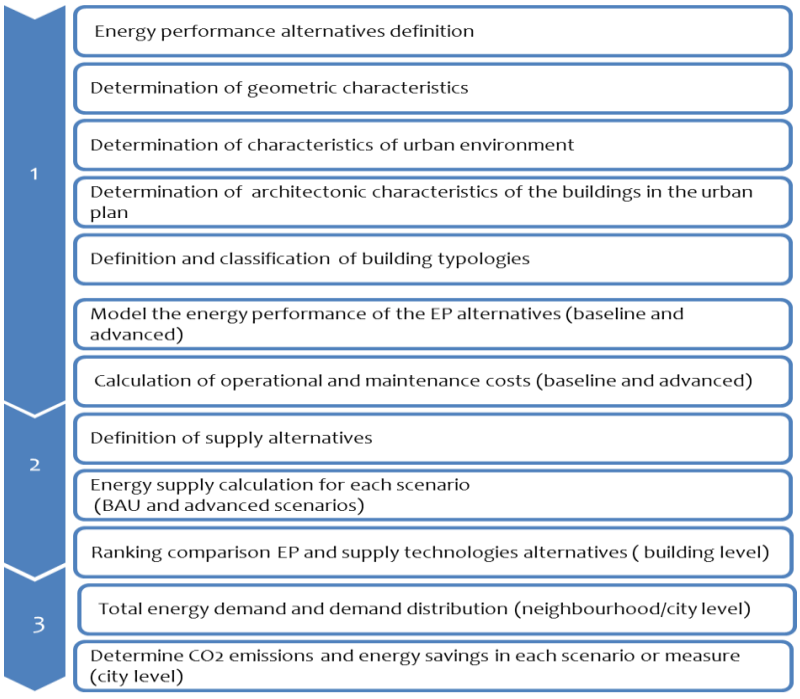

Figure 5. Overall analysis approach of the North Harbour project

4.3.3 Further contextualizing the use cases

4.3.3.1 Goal of the use case

To calculate the energy consumption, CO_2 emissions, costs and /or socio-economic benefits of an urban plan for a new development

The activities involved are:

A1. Define different alternatives for urban planning and local regulations

A2. Define systems and occupation (socio-economic) parameters for each alternative

A3. Determine the characteristics of the urban environment

A4. Determine the architectural characteristics of the buildings in the urban plans

A5. Model or measure the energy performance of the neighbourhood

A6. Calculate CO_2 emissions and energy savings for each proposed intervention

A7. Calculate investment and maintenance costs for each proposed intervention

4.3.3.1.1 How is the goal of the use case and its activities relevant to Actors and Users?

The ultimate goal of the use case is to ensure that Actors and Users fulfil the political objectives regarding reduction of carbon emissions in the most cost-effective manner implementing the optimal measures on both the energy supply side and the energy demand side.

4.3.3.1.2 How is the goal of the use case related to national /local policy frameworks?

The goal of the use case is related to the local policies/objectives of urban development projects and municipalities in relation to either individual ambition level (e.g. CO_2-neutral) or the SEAP under the Covenant of Mayors.

At a national level, the Danish Government has committed itself to a very ambitious long-term goal: the entire energy supply – electricity, heating, industry and transport – is to be covered by renewable energy by 2050. In March 2012 a historic new Energy Agreement was reached in Denmark. The Agreement contains a wide range of ambitious initiatives, bringing Denmark a good step closer to the target of 100% renewable energy in the energy and transport sectors by 2050. In many ways, Denmark has started the green transition well. However, the Agreement moves Denmark up a gear, with large investments up to 2020 in energy efficiency, renewable energy and the energy system. Results in 2020 include approximately 50% of electricity consumption supplied by wind power, and more than 35% of final energy consumption supplied from renewable energy sources.

No energy agreement has ever been reached by a larger and broader majority in the Danish Parliament than this one; and no Danish energy agreement has previously covered such a long time horizon. Hence, the goal of the use case is generic and can be applied at local, regional and national level.

4.3.3.1.3 How the tools/methods identified in the Use Cases are related to the needs /requirements of actors and related national or local policy frameworks

The tools/methods identified in the use case are aimed at providing answers to complex problems regarding which energy supply technologies to implement in order to meet the required energy demand within an urban area that it both cost-effective and carbon efficient. The analysis required to give very detailed answers (that could eventually be used to design buildings and energy systems) may be out of scope for the tools/methods developed in SEMANCO. However, from a planning perspective, tools and methods can be applied to

carry out simple multi-criteria analysis showing what would be optimal solutions on the energy supply side and which technologies would be feasible to invest in the long-term.

In addition, tools/methods developed in SEMANCO providing good visualisation features (e.g. simple graphs, 3D-maps) are often a great way to explain both current state in terms of energy consumption and CO_2-emissions and define the measures required to reach political targets and objectives.

5 REQUIREMENTS CAPTURE IN THE SPANISH CASE STUDY

5.1 Introduction

This section discusses how the specific real world problems to be addressed in the Spanish case study area by the tools developed within the SEMANCO project were identified using the methodology described in chapter one. As such, it describes how the research captured an understanding of different stakeholders'/ actors perspectives and the issues that they face in relation to the Spanish Case study. It then goes on to discuss how these methods were used to translate this knowledge into the requirements to be built into the functionality of the tools underdevelopment in WP5. Finally. it discusses the processes conducted to further define user requirements, validate the feasibility of Activities and verify the need for the tools and methods provided by the tool development with the SEMANCO project in the real settings.

5.2 Identifying specific real world problems

5.2.1 Developing the Rich Picture of the problem situation in Spain

The Rich Picture illustrated in figure 6 is the collective outcome of ideas expressed in meetings between potential users and actors and domain experts[16]. During these meetings, participants have identified the need of considering the different urban planning schemes in the SEMANCO platform. They have also identified tools that are useful in the different stages of and scales in the urban planning process. For instance, at the municipal level, the city council designs the entire city within its boundaries, including the urban environment and rural hinterlands, through the **Municipal Urban Ordering Plan (POUM).** The POUM categorises the municipal territory into urban land (most of it already built), future/possible urban land (areas that are meant to be urban land in the future) and land protected from urban development. In practical terms, it mandates the height and depth of buildings, the sections of the streets, the direction of the traffic, the use of the buildings, the population densities, the size of the balconies, the slope of the roof and the size of the public squares among other general definitions.

Sometimes, the directives of the POUM are not enough to achieve the expected vision of the city. In those cases, the city council uses the legal figure of the Derivative plans (in its several forms: Partial plans, Special plans, detailed studies) to define certain areas where a set of rules are mandated. One of the aims of the derivative plans is to solve problems with existing built environment (e.g. low commercial demand) or to achieve a new development area with wider public benefits such as the provision of green infrastructure. Derivative plans define a set of requirements and constraints for the development of the urban projects. The plan also has the statutory powers to promote collaboration between differing actors' interests to define a set of common project goals. The urban planner can set out detailed statutory requirements through the use of a technical code or even stricter conditions within an urban area boundary for derivative planning (See Table 3). All public or private developers then have to comply with these requirements at the design and implementation stages of their project.

The various urban planning schemes work at different scales and with different degrees of detail. While the POUM acts at the city level, derivative plans define urban regulations from block to neighbourhood levels with higher levels of details in the definition of urban rules. In the case of Manresa, the old neighbourhood of the city has a Special Plan to Revitalise the Old of Integral Refurbishment (PERNI): a set of derivative plans aimed at formalising the vision of urban planners and politicians about what the city should (or shouldn't) be. The city

[16] See Appendix B Table B1 for a list of the participants.

is ageing; with abandoned and empty buildings and plots, decreasing social and economic activity, decreasing hygiene and there is a need to improve aging infrastructures. The PERNI responds to these issues and promotes the modernisation of the old neighbourhood. The aims are to improve the quality of life of its inhabitants. In order to do so, the plan objectives are to increase the habitability and refurbish the building structures and construct new buildings in highly degraded areas, to open spaces and renovate and improve areas with high density of buildings and narrow streets.

Figure 6. Rich Picture of the Spanish Case Study with the challenges of integration between energy data at different scales of spatial planning

Table 3 Parameters that delimit the option space for urban development.

Family of parameters	Possible requirements from the urban planner
Parameters aimed at limiting the volume of the buildings	To limit the minimum and maximum height of the building To establish the compulsory depth of the building To establish compulsory alignments To define the maximum or compulsory limits
Parameters describing the activities of the zone under urban planning of mixed uses.	Define the buildable area (maximum square meters to be constructed) Occupation rates (maximum surface that can be occupied) Density (maximum Lumber of houses that can be constructed) Delimit land uses.
Other parameters	Set the qualification level of the building (a / B on the national certification scheme) To require a percentage of electricity produced locally from renewables. At urban scale, the urban planner can also reserve space to construct a RES power plant (biomass, photovoltaic or whatever is decided by the urban promoter). To require a certain amount of domestic hot water generated locally (solar thermal) To bind the implementation of cross ventilation, and related volumetric aspects

Usually, urban planners have performed this task without much consideration of environmental criteria such as the reduction of greenhouse gas emissions. The dominant criteria are local to the city: e.g. the willingness to refurbish a degraded zone, classify an urban zone for new developments (i.e. city expansion due to demographic growth) or improve mobility issues by widening the streets. The absence of environmental criteria in urban planning is not due to a lack of interest from urban planners, but rather due to the lack of adequate tools and access to required data. On one side, the tools used by Spanish urban planners are individual tools with their own input processes and formats. In the case of decision-support tools aimed at assessing energy performance, they have specific objectives (e.g. energy certification) and only perform calculations at building level without any consideration for the surrounding urban environment. On the other side, the access to data in different formats and from different sources presents challenges in using the various tools for different aims.

Despite the fact a private developer becomes involved in the urban development process once the derivative plan is already defined alongside local parameters for the urban project (e.g. at building level), they still have the opportunity to further consider environmental issues and CO_2 reduction potential: The urban developer might want to compare different alternatives for the urban project considering the variation of general characteristics of the specific project, such as volume, location, orientation or shape of the building. Once the urban promoter has chosen one or two options, they would expect to export basic data to run more detailed simulations (e.g. in Energy Plus or Calener) and proceed to the certification procedure. In this way, the scheme developer can interact with the owners, other urban developers, neighbours or the city council in order to define general aspects of the project with common data.

5.2.2 Actors key problems

The process of the development of the rich picture identified different but related problems of different Actors at each geographical scale. In this way, the research identified how the tools and methods under development in the project are supposed to further refine the aims of the Actors in the Spanish case study area.

At the ***micro level*** [neighbourhood/building] the following issues were identified:

- Urban planners would like to have a preliminary knowledge about the performance of the building according to the technical code, by only defining the shape and location of the building.
- Planners and both public and private sector developers wish to calculate the energy performance of a building, with detailed input information, before implementing a special or partial urban plan, retrofitting or refurbishment.
- Developers and property owners need to know the energy performance of the building in order to initiate the process of certification.
- Urban planners and public housing companies would like to identify the causes of poor energy performance by comparing different performance indicators against benchmarks or reference values in order to identify hot spots of poor energy performance. And then to prioritize investment in energy savings improvements.
- Urban planners and community / neighbourhood organisations would like to assess the potential of a building or neighbourhood to implement renewable energy sources. For instance, to know the potential solar energy production from solar radiation in roofs and walls.
- Urban planners operating locally and regionally are required to evaluate the impact of urban plans aimed at changing the structural/architectonic parameters in some buildings types. That is, for example, a plan promoting changes in windows or isolation systems. Consider the case of a plan trying to minimize noise of the mobility

surrounding the building and the effects on energy consumption.

- Private and public developers would like to identify energy intensive buildings with potential energy savings improvements. Calculation of the profile of energy carriers and final energy uses, which can be compared with benchmarks in order to identify potential improvements.
- Community / neighbourhood organisations want to know the effects of an urban plan on the annual energy bill. For instance, whether the overall energy bill (electricity + gas + heat) changes after the construction of a district heating plant.

At the ***meso level*** [City] the following issues were identified:

- The Municipal Planning Authorities need to validate/compare the General Urban Plan of the city against the current situation, and to identify buildings with potential energy savings after a refurbishment. The user would change some parameters such as height and shape of buildings, and/or redefines urban elements such as streets or open spaces.
- The Municipal Planning Authorities want to determine neighbourhoods with higher potential of energy savings. Calculation of the profile of energy carriers and final energy uses at neighbourhood level for the whole city.
- The Municipal Planning Authorities wants to know the characteristics and the costs associated to gas, electricity and water networks required by urban plans. In cases of district heating, new green areas, new buildings, among others.

5.3 Translating real world problems into systems requirements

5.3.1 Identifying the goals of the Use Cases

From the concerns facing Actors in the Spanish case study as described above and depicted in figure 6 the following goals were identified during the initial development of Use Cases:

- UC1-M. To calculate the energy consumption and CO_2 emissions of a new or existing buildings and of the urban area, for a new or existing urban development;
- UC2-M. To calculate the operational and maintenance costs, and other socio-economic benefits of a urban intervention;
- UC3-M. To evaluate the potential of energy production from solar radiation;
- UC4-M. To assess the changes in the energy bill after the implementation of an urban plan (demolish & new construction, refurbishment);
- UC5-M. To compare different alternative urban plans between them and against the baseline.

5.3.2 Focusing the tool development

From the requirements identified using the Rich Picture (*Figure 6*) methodology, the following Use Cases, were defined to drive the tool development in WP5 *Tool Development and Integration*, and the Spanish demonstration scenario to be conducted as part of WP8.

- UC1-M. To calculate the energy consumption and CO_2 emissions of a new or existing building and of the urban area, for a new or existing urban development (see Appendix A Table A11).
- UC1-M. To calculate the energy consumption and CO_2 emissions of new or existing buildings and of the urban area, for a new or existing urban development (see Appendix A Table A12).
- UC2-M. To calculate the operational and maintenance costs, and other socio-economic benefits of an urban intervention (see Appendix A Table A13).
- UC3-M. To evaluate the potential of energy production from solar radiation

- UC4-M. To compare different alternative urban plans between them and against the baseline (see Appendix A Table A14).

These particular Use Cases were defined as they deal with most of the problems identified by local actors. Also, they are coherent with the current process of urban planning that is taking place in Manresa; that is the development of the update of the General Urban Plan.

5.3.3 Further contextualizing the use cases

To further ensure that the goals and the Activities of the Use Cases are applicable to the needs and requirements of Actors, this section explicitly illustrate how the reviews of national and local policies and interventions of the Spanish Case Study presented in Deliverable 2.1 *Report of the case studies and analysis* (Gamboa *et al* 2012) informed the requirements capture process.

5.3.3.1 To calculate the energy consumption and CO_2 emissions of a new or existing building

The activities involved in this use case are:

- Definition of system and occupation parameters (Occupancy, hot water profile, electric appliances, comfort conditions, efficiencies, socio-economic parameters);
- Determination of the characteristics of the urban environment (shadows, solar radiation, external temperatures);
- Determination of the architectonic characteristics of the buildings in the urban plan (year of construction-technical code, height, footprint, U-values of enclosures and windows);
- Determine the energy performance of the building (energy demand for heating and cooling, electricity, gas and liquid fuels consumption);
- Determine the CO_2 emissions of the building.

5.3.3.1.1 How is the goal of the use case and its activities relevant to Actors and Users?

Use Case UC1-M is particularly relevant to urban planners and/or building owners/occupants as it will support the assessment of the current state of energy consumption of a certain building. In case of calculating the performance of a new development in energy and economic terms, the relevance of the use case derives from the possibility of comparing different alternative plans between them and against the baseline.

As mentioned before, environmental criteria are seldom considered in the urban planning processes, within the Spanish context. Those criteria are becoming increasingly relevant in the urban planning domain.

5.3.3.1.2 How is the goal of the use case related to national /local policy frameworks?

The identification of requirements in the Spanish case takes place within the current statutory urban planning context at municipal and city levels. At building and neighbourhood level we are within the framework of the Special Plan for Revitalizing the Old Neighbourhood, which in general terms is aimed at modernising this part of the city and to improve the quality of life of its new and old inhabitants. In practical terms, this can be translated in improving the energy performance of buildings, which entails to lower the energy consumption and a reduction in annual energy costs.. The use cases UC1-M and UC2-M are intended to assess this expected reduction in energy consumption. In addition, , it will assess the expected reduction in CO_2 emissions, which has to be reduced in accordance to the Covenant of Mayors signed by the city council.

Therefore, initially, we must understand the current energy performance of the buildings and

the entire neighbourhood. Only in this way it would be possible to propose improvement measures (e.g. to refurbish buildings, demolish old and construct new buildings, widen streets and public spaces), to assess them against the current state and to conclude to what extent the new proposals would improve the quality of life of people.

5.3.3.1.3 How the tools/methods identified in the Use Cases are related to the needs /requirements of actors and related national or local policy frameworks

URSOS is the main tool to be used to assess energy performance of buildings and neighbourhoods. By means of this tool, we can assess the energy and environmental performance of buildings in an urban area. The program simulates the thermal behaviour of buildings or of residential areas according to climate conditions, thermal characteristics of enclosures, ventilation rates and volume. It also considers the interaction with the surroundings of the building by means of considering shadows effect in the calculation. This feature is of fundamental importance if we want to assess and compare different alternatives of energy efficient urban planning. Those potential energy savings measures range from actions at building to urban level, and are compared at both levels. It is required because it is necessary to assess whether actions implemented at building level increase or decrease energy consumption and CO_2 emissions at urban level (Gamboa 2012).

5.3.3.2 To calculate the energy consumption and CO_2 emissions of an urban area, for a new or existing urban development

The activities involved in this use case are:

- To perform UC1-M for all the buildings in the target urban area. That is calculating the energy consumption and CO_2 emissions of existing buildings.
- To aggregate the calculated values of energy demand and CO_2 emissions according to different land use categories and at urban level.

5.3.3.2.1 How is the goal of the use case and its activities relevant to Actors and Users?

Interventions and actions at the building level may have positive and/or negative effects on its environment regarding energy performance and CO_2 emissions, and vice versa (see Gamboa 2012). This is the rationale behind performing evaluations at building as well as urban level. In this way, we may avoid actions aimed at improving energy performance of a building negatively affecting the performance of neighbouring buildings in a given area.

5.3.3.2.2 How is the goal of the use case related to national /local policy frameworks?

National and local policies (e.g. Special Plan for Revitalizing the Old Neighbourhood and Covenant of Mayors) aim at reducing the energy consumption and CO_2 emissions of urban areas (i.e. cities, regions and countries as a whole), and not only specific buildings. The reduction of energy consumption of one building does not make sense if this reduction causes an increase in consumption in other buildings.

5.3.3.2.3 How the tools/methods identified in the Use Cases are related to the needs /requirements of actors and related national or local policy frameworks

The method that aggregates energy demand and CO_2 emissions from building to urban area is, in practice, quite simple. It classifies built surfaces according to their uses, and aggregates the calculated values following a hierarchy of land use categories defined in Table C1, Annex C, Deliverable 2.3 (Gamboa 2012). In this way we can provide a coherent method of aggregation across scales and an easy way to define and use benchmark values of energy demand and CO_2 emissions across scales and according to different activities (office, residential, commercial, industrial etc.).

5.3.3.3 To evaluate the potential of energy production from solar radiation

The activities involved in this use case are:

- To perform UC1-M for all the buildings in the target urban area (in order to obtain solar radiation on the walls of each building)
- To calculate the potential electricity production from photovoltaic solar panels in each building.
- To aggregate the calculated values of potential electricity production at urban level

5.3.3.3.1 How is the goal of the use case and its activities relevant to Actors and Users?

There is an increasing interest in the implementation of photovoltaic solar panels on building roofs by the owners of buildings. It can be a source of decreasing the energy cost and can, depending on the size and productivity, become a source of income for building owners if they are able to sell surplus electricity production back to the national grid.

5.3.3.3.2 How is the goal of the use case related to national /local policy frameworks?

Local electricity generation from PV solar panels offer a realistic method of reducing energy dependency and CO_2 emissions[17], which are key objectives of policy frameworks such as the Spanish Building Technical Code and the Covenant of Mayors.

5.3.3.3.3 How the tools/methods identified in the Use Cases are related to the needs /requirements of actors and related national or local policy frameworks

The chosen method to assess the potential of electricity production is a simplified method. Its aim is to give a preliminary indication of this potential rather than a detailed calculation of electricity production. At building level, it may serve as a preliminary filter to decide whether or not to perform a more detailed assessment. At urban level, it serves to identify which of the urban planning alternatives maximises local electricity production from solar PV panels.

5.3.3.4 To compare different alternative urban plans between them and against the baseline

The activities involved in this use case are:

- To perform UC1-M for all the buildings in the target urban area
- To aggregate the calculated values of energy demand and CO_2 emissions according to different land use categories and at urban level
- To perform a multi-criteria evaluation between alternatives (according to the set of performance indicators calculated in previous activities, at building and urban scales)

5.3.3.4.1 How is the goal of the use case and its activities relevant to Actors and Users?

In current times, budgets to implement energy saving measures in urban planning are limited. A few years ago, the most common way to proceed from the social housing company was to buy old buildings, demolish them and construct new ones. In this way, they contributed to the general objective of the PERNI to revitalize the old neighbourhood (by widen public spaces and streets, improving the habitability of the area and increasing the number of social housing and inhabitants).

By performing a multi-criteria comparison of urban plan alternatives, decision makers are enable to choose the option that balances environmental, social and economic criteria. Recall the fact that, in complex situations, the optimal alternative that maximizes all criteria

[17] Depending on the case, it is not clear whether solar PV panels decrease CO_2 emissions at global level if we consider extraction and processing of raw material, and the production process. Which are both highly energy intensive.

simultaneously hardly exists.

5.3.3.4.2 How is the goal of the use case related to national /local policy frameworks?

National and local policy frameworks have different and sometimes contradicting objectives. For instance, the Spanish technical code sets up a minimum amount of air renovations in a building. On the one side, this issue aims at assuring healthy spaces within households. On the other side, high air renovation rates imply higher heat losses and higher demand of energy for heating during winter time. As mentioned before, using a multi-criteria method to compare different urban planning alternatives has enabled us to identify an alternative that balances different and sometimes contradicting criteria.

5.3.3.4.3 How the tools/methods identified in the Use Cases are related to the needs /requirements of actors and related national or local policy frameworks

The chosen multi-criteria method is called the CKYL method (Munda, 2005). It is an outranking method that requires the definition of preference thresholds for each criteria and the use of weights as importance coefficients. Therefore, it does not allow compensation between criteria in the aggregation procedure. This is an important feature for multi-criteria methods to be applied in the public policy domain, since it assures that all dimensions considered important by one or more stakeholder groups are included in the process.

6 VALIDATING THE REQUIREMENTS CAPTURE

6.1 Introduction

This chapter focuses on identifying a common range of stakeholder requirements. These are based on the responses of users and actors to the initial stages of the SEMANCO tool development completed in the first year of the project. This chapter frames these findings with a review of currently used decision-support models and tools for CO_2 reduction in energy related urban planning, urban development and redevelopment. It then presents a summary of the common stakeholder requirements across the different case studies that were identified by focus group discussions and through the meetings and interviews with the key stakeholders in each of the case studies.

6.2 Literature and desk-based practice review

The literature and desk-based practice review identified specific 'gaps' in the existing evidence related to current decision support tools for CO_2 reduction in energy related urban planning, urban development and redevelopment. This included knowledge of instruments; policies, tools, models (with particular reference to ICT tools) training, management / the updating of supporting databases, external validation and other requirements for stakeholder support. Within this review, many of the users and actors interviewed highlighted problems arising from 'information overload' and 'noise' surrounding the application of technical tools. The complexity of the situation is illustrated Figure 7. This figure presents the output of the mapping exercise conducted across the three case studies to identify the current availability and use of decision-support tools and instruments for stakeholders at regional, city, neighbourhood and building levels. Stakeholders also emphasised a lack of consideration in relation to quality control and understanding of end-user requirements. Steinebach *et al.* (2009) have also highlighted this as a common concern around technology driven processes and tools. These findings make it essential to check the assumptions and expert requirements within the tools being used against stakeholder requirements this was done in a second wave of interviews and workshops.

6.3 Key findings from the stakeholder engagement

In the meetings, interviews, conversations and focus groups with stakeholders the objectives of the SEMANCO project were presented. In addition for some of the stakeholders, the development of the initial pilot tools were presented as a series of hypothetical 'use cases' and worked examples of how they may be used.

It must be noted that the relationships with the most significant stakeholders vary between the different case studies. Two of the SEMANCO project partners FORUM in Spain and RAMBOLL in Demark have direct involvement in the implementation of the urban development /redevelopment projects at the heart of the case study areas in Spain and Denmark. However, the UK project partners do not have a direct involvement in the implementation of the urban redevelopment project that lies at the heart of the UK case study area. Due to this it was necessary to conduct a more in-depth assessment of the initial stages of the tool development with a broader range of stakeholders in the UK. This included stakeholders with similar statutory responsibilities and interests as FORUM and RAMBOLL.

Table 4 presents a summary of the common stakeholder requirements across the different case studies identified by focus group discussions and through the meetings and interviews with the key stakeholders, including the SEMANCO project partners, in each of the case studies. These key findings are then further discussed in the remainder of this chapter.

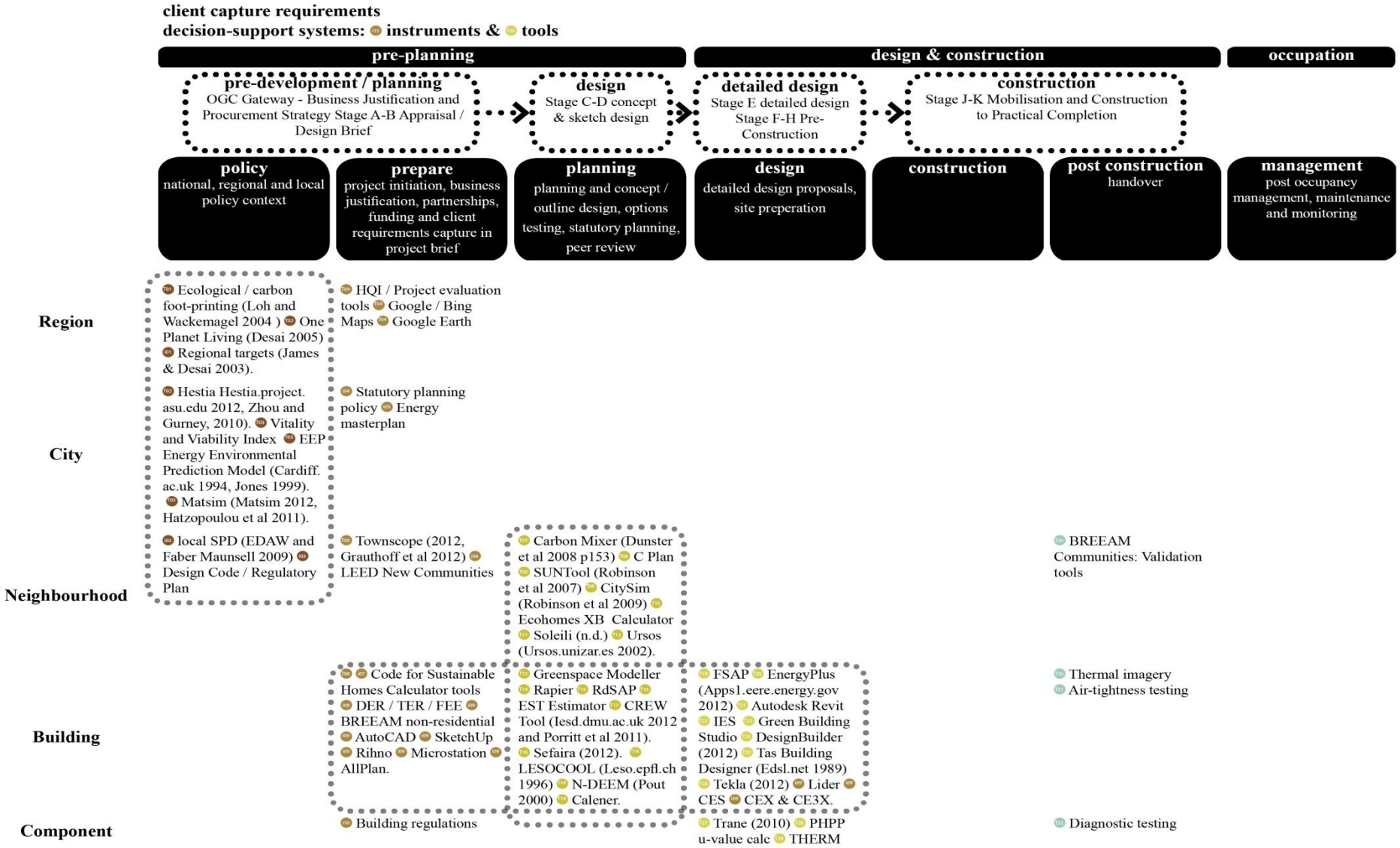

Figure 7. Current availability & use of decision-support tools & instruments at regional, city, neighbourhood, building and component levels

Table 4 Summary of stakeholder requirements across the different case studies

Issues and potential applications	Stakeholder(s) Relevance to specific case study Denmark (DK), Spain (ESP), UK
Business planning tool providing evidence to target geographical areas of interest and commercial demand	Commercial energy providers (DK, UK, ESP), energy charities (UK), public housing providers, municipalities (DK, ESP, UK)
Providing evidence of environmental and socio-economic 'impacts' to secure scheme funding	Social / public housing providers (ESP, UK), public funding agencies (DK,ESP, UK)
Monitoring and management of the environmental performance of building stock	Municipalities (DK, ESP, UK), National Government agencies (ESP, UK, DK)
Evidence for advocacy around new policies and initiative for linked energy and social indicators	Environmental charities / professional institutes (ESP, UK)
Effective use of limited organisational resources and supporting financial investment (provision of new buildings and upgrades or new energy supply infrastructure)	Public housing providers (ESP, UK, DK), private developers (DK,ESP, UK), municipalities (DK,ESP, UK), Energy providers (DK,ESP, UK)
Fulfilling national / local statutory and legal obligations for monitoring energy use and emissions	Municipalities (DK,ESP, UK), private and public developers (DK, ESP, UK), property owners (ESP, UK, DK)
Supporting statutory certification for building energy performance	Private developers (DK, ESP, UK), social / public housing providers (ESP, UK, DK), property owners (ESP, DKUK), Professional associations (ESP, DKUK)
Cost effective integration with existing organisation stock data for locality specific and adapted modelling	Social / public housing providers (ESP, UK), private landlords, commercial property management consultants (UK), design consultants (DK, ESP, UK)
Informing project brief and strategy for new build development	Public housing providers (DK, ESP, UK), private developers (DK, ESP, UK), commercial energy providers (DK, UK), Municipalities (specially technical departments: urban planning, environment, …) (ESP, DK, UK)
Guidance on the retrofitting of existing stock	Public housing providers (ESP, UK), private developers (ESP, UK), Public and private owners (ESP, UK), Associations of professionals and private professionals (architects, master builders, engineers…) (ESP, UK)
Early stage design tool	Municipalities (ESP, DK), Public housing providers (ESP, DK) design consultants (DK, ESP), Associations of professionals and private professionals (architects, master builders, engineers…) (ESP, DKUK)
'Expert' tool with training and / or technical support during use	Environmental and energy planning consultancies (DK, UK), municipalities (DK, ESP, UK)
Investment in renewable energy infrastructure	Commercial energy providers (DK, UK), municipalities (DK, ESP, UK), Public and private owners (large or small stock… (ESP, DK,), consumers/inhabitants (DK,)
Supporting area-wide stock management and property maintenance	Public housing providers (ESP, UK), private developers
Flexibility to adapt and support new policy initiatives	Municipalities (ESP, DK), environmental and energy planning consultancies (DK, UK), public and private developers (DK, UK), Energy utilities (DK,UK)

Large social / public housing providers have an interest in the speed and cost-effectiveness to use the tool (even within the beta version). For example, in the case of FORUM (the social housing provider in Manresa) and other large housing organisations, there is a new legal requirement and thus interest in energy certification for building stock. This is similar in the UK where an estimation of SAP[18] figures was considered adequate for organisational needs and comparable to current forms of sampling large housing stock. For example, Nottingham City Housing (hold a stock of 35,000 homes) had an interest in making an internal business case – a working proposals for securing internal investment funds for the stock, that was competitive within a large organisation with limited resources and still needing to make a significant social and environmental impact.

The scope of the SEMANCO indicators is about demonstrating the environmental and social benefits of a large scale retrofitting / upgrading programme. In the UK this was with a particular interest in follow-up programmes on properties that have already been subject to the Decent Homes Programmes. Spanish stakeholders were interested in similar applications for the identification of appropriate areas for refurbishment and obtaining appropriate evidence to initiate a project.

Supporting the development of an external business case requires a competitive approach to securing external funding sources. This requires high quality and cost–effective evidence on current environmental performance to compare against modelling different scenarios and options. In each instance (internal and / or external business case) targeted investment programmes into the building stock had to be supported by very clear, albeit pragmatic sources of evidence. The applications are needed to support strategic regeneration and to fit well into compulsory purchase and land acquisition processes. If there was a public enquiry or legal case arguing for demolition or against – SEMANCO could provide useful evidence.

Within the larger municipalities there were clear divisions of interest and responsibilities. These are complex organisations and internally, local municipalities (stock asset management responsibility) had a direct interest in improvements to their environmental management.

In the UK, there was a demand to include multi-occupancy properties and non-residential land uses as part of the further tool development. The requirements for understanding CO_2 emissions from non-residential properties, reflected the historical transfer of particular local authority housing stock to registered social housing providers, arm's length management organisations and in some instances to community development trusts; effectively leaving the municipality with an almost exclusively non-domestic property portfolio.

Small social housing providers had a different interest due to scale of operation. Their awareness of the stock and local knowledge meant that the potential to target resources was limited and could simply reassert things they already knew about the quality and environmental performance of their stock.

Environmental charities and professional consultants had an overlapping, partly commercial, interest that focused on supporting and guiding but within this focussed area of strategic planning and towards large property owners / managers. They considered they could have a direct role in technical support as a user of any technical modelling tools. This was a common experience from each of the case studies. Local municipalities (environmental strategy and policy functions) needed to know what the baseline figures are, including some approach to retrospectively producing a baseline figure prior to any additional measurements. Ideally this should be suitable for visualisation.

[18] The UK's national calculation methodology [SAP] is the indicator used to measure the success of UK Government policies designed to improve the energy performance of the UK's housing stock.

There were a number of large and small organisations that required follow-up conversations around potential trial and testing within their geographical areas and with their stock. This was a mixed interest in validating information they already held for some areas (effectively testing if the SAP estimates were accurate enough and the associated speed and cost of undertaking the exercise), as well as looked at emerging challenges for business planning within new geographical project areas. Here, there was a clear potential for developing a business case with the support of the SEMANCO tools. SEMANCO was considered a cost-effective step that could help generate further revenues. Modelling could be used to generate the case to attract investment in a neighbourhood / city wide energy programme. For example, in Manresa, financial viability was central to all the planning initiatives and the accuracy of the energy estimations had to be sufficient to form part of financial investment decisions.

Although, where there were concerns over the adequacy and / or accuracy of SEMANCO, this was also the case for other energy modelling tools. In several cases, engaged energy officers / planners were interested in the SEMANCO tool alongside others and more than willing to consider more than one model in making their business case for investment in energy efficiency programmes. Here there was a realistic response to understanding the relationship between costs and accuracy in the data. As the quality of data improved, the accuracy in the calculations improved. Most stakeholders were relatively content with an 'approximation', as they know there will be limitations with all models. Applications had a competitive understanding – organisations requiring relatively better data, of relatively better linking and analysis of the data they already hold but within a realistic cost. Often the main attraction was about the desk-based nature of the modelling and the corresponding low cost. The model didn't need to be precise to inform decision making at the early project stages. Although for both the Spanish and UK case studies, increased accuracy that could provide statutory certification would be an additional advantage of the tool.

In a corresponding manner, SEMANCO was not considered primarily a design[19] stage tool, at least regarding the prototype as it was too imprecise to consider for any detailed design work to specific properties or entire urban areas. However, it would benefit from improved input and output function with other planning and design based software and could be usefully connected to these. There should be the ability for manual inputs to over-ride many of the automated presets.

There were several potential large – scale Use Cases that were discussed in and around the workshops and meetings. Central to thinking about large-scale applications of the SEMANCO tool is the potential to get Governmental departments to fund this as a three pronged approach to dealing with energy intensive buildings, reduce carbon emissions (including informing decisions on decarbonise the grid), reduce fuel poverty. For a significant number of national Government objectives, the starting requirement was around the acquisition of data and baseline figures. This was true for all three case studies. While such potential applications are outside of the remit of most case study stakeholders, there was an interest in how it could be applied as a tool above the municipal scale.

The requirements capture process has highlighted that the development of decision support tools are as much about knowledge and data management, with issues of quality control, accuracy and accessibility being as significant as the level of use and functionality. Functionality requires a useful format based on the design, appearance and simplicity of the interface together with the levels of stakeholder control (Hunt 2006). Taking the control out of the remit of the stakeholder and requiring technical support and expert advice on use and analysis has implications for operability and functionality. In this context, it is highly likely

[19] This is understanding 'design' function within the generic procedural framework and following on the establishment of a clear breif from building a busines case and procurement strategy for undertaking the work.

that all indirect strategic stakeholders involved in project initiation and business justification stages of work will remain 'actors' rather than 'users' of the SEMANCO tools. Exceptions to this do arise in the Manresa case study where there is more direct involvement in the project and a larger number of expected users.

Whenever a project proceeds to planning and design stages there are signification implications arising out of organisational requirements for accreditation and / or external validation. For example, in the UK case study context many instances; including the use of SAP, CSH and the validation of LEED and BREEAM as measures of energy efficiency and wider sustainability; require the involvement of a trained and accredited professional. In the UK, the headline aspect being the stepped approach towards zero carbon housing standards by 2016 delivered through incremental stages to statutory planning requirements and building regulations (CLG 2006), albeit both mechanics do this with reference to SAP and a measured percentage improvement against this that require training and accreditation of the individuals undertaking and reviewing any assessment. There are similar statutory requirements highlighted within the Manresa case study that have set some of the basic 'industry standard' measurement methods. In each case there is a high level of documentation required to attain formal accreditation.

In the Danish case study context much of the debate related to energy efficient buildings and urban area development projects. Here the central question was the socio economic benefits in applying the strict building codes (expected to be introduced in 2015 and 2020) giving very low energy demands and forcing buildings to be equipped with decentralised energy systems compared to central district heating, These differences in problem domains is likely to influence actors/users requirements to projects like SEMANCO.

There was a common concern over any organisation acting as a 'user' without fully understanding the quality and accuracy issues around initial data-capture and input into the SEMANCO tool. It is unlikely that any organisation indirectly involved in SEMANCO would be acting as a totally independent user of the tools. This is an issue of importance in advance of any concern around 'user' skills, experience and training requirements. In Manresa this issue was discussed with one outcome being the use of the tools being restricted to work by and within the municipality.

The uncertain quality of the data' expressed in the stakeholder meetings, workshops and interviews through the maxim 'rubbish in rubbish out', was a potential negative of independent 'users' operating the SEMANCO tools through an open source platform and interface. There was a general understanding that confidence and trust in the data populating the model is crucial to the fundamental quality of the model. The best (most trustworthy) means of addressing this was through a mix of 'user' training and consultancy support to ensure the accurate operate of the software and data inputs. A repercussion being that accuracy in the data input and use of any decision support tools and software is often dependent upon support training for identified 'users' of the tools – leading to additional running costs in staff training in addition to any on-going cost of licenses. Where the development of new tools can improve the level of accuracy in data collection and model inputs; effectively reducing 'user' input errors; then there should be clear benefits from their use.

The attraction of speed and cost benefits in the use of any decision-support tool included the development and testing or evaluation of options. The SEMANCO tool needs to have the additional functionality of addressing some of the real-world complexity around hybrid solutions that include a mix of new development, renovation / retrofitting or demolition considerations and comparisons between these options. This was true even when individual case studies had an emphasis on new build or retrofitting.

This level of functionality to test highly contentious scenarios is a significant issue which is

currently lacking evidence, particularly relevant to northern conurbations densely populated with older terraced (row housing) stock and those urban areas dealing with significant housing market restructuring. This is also the case for new urban development areas dealing with the issue of connecting to an already existing central energy infrastructure or each building being supplied with a decentralised energy system The SEMANCO tools provide an opportunity to undertake this type of holistic assessment that could have benefits in ensuring some basic statutory requirements are met (for example, in the requirement to test all viable options as part of any comprehensive regeneration with the operation of compulsory purchase powers) and more importantly, quantify whether public bodies (national, regional and local authorities and agencies) are spending their money correctly and effectively.

Within the larger municipalities and social / public housing providers there is a significant responsibility for stock management and maintenance. Thus, there was an attraction in this functionality of the SEMANCO tool with regard to retrospectively setting a baseline for the energy performance and level of emissions of historical housing stock, then assessing upgraded stock (where typical measures such as cavity wall / roof insulation, installing more efficient boilers, window upgrades have already been undertaken), prior to testing the potential for other physical interventions. For example, in the UK, Retrofitting and "… accelerat(ing) the upgrading of the existing housing stock" (see SDC 2009, p.18) has been set as a priority for Government 'green stimulus' spending, thus there was a particular concern about understanding the correct level of specification to any future upgrades to property stock and / or energy systems in a way that prevented over-specification and a corresponding waste of public and organisational capital funds. This was also a significant issue for the work of FORUM in understanding cost effective maintenance and management options.

There has been a consistent message from all stakeholders involved at every level, that linking to costs of energy efficiency work and energy supply options is central to decision-making at all scales of operation. At the household scale, the retrofitting process is significantly held up by up-front capital costs and similarly motivated by the interventions as property investments with measurable payback (Novikova *et al*, 2011). Yet there are also additional concerns over the perceptions of retrofitting as complicated and associated worries over quality control of any work undertaken. In effect another scale in trust and confidence over costs and energy savings expected.

Cost implications (included as Governmental and / or organisational KPI requirements for capital and revenue budgets) are essential inputs to support the development of both internal and external business case. The connections between costs, fuel prices and emissions are most obvious in fuel poverty as a policy indicator metric (Boardman 2010) that is described as integrated policy. However, it is the organisational budgetary considerations that are the drivers behind taking cost-effective action. The development of such a business case includes a broad scope of work that is currently only partly covered by SEMANCO. This is an issue of potential for the exploitation plan for SEMANCO.

Increasingly the emphasis for any business case has moved from the 'low hanging fruit' of the most energy inefficient properties towards parts of the housing and building stock that has already been improved (for example in the UK Decent Homes programme with the addition of wall and roof insulation and replacement double glazed windows and more efficient combination boilers). The need within any business case for large-scale retrofitting will then begin targeting ownership and tenure as much as property or age-based construction typologies through the compulsory use and enforcement of Energy Performance Certificates (EPCs), the use of incentives for private landlords and minimum SAP standards set at a level to specifically impact on levels of fuel poverty as all properties are subject to renovation (Baker & Lainé, 2010).

On the energy supply side, property developers need to know how a new urban area (e.g. the

Danish case study area) is to be supplied with heating and electricity and what investments are needed in energy supply technologies and infrastructure. In this context it is essential to know if the energy systems are decentralised and have to be provided, operated and managed by the developer or the individual consumers or provided by a professional energy supply company. Initial investments will be higher for decentralised energy supply systems, which have to be incorporated into the total property costs. SEMANCO can help property developers to get an understanding of these issues at an early stage in the planning process.

Cost issues will be central to later stages of post-completion management and monitoring. Ideally, this would link SEMANCO with possible requirements for independent metering and monitoring or actual energy usage referenced back to predicted usage, to make a comparison between real and predicted costs. Although at post occupancy stages costs have to also relate to supporting information on technical suitability, feasibility plus reliability in maintenance, any issues around disruption or safety. This would provide realistic (and validated / evidenced) capital and revenue costs (including calculation around financial constraints) with calculated payback periods.

The inclusion of detailed project costs into the SEMANCO tool extended the potential applications on options testing. There was significant interest expressed in how the tool could support several different options for contracts and procurement of works, including those which are link energy efficiency calculation methods, with savings, against contractor works where the lead contractor would take responsibility for physical works to provide the necessary, and measurable, energy efficiency measures.

The potential business options where the estimated energy savings are the responsibility of a contractor, place issues of trust in calculation methods in the remit of the private sector. Including trusted costs may actually have a significance in the lead / commissioning organisation and the best methods of procurement – this in a way that can be unpredictable.

6.4 Summary of the key issues for tool development

The stakeholders' requirements are complex with multiple Use Cases required to meet the specific requirements of individual organisations. Stakeholders' requirements can also change over time and appear contradictory in the emphasis on early stage business planning and project justification due to changing externalities on costs, policies and timescales[20]. The dynamic nature of the stakeholder requirements became clear during the meetings, workshops and interviews. While this in itself doesn't undermine Use Cases selected to form the focus of the tool development and integration within the SEIF, it has places emphasis on the flexibility and adaptability of the tools to respond to alternative applications.

It must be emphasised that the stakeholder engagement proved to be largely positive with respect to the tool development and the potential functionality to fit their specific applications. This is due to:

- a lack of appropriate tools that are fit for these Use Cases at present, particularly the role of considering CO_2 emissions in urban planning;
- requirements for setting baseline measurements and the evaluation of options;
- requirements for cost-effective measurements for statutory energy certification, in a new regulatory environment;
- Interest in straightforward visualisation of energy consumption alongside key urban planning indicators.

[20] This work will be further extended as part of D6.3 in the trialling and testing of the Beta Version of the demonstration tools for a wider body of stakeholders.

There was a high level of agreement on the practical use of the initial Use Cases between the stakeholders in the separate case study areas.

The outcomes have been a set of initial Use Cases that will be useful for a broad range of stakeholders. Sometimes these have been common Use Cases between the separate case studies and have the potential to be transferable between new development and refurbishment, and between different locations. Sometimes they are unique to the context of the development location and importantly of a particular time. There is clear evidence within the range of stakeholder responses that one of the attractions of a semantic approach to the use of data for the energy performance of buildings and neighbourhoods is the long term flexibility to replace these Use Cases as and when the need arises.

7 CONCLUSIONS

7.1 Contribution to overall picture

The stakeholder requirements capture within the three case studies has demonstrated numerous possible applications for the SEMANCO tools. It has provided verification of the overall approach of using semantically structured data about energy performance by identifying a high level of interest from a broad range of potential actors and users.

7.2 Impact on other WPs and Tasks

The common concerns in the three case study areas, discussed in chapter 6, point to several issues for the development of SEIF and the pilot tools.

7.2.1 Data Quality and Reliability

The findings of the requirements capture suggest that there has to be professional trust and competency in the use of the SEMANCO tools that can be addressed through the appropriate use of metadata standards and protocols that provide;

- Indicators in understandable units of measurement;
- KPIs / indicators that allow for direct and visual comparison at a local to regional scale and are referenced in national, regional or local policies or mandated standards;
- Quality assurance in the display of indicators alongside the relevant units of measurement but also ensure there is clarity around what is being measured by providing clear references and explanations concerning metadata, sources and dates.

These concerns relate to the quality of the input data and making the source data understandable and trustworthy within an acceptable cost.

7.2.2 Requirements for the pilot tools

The findings of the requirements capture also suggest that the functionality of the pilot tools under development within work package 5 will be enhanced by;

- The ability to quickly extract data and representative spatial graphics to target locations, with corresponding (area / location) ranking as part of this exercise.
- Mapping CO_2 emissions and fuel poverty and other important energy indicators. These are critical measures to get political interest and associated financial support. Locally collected data would supplement some presets and provide a fine grain level of targeting streets and estates. For example, NEA / Warmzone internal research suggests that over 10% of total retrofitting costs can be attributed to identifying properties suitable and eligible for funding criteria. In Manresa and the new legal framework, this information will be valuable in identifying areas where buildings of poor energy efficiency are concentrated.
- Providing calculation of statutory planning and urban indicators. In practice this would mean that at the neighbourhood level, some of the potential urban indicators would relate better to statutory planning KPIs (for example; measuring density of dwellings as the gross number of dwellings per hectare, and levels of occupancy / % void properties) and building indicators (for example; display DER / TER alongside primary energy consumption CSH level equivalent). Including social indicators has been constantly seen as a useful step.
- Provide the ability in the interface to isolate separate land / buildings use to avoid any confusion in operation.

These factors relate to the pilot tool interface and graphic representations as much as the underlying functionality. This issue will be further extended as part of T6.3 in the trialling and testing of the Beta Version of the demonstration tools for a wider body of stakeholders. The findings presented in this report are germane to the exploitation strategy for the SEIF and associated tools (Task 7.4) and as well as the practical functionality of the prototype tools under development in WP5.

7.3 Contribution to demonstrations

There were common experiences and understanding around the need for increasing both awareness of and technical capacity on energy planning above the scale of the individual property for actors and users within stakeholder organisations. While there were many discussions around the development of the SEMANCO tool and a range of potential future applications, the immediate and most relevant recommendations for the development of the demonstration tool are as follows;

- the focus of the practical applications, and thus data capture requirements, is working at a strategic scale with statutory organisations who should have a significant role in the practical development and use of the SEMANCO tools;
- these strategic statutory organisations will require organisational support, training and consultancy involvement to become effective 'users' of the SEMANCO tools and to be able to ensure appropriate analysis and understanding of the tool outputs;
- the tool should include the relevant KPIs for the scale and jurisdiction of operation as a core set of indicators to ensure it can relate and compare with other sites, areas and regions and to enhance the potential for long-term monitoring functionality;
- the emphasis of business justification; for new build, retrofitting and hybrid projects; requires significant integration with capital and revenue costs to actually inform decision-making, where the most significant trade-offs between different indicators and potential impacts will be between the cost plus additional impact measurement.

Many of these generic recommendations are useful starting points for further meetings and discussions with an expanded set of stakeholders in Task 6.3 and those stakeholders involved in the development of the initial Use Cases as they begin to be trialled and tested in practice in Tasks 8.2 and 8.3.

7.4 Other conclusions and lessons learned

Consistent with other mixed qualitative study findings on energy-efficiency (Crosbie and Baker 2010), there should be no assumption regarding rational behaviour undertaken by stakeholders (actors) at the strategic policy scale in response to any form of energy and emissions modelling. In some instances the role of a decision-support tool is as justification and isn't a requirement or benefit to use it where actors already internalise trade-offs between their own options and objectives. In this context, one of the potential uses of the SEMANCO tool is as a 'policy-comforter', using data as suitable and accessible justifications for decisions that are already relatively clear and intuitive but lacking some quantitative evidence. This may be a case of reassuring stakeholders that they are making the best informed decisions around carbon reduction; with issues of costs and benefits for possible interventions, both new build and retrofitting; being less convincing for similar tools compared to assumed figures for carbon emissions. Although there would be additional benefits around understanding more clearly, the relative benefits for a range of different options being considered: Where the general direction around action is clear regarding the scope of work but lacking in detail regarding the extent of travel and the benefits of specific interventions and packages of intervention work.

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9 APPENDICES

APPENDIX A. Initial Use Cases

Table A1 Use Case 1 - Newcastle

Acronym	UC1-N
Goal	Calculate the costs and CO_2 implications of the way Biomass district heating systems are used at differing scales and phases of operation.
Urban Scale	Meso
Process scale	Operational
Actors	Social Housing Providers City Councils Local Planning Authorities (enforcement or relevant planning conditions) Energy Consultants (SAP and CSH assessors) Supply chain partners (biomass fuel & systems)
Related national/local policy framework	The Climate Change Act – It sets a legally binding target to reduce the UK's greenhouse gas emissions by 80% by 2050. The Covenant of Mayors - EU movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. Sustainable Energy Action Plan (SEAP) have been developed by each of the signatories. National Planning Policy Framework – Provides mechanisms to mandate connection to municipal heat / energy networks. Core Strategy / Local Development Framework – Sets legally binding minimum standards for energy efficiency and provision of LZC energy and defined 'allowable solutions' including Biomass district heating. City Council Corporate Asset Management Plan – Operational framework for the efficient management of public sector housing stock, procurement processes and 'best vale' considerations.
Activities	A1. Calculate the costs and CO_2 implications of the way the biomass system is currently used against planned / estimated usage at design stage. A2. Calculate the capital and revenue costs / implications and CO_2 implications of different options for extending the biomass system A3. Map the heat network and areas, locations and uses of high heat / energy demand.

Table A2 Use Case 2 - Newcastle

Acronym	UC2-N
Goal	Optimise renovation plans for an existing building in terms of cost and CO_2 emissions.
Urban Scale	Micro
Process scale	Operational
Actors	Planning Authorities/City Councils Social Housing Providers Utilities industry
Stakeholders	Building owners Building tenants
Users (SEIF tool users)	Energy Consultants (accredited assessor) Developer (development of business case / commercial viability) Urban Planners / Urban Designers Architect Structural Engineers
Related national/local policy framework	The Climate Change Act – It sets a legally binding target to reduce the UK's greenhouse gas emissions by 80% by 2050. The Covenant of Mayors - EU movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. By their commitment, Covenant signatories aim to meet and exceed the European Union 20% CO_2 reduction objective by 2020

	Part L of UK Building Regulations – relates to the performance standards applying to new homes and non-domestic buildings and works carried out in existing buildings Building Energy Certificates: Display Energy Certificate (DEC) – as it currently stands required for buildings occupied by public authorities and institutions (central and local Government, schools, courts and prisons). DEC's were introduced by the British Government in response to the EU Energy Performance of Buildings Directive. Likely to include other public buildings as a matter of law. And Energy Performance Certificates (EPCs)
Activities	A4. For an existing building calculate the energy use as an indicator of cost and CO_2 emissions (method/tool used: real data or IES<ve> (or similar)) A5. For each proposed renovation option calculate the build cost A6. For each proposed renovation option calculate the operational energy use as an indicator of cost and CO_2 emissions (IES<ve> or similar)

Table A3 Use Case 3 - Newcastle

Acronym	UC3-N
Goal	Calculate the built cost and CO_2 implications of different options for the cost effective redevelopment of urban land
Urban Scale	Meso
Process scale	Design
Actors	Housing associations City Councils Energy consultants Construction contractors Private developers Financial institutions (lenders)
Related national/local policy framework	The Climate Change Act – It sets a legally binding target to reduce the UK's greenhouse gas emissions by 80% by 2050. Community Energy Savings Programme (CESP) - Obligation on energy suppliers to provide 'whole house' energy saving solutions to domestic consumers in low-income areas. The Covenant of Mayors - EU movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. Sustainable Energy Action Plans (SEAP) are developed by each of the signatories. Local Development Framework (LDF) - the Urban Development Plans introduced by the Planning and Compulsory Purchase Act 2004.
Activities	A7. Assess the cost of different redevelopment options. A8. Assess the CO_2 implications of the different redevelopment options. A9. Compare the different options for the redevelopment of the cleared land e.g., residential, commercial or mixed use based on the output of the LEAP tool.

Table A4 Use Case 4 - Newcastle

Acronym	UC4-N
Goal	Identify low-income (Fuel Poor) households living in energy intensive dwellings with a poor SAP (Domestic Energy Efficiency Rating).
Urban Scale	The Meso/Macro
Process scale	Operational
Actors	Social Housing Providers City Councils Public Health Bodies Social enterprises / community interest companies Energy Consultants Members of Parliament [MPs] / national Government departments and agencies Third Sector Organisation(s) Utilities industry
Related national/local policy	The Climate Change Act – It sets a legally binding target to reduce the UK's greenhouse gas emissions by 80% by 2050. Energy Act 2011 includes provisions for the new 'Green Deal', which intends to reduce

framework	carbon emissions cost effectively by revolutionising the energy efficiency of British properties. UK Fuel Poverty Strategy - the current approach of the UK Government to tackle fuel poverty. It focuses primarily on practical measures on working together to improve energy efficiency and reduce the costs of fuel. UK Utilities industry regulations Energy Company Obligation (ECO) is integrated with the Green Deal, to allow supplier subsidy and Green Deal Finance to come together into one seamless offer to the consumer to finance CO_2 reduction interventions in houses Community Energy Savings Programme (CESP) - Obligation on energy suppliers to provide 'whole house' energy saving solutions to domestic consumers in low-income areas. The Housing Health and Safety Rating System (HHSRS) – This is a national risk-based evaluation tool to help local authorities identify and protect against potential risks and hazards to occupants from any deficiencies identified in dwellings. The HHSRS assesses categories of housing hazard, one of which is Excess Cold (a string indicator of fuel poverty). Each hazard has a weighting that will help determine whether the property is rated as having Category 1 (serious) or Category 2 (other) hazard.
Activities	A10. Identify neighbourhood areas with the highest percentage of households living in fuel poverty. A11. Estimate the energy consumption and CO_2 emissions from the existing domestic dwellings (used method/tool: SAP/simplified SAP calculation tool). A12. Identify options for fabric interventions suitable for different tenures and ownership patterns at varying scales.

Table A5 Use Case 5 - Newcastle

Acronym	UC5-N
Goal	Identify the CO_2 emissions of domestic dwelling stock and estimate its CO_2 emission reduction potential.
Urban Scale	Meso
Process scale	Operational
Actors	Registered Social Housing Providers City Councils Local Planning Authorities Energy Consultants
Related national / local policy framework	The Climate Change Act – It sets a legally binding target to reduce the UK's greenhouse gas emissions by 80% by 2050. (The underlying reason why this exercise needs to take place, it has the requirement for estimation of historical baseline carbon emission figures). Carbon Emissions Reduction Target (CERT) – CERT is a legal obligation on the six largest energy suppliers to achieve carbon dioxide emissions reductions by improving the energy efficiency of housing (the goal will enable situating the energy inefficient houses and targeting energy efficiency interventions to improve the SAP rating). Community Energy Savings Programme (CESP) - Obligation on energy suppliers to provide 'whole house' energy saving solutions to domestic consumers in low income areas (Same as above). Green Deal (ECO) and / or local variations on the green deal being developed by registered social housing providers and energy companies.
Activities	A13. Estimate the energy consumption and CO_2 emissions of existing domestic dwellings (used method/tool: SAP). A14. Estimate a historic baseline figure for CO_2 emissions. A15. Evaluate the applicability of energy efficiency and renewable energy interventions.

Table A6 Use Case 6 - Newcastle

Acronym	UC6-N
Goal	Identify the relationship between energy demand reduction and provision of renewable energy in the financial viability and business planning for a municipal ESCo.
Urban Scale	Meso
Process scale	Operational
Actors	Social Housing Providers City Councils Energy Supply Company / Multi-utility Supply Company Energy Consultants Cost Consultants
Related national/local policy framework	Local Development Framework (LDF) - the Urban Development Plans introduced by the Planning and Compulsory Purchase Act 2004.
Activities	A16. Estimate the potential of a municipal ESCo and the trade-offs between demand reduction and renewable supply.

Table A7 Use Case 1 – Copenhagen

Acronym	UC1-C
Goal	Calculate costs of production of energy (electricity, heating and cooling) for a variety of production technologies for both individual and district energy systems based on conventional as well as renewable energy sources.
Urban Scale	Micro (Building) / Meso (urban area) / Macro
Process scale	Planning
Actors	Utilities City Councils Town and Country Planning Authorities Energy Consultants
Related national/local policy framework	Danish Heating Act Strategic heat planning Strategic energy planning Covenant of Mayors
Activities	A14. Estimate the investment cost for different energy production forms A15. Determination of current and future fuel and energy carrier cost, CO2 cost etc. A16.Estimate the net running costs for different energy production forms A17. Estimated price of electricity produced at and sold from CHP plants, RE plants etc. A22. Determination of the combined costs for cooling incl. investment costs and running costs for different cooling options e.g. air condition cooling (split units), district cooling, ground water cooling, sea water cooling A24. Determination of operation and maintenance costs

Table A8 Use Case 2 – Copenhagen

Acronym	UC2-C
Goal	Calculate the costs of energy saving measures (e.g. window replacement, improved insulation, energy efficient electric appliances and systems, smart grid etc.)
Urban Scale	Micro (Building) / Meso (urban area) / Macro
Process scale	Planning
Actors	Utilities City Councils Town and Country Planning Authorities Energy Consultants
Related national/local policy framework	National building code National energy savings and CO2 reduction targets Covenant of Mayors Agenda 21
Activities	A1. Determination of the structural parameters of the building A2. Determination of user profile (also proxy of socio-economic conditions) A3. Determination of contextual conditions of the building A4. Model the energy performance of the building: Calculation of final energy uses and

	requirements of energy carriers A15. Determination of current and future energy prices A20. Estimate of the investment costs per measure and m2 A21. Estimate of the energy savings per measure and m2 A27. Determination of power consumption in electric appliances and systems A28. Determination of the effect of rolling-out remote metering and smart grid

Table A9 Use Case 3 – Copenhagen

Acronym	UC3-C
Goal	Calculate impacts of alternative energy supply and demand options on CO2 reduction, final energy consumption and primary energy consumption.
Urban Scale	Micro (Building) / Meso (urban area) / Macro
Process scale	Planning
Actors	Utilities City Councils Town and Country Planning Authorities Energy Consultants Home owners
Related national/local policy framework	National CO_2 emission reductions targets CHP directive National CO_2 quota act National CO_2 tax act
Activities	A19. Calculation of total energy demand in a baseline and alternative scenario. A23. Calculation of the CO_2 emission and primary energy factors for the different energy supply forms (electricity, heating and cooling)
Issues to be addressed	Quantify the impacts of alternative energy supply and demand in different ways compared to a baseline scenario. • Calculation of baseline and alternative energy demand (final and primary energy) • Calculation of baseline and alternative energy production and supply (final and primary energy) Calculate the specific CO_2 emission factor for the baseline and alternative scenario
Methods	See overall approach in flowchart below

Table A10 Use Case 4 – Copenhagen

Acronym	UC4-C
Goal	Map potentials of local energy sources (e.g. conventional and renewable energy sources)
Urban Scale	Micro (Building) / Meso (urban area) / Macro
Process scale	Planning
Actors	Utilities City Councils Town and Country Planning Authorities Energy Consultants Home owners
Related national/local policy framework	Danish Heating Act Strategic heat planning Strategic energy planning Danish Electricity Act Municipal planning
Activities	A18. Determination of how large a surface area is needed to cover X % of the heat demand and electricity demand by solar panels and solar cells respectively A25. Determination of how large the wind potentials is in the urban area for electricity production by wind turbines A26. Determination of cooling potential from ground water, sea water, district cooling, conventional cooling etc.

Table A11 Use Case 1 – Manresa

Acronym	UC1-M
Goal	To calculate the energy consumption and CO_2 emissions of new or existing buildings and the urban area, for a new or existing urban development.
Urban Scale	Micro (Building) / Meso (urban area)
Process scale	Operational
Actors	Municipal technical planners Public company of social housing Owner/promoter of the building(s) Neighbourhood / community association
Related national/local policy framework	Sustainable energy action plan Local urban regulations (PGOUM, PERI, PE) Technical code of edification and national energy code (CTE, Calener).
Activities	A.M1.- Definition of the different alternatives of urban planning and local regulation to implement (Baseline, BAU and advanced scenarios) A.M2.- Definition of systems and occupation parameters A.M3.- Determination of geometry of buildings and urban environment A.M4.- Determination of technical parameters of buildings A.M8.- Determination of environmental characteristics of urban environment A.M5.- Calculation of energy performance of buildings and of the urban area A.M6.- Calculation of CO_2 emissions of buildings and of the urban area

Table A12 Use Case 2 – Manresa

Acronym	UC2-M
Goal	To calculate the operational and maintenance costs, and other socio-economic benefits of an urban intervention.
Urban Scale	Micro (Building) / Meso (urban area)
Process scale	Operational
Actors	Municipal technical planners Public company of social housing Owner/promoter of the building(s) Neighbourhood / community association
Related national/local policy framework	Sustainable energy action plan Local urban regulations (PGOUM, PERI, PE) Technical code of edification and national energy code (CTE, Calener).
Activities	A.M7 – Calculation of operational and maintenance costs of interventions of buildings and urban area A.M13 – Calculate socio-economic benefits (e.g. saving in energy bill) of an urban intervention

Table A13 Use Case 3 – Manresa

Acronym	UC3-M
Goal	To evaluate the potential of energy production from solar radiation.
Urban Scale	Micro (Building) / Meso (urban area)
Process scale	Operational
Actors	Municipal technical planners Public company of social housing Owner/promoter of the building(s) Neighbourhood / community association
Related national/local policy framework	Sustainable energy action plan Local urban regulations (PGOUM, PERI, PE) Technical code of edification and national energy code (CTE, Calener) Covenant of majors
Activities	A.M9 – Calculation of potential of local solar gains (based on calculation outputs)

Table A14 Use Case 4 – Manresa

Acronym	UC4-M
Goal	To compare different alternative urban plans between them and against the baseline.
Urban Scale	Micro (Building) / Meso (urban area)
Process scale	Operational
Actors	Municipal technical planners Public company of social housing Owner/promoter of the building(s) Neighbourhood / community association
Related national/local policy framework	Sustainable energy action plan Local urban regulations (PGOUM, PERI, PE) Technical code of edification and national energy code (CTE, Calener).
Activities	A.M7 – Calculation of operational and maintenance costs of interventions of buildings and urban area A.M13 – Calculate socio-economic benefits (e.g. saving in energy bill) of an urban intervention A.M9 – Calculation of potential of local solar gains (based on calculation outputs) A.M10 - Multi-criteria analysis of different scenarios (neighbourhood level)

APPENDIX B. Interview Record and Referencing

This appendix sets out a structured record of the series of semi-structured interviews undertaken with a broad scope of stakeholders (including both decision-making **a**ctors and technical **u**sers of decision support tools). Within the methodology being followed, the task of scoping stakeholder requirements has focussed on understanding the degree of involvement at each stage within the project development. Unique reference identifies role as actor (decision-maker) and / or user (tools informing decision-making). Rather than including a full transcript and record of the interview, this is a record of the meetings, interviews and workshops. A complete record of the individual interviews has been retained within the project team as a record of discrete statements of facts, options, views and values as they relate to the individual case study and the use of any decision-support tools. These statements have consistently been arranged with regard to their relevance to the specific stage of project development rather than a chronological record of the conversation(s), and the level of detail contained within each individual interview record reflects the range of views and options expressed rather than any relative importance of these statements.

Within the separate case study areas, the emphasis on contacting and working with different local stakeholders has varied according to the local focus. For example, the Copenhagen case study has concentrated on the strategic urban energy planning context and stakeholders and not in a detail design or construction context. As such, certain stages in the project development process have been considered in more detail and specifics for the case study and the broader scope of the SEMANCO tools being developed.

Often there are several stakeholders with differing roles even within the same; often larger; organisations. This framework begins to record these different roles as both decision-making actors and potential users of tools, including those of internal project partners where there is an active role in the development of the specific project. For example, in the Newcastle case study this is the particular interest from the NEA as a local business and as a potential users / consultancy. In Copenhagen, Ramboll as a multi-disciplinary consultancy, also has particular interests regarding the commercial application for the use of the tools.

The records combined a variety of methods of initial contact including face-to-face interviews, telephone conversations, email records and group meetings. This set the scope of issues that were supplemented and tested in the focus groups / workshops. In each case, effort was made to present a summary of the research project and ensure the interviewee has been provided with a consent form upon request.

The intention here is to get a consistent overview of the scale and the stage at which the tool has to focus to be functional and practical. We have also found it useful to highlight those project stages where little or no contact with stakeholders has been made and prompted us to fill these ‘gaps’ as best we can with additional conversations.

Ultimately, these conversations and meetings are on-going as the work progresses and this record is simply a snap-shot of views set in a harmonised framework showing the overall scope of the people we spoke to within all of the case studies.

B.1 Framework for Semi-structured Interviews

In each case, the interviewer where possible followed a semi-structured approach with the use of open-ended questions as prompts. These broadly followed the generic stages of work set out in the generic development framework and are in the table below.

As part of the definition of the Activities, and to assist a more open-ended approach to discussions and questions with stakeholders, the overall objectives of the SEMANCO-project was presented and a number of different mock-ups and pilot tools designed to perform these activities in specific settings were demonstrated to Users and Actors to further specify user requirements, validate the feasibility of Activities, and verify the need for the tools and methods provided by SEMANCO in the real-world settings.

B.2 Interview Record and Referencing

Table B1 Interview Records

Name	Organisation	Role
Policy: National, region and local policy context		
Andrew Sloan	Bridging NewcastleGateshead, Housing Market Renewal Pathfinder	Strategic regeneration in housing market renewal across low demand areas of inner city Newcastle.
National Politician	Spanish Government. Technical Code of Buildings	National political leadership. Responsible for the establishment of national benchmarks for CO2 emissions reduction and energy demand in buildings.
Jordi Serracanta	Local Politician (Environment) Manresa City Council	Political leadership and establishment of the main directives and issues to address in the POUM redaction. Responsible for Environment portfolio.
Ramon Bacardit	Local Politician (Urban Planning) Manresa City Council	Local political leadership. Responsible for Urban Planning portfolio, including the use of data (GIS) on transport, mobility, demographics and planning.
Joanna Carr David Lynch	National Energy Action	National fuel poverty charity (former Director of Research) undertaking research and campaigning through the UK but with interest in local research.
Julian Brooks	UK Green Buildings Council	Business based national campaign organisation for the sustainable construction industry.
Confidential	Covenant of Mayors	Political leadership and the role of local municipalities in reducing CO_2 emissions. Dealing with statistical data regarding CO_2 emissions and the establishment (lobby role) for standards at national scale.
Confidential	Local Government and the Ministry of Energy and Climate	National policy guidance and provision of strategic CO_2 emission assessment tools and reporting.
Hanne Kristensen Annette Egetoft	Municipality of Copenhagen	Overseeing implementation of neighbourhood, municipal and regional (city-wide) strategic housing plans and climate plan for Copenhagen to become CO_2-neutral in 2025.
Kirsten Ledgaard	CPH City & Port Development	Responsible for preparation of land use regulations and project initiation and deals with overall energy planning issues in Copenhagen City & Port Development.
Confidential	Ramboll	Energy and climate change consultancy.
Andy Stephenson	HECA	Home Energy Conservation Advisory Group. Municipality officer technical support network.
Emily Braham	Social Housing Consortium	Environmental and business development manager for consortium of social housing providers.
Prepare: Pre-planning stages from project initiation, business justification, partnerships and procurement strategy, policy and project brief		
Bill Carr	Homes and Communities Agency	North East of England Area Manager for central Government agency. Responsible for the imposition of minimum quality and sustainability standards as condition of project funding
Regional politician	Spanish Regional Government Housing Department	Regional technical leadership. Setting regional legislation regarding energy efficiency (supply and demand management). Use of statistical data concerning housing stock relative to national

		benchmarks.
Regional politician	Spanish Regional Government Land Department	Political-Technical leadership. Defining general organisation of the region. Main mobility axes between cities, define areas of protection, large infrastructures,
Mauro Mas Pujó Núria Oliver	Architect. Head of the Team for redaction of the POUM	Responsible for the Municipal Urban Ordering Plan (POUM) office. Overall design control within city boundaries, including the urban environment, as well as the rural or forest lands.
Alex Quintin	Architect from the POUM's office	Responsible for the Municipal Urban Ordering Plan (POUM) office. Overall design control within city boundaries, including the urban environment, as well as the rural or forest lands.
Toni Pintó	Draughtsman from the POUM's office	Technical users of data related with the city via Autocad, Microstation, AllPlan, Google Maps, Bing Maps, Google Earth, Sketchup, Rhino.
Phil Joyce	Newcastle City Council	Strategic Regeneration function (Head of Regeneration and Sustainable Development). Interest in geographical scope of the project and boundaries.
Claire Wood	Newcastle City Council	Project manager (Senior Regeneration Officer) responsible for contract management and coordination with supporting sub-consultants.
Anna Benbow	Your Homes Newcastle	Strategic Assets and Programme Manager within the arms length management organisation (ALMO). Responsible for strategic ALMO investment priorities and alignment with organisation strategy and corporate planning, including board approval.
Adrian McLoughlin	Newcastle City Council	Special Projects Officer with responsibility for city-wide carbon-descent plan and route mapping.
Greg Stone	Executive Member for Regeneration, Newcastle City Council	Property / site owners of Riverside Dean housing stock and surrounding strategic regeneration sites.
Confidential	Bellway	Private sector development partners entering into Joint Venture (JV) with property / site owners in Newcastle.
Confidential	CPH City & Port Development	Project owner and responsible for the business plan and co-ordination of partners forum in Copenhagen.
Confidential	Municipality of Copenhagen	Defines certain minimum requirements as statutory planning authority.
Magnus Foged	Copenhagen Energy	Local and neighbourhood energy supplier within the new city district.
Confidential	Ramboll	Energy and climate change consultancy.
Katherine Robbie	Your Homes Newcastle	Regeneration officer and project manager for ALMO.
Ricard Torres	Architect. Head of Manresa City Council Urban Planning Department	Technical leadership and development of planning data utilised by the POUM. Undertake on-going review of POUM according to current status of the city. Draw the boundaries and constraints of derivative plans.
Angels Mas Pintó	Manresa City Council Urban Planning Department	Architect supporting development of the POUM.
Raquel Vilar Baraut Maribel Rincon Garcia	Manresa City Council Urban Planning Department	Mechanical Engineers supporting development of the POUM and operation of energy modelling support tools.
Jordi Orozco Vall	Manresa City Council Urban Planning	Draughtsman and 3D design expert / specialist.

	Department	
Xavier Naval	Manresa City Council GIS Unit	Computer programmer and use of technical energy data.
Manel Ribera	Manresa City Council	Technical Engineer. Head of Public Building facilities. Holds records for energy consumption within municipality.
Ramon Culleré	Economist, .Manresa City Council Centre of Studies	Economist dealing with strategic data sets and key performance indicators for the municipality
Planning: Project planning and design including concept / outline design, options testing, sketch design, statutory planning		
Allen Jones	NAREC	Energy Master Planner at the National Renewable Energy Centre. Technical consultant responsible for strategic masterplanning at the urban scale.
Jon Rippon	Development control and building regulations, Newcastle City Council	Statutory planning requirements. Negotiation on and drafting of planning conditions needed for consent.
Francesc Carné	General Manager of FORUM sa, (private developer).	Architect. Promoter and developer on behalf of the sector housing companies.
Joan Oliveras	Technical Director of FORUM sa, (private housing company)	Architect. Key user of decision-support tools within public housing companies.
Ivan Ruiz	FORUM sa, (private housing company)	Master Builder. Responsible for management and maintenance of the housing stock.
Toni Delgado	Technical officer. FORUM sa, (private housing company)	Draughtsman responsible for technical design and user of energy modelling tools.
Ana Cerdan	FORUM sa, (private housing company)	Social worker. Direct work with tenants and information into the design / refurbishment brief.
Enric Masana	Architect. Officer of the College of Architects of Catalonia. Central Catalonia branch.	Professional architectural network and support for private sector practices. Significant and growing interest in business development involving the refurbishment of existing building stock.
Kirsteen Thompson	North East design review panel, IGNITE	Independent peer review of project proposals across the North East of England. Expectation that review comments will have considered responses and / or become incorporated into revised proposals and supporting DAS.
Matthias Wunderlich	Urban Initiatives	Urban Designer and masterplanner. Responsible for the development of the strategic masterplan for the west end of Newcastle and the planning application for the nearby strategic Scotswood development in the West End of Newcastle.
Confidential	Municipality of Copenhagen	Local authority/ potential user of the tool as part of their statutory role for the approval of master plans and land use codes within the municipality
Confidential	Copenhagen Energy	Assessment of Cost-benefit of varying urban layout, varying energy intensities, varying energy supply schemes and varying implementation schedules.
Confidential	Ramboll	Energy Consultancy.
Bobby Gilbert	North East Assembly (CarbonMixer)	Carbon modelling / options appraisal and training support.
Design: Detailed design proposals		
Peter Robinson	Sustainable Urbanism	Project manager. Role in coordination over project proposals, tasks / phases and budget controls.
Colin Haylock	Ryder Architects, Newcastle	Project Architects responsible for site planning. Initial masterplanning and options testing.
Confidential	Ramboll	Energy Consultancy working on Copenhagen Harbour masterplan.
Confidential	Housing companies (public developer)	Developer's design team. Responsibility for urban design lead, including public realm and infrastructure.

Confidential	Private companies (public developer)	Developer's design team. Responsibility for urban design collaboration with public sector partners. User of mixed range of technical design tools.
Andy Mace	Arup	Mechanical & Services Engineer with responsibility for strategy (including West End of Newcastle Energy Strategy) detailed design of heating, cooling and ventilation systems.
Mark Siddell	Passiv Haus Trust	Architect and accredited passivhaus designer.
Construction		
Confidential	CPH City & Port Development	Responsible for land preparation (pre construction / infrastructure provision) within the new city district.
Confidential	Ramboll	Energy Consultancy.
Andrew Mayfield	DKS Architects	Clerk of works with on-site quality control. Code for sustainable homes assessor / Architectural Technician.
Confidential	Manresa public sector housing company	Technical / Social leadership. Handover of the construction to the user/owner. Most of it deals with record and repair mistakes during construction.
Confidential	Manresa private developer	On-site technical management and handover responsibilities.
Management: Post occupancy management, maintenance and monitoring		
Dave Henry	Your Homes Newcastle	Housing Maintenance Officer.
Graeme Williams	New Deal for Communities	Contact and coordination with private sector tenants – individual(s) or organised groups within Newcastle West End.
Confidential	Manresa housing company	Building maintenance and management, including energy performance. Provision of input data for SEIF.
Confidential	CPH City & Port Development	Land owner and developer. Potential ongoing management role within long-term development.
Confidential	Ramboll	Energy Consultancy working on Copenhagen Harbour masterplan.
Confidential	Spanish neighbourhood association.	Residents' association. Responsible for the maintenance of the building during its lifetime. Management of the community, mostly to do with the yearly accounts. Employing technical consultants / energy specialists for support and advice.
Confidential	Resident (owner occupier).	President / chair person role. Interested in the promotion of citizen activities and the use of information / municipality provided data on energy efficiency and consumption.

Each of the case study areas kept a record of individual contacts and stakeholders comments structured using a standard pro forma structured under the generic project stages. This systematic approach allowed for the cross-referencing and harmonisation of views at each of the generic project stages. It also provides, where necessary, the use of narrative quotations to illustrate common views from stakeholders. Any additional stakeholder contacts also have the potential to be used as the basis for testing the tool development and opportunities were used to collect views on the prototype tools as they are developed. These records are available for review on request.