Deliverable D 5.2

Brief progress reports to WP 1,2,3, 4 and 6 on stakeholder experiences on (prototypes of) the ECODISTR-ICT tool
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### ABSTRACT

Deliverable D5.2 reports on the testing of the ECODISTR-ICT IDSS tool in the five case studies. In the cases in Rotterdam and Valencia this testing is complete, and full feedback on the development and use of the software is given. For the cases in Stockholm, Warsaw and Antwerp, only preliminary reports are included.
EXECUTIVE SUMMARY

An enormous diversity of operators are involved in the built environment. The inhabitants, local policy level, housing associations, developers, suppliers of components or subsystems, contractors/builders, service providers, and many others play a role in taking decisions about the design, the construction, occupation, renovation or renewal of buildings and districts. Currently, many of these stakeholders have their own decision-making processes that are not or only partially integrated.

The ECODISTR-ICT Integrated Decision Support System (IDSS) will facilitate intensive collaboration between diverse disciplines and different stakeholders, each with their specific goals, questions and decision-making processes concerning district renovations. The questions and goals of stakeholders - such as service providers - can differ greatly from other stakeholders - such as individual homeowners or facility managers -, but nevertheless they are closely interrelated and their choices can influence each other. The ECODISTR-ICT IDSS can help to align all stakes and decisions to reach a mutually supported vision, based on comprehensible data.

The objective of Work Package 5 (WP5) of ECODISTR-ICT is to test the IDSS through design, planning and implementation of real life case studies, bringing together communities, building owners, developers, tool owners and knowledge institutes. The case studies are mainly initiated by local architecture, design and planning firms with extensive experience in the local context and everyday practice. In the case studies, we provide a close cooperation with the research institutions and a broad range of local stakeholders. The feedback of these case studies will allow an iterative development of the tool in close collaboration with actual users and stakeholders.

This Deliverable report presents a summary of activities of WP5 in the first two years of the project. The IDSS has been tested in Rotterdam and Valencia. A comprehensive documentation and a summary of lessons learned from these test sessions are included in this report. Furthermore, an outlook to the next cases in Stockholm, Warsaw and Antwerp is provided. Although preliminary, the testing of the ECODISTR-ICT IDSS already provides valuable lessons on the future use of the software.
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## Glossary / List of Acronyms

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<th>Description</th>
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<tr>
<td>Alternative</td>
<td>A possible solution, represented by a set of related values for variables. Typically, a decision is based on a comparison of the KPI scores of alternatives in several contexts.</td>
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<tr>
<td>Ambition</td>
<td>A quantified vision that includes a target for each KPI (both the value and the time when to reach it)</td>
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<tr>
<td>Assessment</td>
<td>Quantification of the KPIs of an alternative within contexts.</td>
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<td>Calculation modules</td>
<td>Calculation of KPIs</td>
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<tr>
<td>Component</td>
<td>A component is a smallest independent part of the IDSS-framework that performs a specific task within a module or in the IMB communication framework.</td>
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<tr>
<td>Context</td>
<td>A future situation which is determined by the external factors that the stakeholders in the decision process cannot influence</td>
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<tr>
<td>District</td>
<td>A subdivision of a city or municipality. In this project we expect a district to encompass +/- 1000 buildings.</td>
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<td>Dry run</td>
<td>A dry run or a practice run is a testing process where the effects of a possible failure are intentionally mitigated; a repetition process</td>
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<td>End User</td>
<td>The user of the tool, e.g. a trained city planning professional.</td>
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<tr>
<td>ESCO</td>
<td>Energy service contracting company</td>
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<tr>
<td>Evaluation</td>
<td>The process of comparing the assessment score of a variant with the targets set in the ambition</td>
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<tr>
<td>Framework</td>
<td>Platform for integration of system components, e.g. based on Inter Model Broker</td>
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<tr>
<td>Geojson file</td>
<td>A geojson file includes geometric data and other data per building, such as kWh/m² for each building</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technologies</td>
</tr>
<tr>
<td>IDSS Dashboard</td>
<td>The interface of the end-users to the IDSS that enables them to use the IDSS in their decision processes.</td>
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<tr>
<td>IMB</td>
<td>Inter Model Broker</td>
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<tr>
<td>Integrated Decision Support System</td>
<td>Abbreviated as IDSS, refers to a tool that supports the decision-making process in district renovation activities.</td>
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<tr>
<td>Interface</td>
<td>In technical contexts, interface requirements are governed by standard conventions called protocols which could be so complex that the interface itself is considered a separate device or system. In the context of computers, three common interface types are: Hardware, Software and User interface.</td>
</tr>
<tr>
<td>KPI</td>
<td>Key performance indicator = a measurable indicator for one aspect of the users’ ambition</td>
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<tr>
<td>KPI Value</td>
<td>Required or predicted score of a KPI</td>
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<tr>
<td>Measure</td>
<td>A punctual intervention (i.e. e.g. Measure window replacement; Measure PV panels installation; Measure building demolition)</td>
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<tr>
<td>Model</td>
<td>A model performs calculations of KPIs as a view of reality. It makes use of data input and creates data as output.</td>
</tr>
<tr>
<td>Module</td>
<td>An independent functional part of the IDSS. A module can consist of several coherent components e.g. calculation model, IMB client, data storage, assessment of variants visualization (in order to gather, create, change, present, and/or analyse data)</td>
</tr>
<tr>
<td>On-the-fly</td>
<td>“On-the-fly” describes activities that develop or occur dynamically rather than as the result of something that is statically predefined.</td>
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<tr>
<td>Prototype</td>
<td>Pre-production model of a product, engineered for full service test. Changes based on test results are incorporated into the prototype which undergoes the same tests again. On achieving the desired results, the product is approved for volume production.</td>
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<tr>
<td>Scrums</td>
<td>A flexible and intensive software development method</td>
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<tr>
<td>Stakeholder</td>
<td>A person, group or organization that has interest or concern in an organization. Stakeholders can affect or be affected by the organization's actions, objectives and policies.</td>
</tr>
<tr>
<td>Variant</td>
<td>A design proposal within a context; typically, by analysing a variant by a module resulting in a predicted score of KPIs.</td>
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**READING GUIDE**

This document should be read completely by the ECODISTR-ICT participants. Others should start with the Executive Summary and from there select those sections that are relevant to them.

Chapter 1 introduces the document and gives a brief overview of the case study progress since the production of deliverable D5.1.

Chapter 2 explains the methodology for the case study testing and reporting in D5.2.

Chapter 3 summarizes the findings of the rapid actor-institutional analyses of the five ECODISTR-ICT case studies in Antwerp, Rotterdam, Stockholm, Valencia and Warsaw, as reported in D1.2. It refers to table 6 of D1.2 ‘Summary of stakeholder objectives and decision-making criteria’, to identify KPIs for the different case studies, based on an understanding of the existing processes of renewal in the case study areas. These analyses frame the IDSS testing processes and are starting-points for recommendations on the further development of the dashboard and the implementation of software modules.

Chapter 4 contains brief overviews of the past one and a half year’s trajectories for each of the five case studies. Moreover, since the ECODISTR-ICT IDSS has now been fully tested in the Rotterdam and Valencia cases, lessons for improving and using the software for these cases are further elaborated.

Chapter 5 first develops cross-case conclusions and recommendations regarding the further design of the IDSS. Second, conclusions provide insight into the possible role of the software in decision making processes and the interactions between software and users. Since the software has only been fully tested in two of the five case studies, these conclusions are preliminary.
1 INTRODUCTION

1.1 PURPOSE AND SCOPE

The objective of ECODISTR-ICT is to develop an integrated decision support system (IDSS) for sustainable retrofitting projects on district level, which can help to align all stakeholders and decision-makers to reach a mutually supported vision, based on comprehensible data. This includes two challenges. The first is to show all the different needs of stakeholders in a single, integrated software environment, as the ambition is to respond to the multidisciplinary character of retrofitting projects. The other is to create a truly integrated platform that combines the strengths of existing assessment tools on both building and urban level.

In order to meet these challenges and to enhance the potentials and usability of the ECODISTR-ICT tool, in WP5 the software is tested in five real-life case studies in Antwerp, Rotterdam, Stockholm, Valencia and Warsaw. A geographical distribution of the case studies may reveal contextual differences regarding culture, climate and policies in relation with energy-use and energy efficiency as well as with other retrofit issues. These differences will be incorporated in the development of the tool, which will enhance the wide applicability of the tool.

WP5 thus primarily aims to:
- test and demonstrate the scenarios developed in WP1, the data gathered in WP2, the software modules developed in WP3, and the integrated tool developed in WP4, through real life case studies
- discuss and test the ECODISTR-ICT software through design, planning and implementation of case studies
- establish a strong interaction with the other work packages through case studies and to provide continuous feedback of real-life cases allowing for an iterative development of the tool in close collaboration with actual users and stakeholders.

This deliverable D5.2 thus reports on the testing of the IDSS in the interaction between the case studies and the software development.
1.2 INTERACTIVE PROCESSES

The case studies are implemented by the partners OMGEVING (Antwerp), TNO (Rotterdam), White Architects (Stockholm), Bipolaire (Valencia) and ARUP (Warsaw), who all have extensive experience in the local context and everyday practice. In the case studies, these partners develop a close cooperation with the software developers and research institutes on the one hand and a broad range of local stakeholders on the other. The testing thus interacts with decision-making in the consortium on the focus, target groups, business model, support modules and structure of the software, but also with decision-making in the case study areas themselves. As such, the case studies develop specific interactive processes, creating interactions between (1) the process of the ECODISTR-ICT software development, (2) the process of the case study analysis and design, and (3) the ongoing processes of collective decision making in the case study area.

For this purpose, trajectories for testing the IDSS in case studies were organized which followed the next format, as explained in D5.1 ‘A roadmap for the analysis of the case studies’:

- preparation of the case studies
- start-up of case studies
- elaboration of reflection and/or decision-making process for the neighbourhood
- testing of the IDSS as part of these processes
- drafting of final evaluations and recommendations on the development and use of the software.

1.3 GENERAL WP5 PROGRESS

The following steps were taken since the submission of D5.1 (June 1st 2014 - November 30th 2015).

- The case studies created platforms for software testing in interaction with ongoing or emerging neighbourhood development processes. Some cases were able to build on well-established neighbourhood development platforms (Rotterdam, Valencia), others had to create their own decision-making environments (Antwerp, Stockholm, and Warsaw).
- Within these trajectories, the WP5 partners organized series of interviews, bilateral meetings, focus groups, workshops, demo-sessions, etc. as ways to interact with the case study stakeholders.
- WP5 partners elaborated brief actor-institutional analyses, in order to identify key-issues in the case study areas (see D1.2 ‘Stakeholders’ objectives and decision-making criteria and mutual interdependencies’), KPIs as indicators for these key-issues, and suggestions for software modules to connect to the IDSS.
- WP4 partners presented different versions of the IDSS dashboard to the WP5 case study partners. In a number of demo-sessions, WP5 partners gave feedback, feeding in consecutive improvements to the IDSS. In some of the feedback sessions, case study stakeholders were directly involved.
- The general case study roadmap, explained in D5.1, was specified with respect to the software testing. WP4 and WP5 partners thus agreed on the following order of testing in the different case studies: Rotterdam, Valencia, Stockholm, Warsaw, Antwerp.
- By cooperating in various WP2 and WP3 working groups, WP5 partners gave inputs to the handling of data (WP2) and the integration of software modules in the IDSS (WP3).
- The Rotterdam and Valencia case studies were actually brought to a final testing of the IDSS in September resp. October 2015. In this stage, WP5 partners actively challenged WP2, WP3 and WP4 partners to improve the IDSS and enable implementation in the case study workshops. In 2016, this will be repeated for Stockholm, Warsaw and Antwerp.

The following sections 3 and 4 of D5.2 further elaborate these steps for the specific case studies. In section 2 we first briefly review the methodology for reporting.
2 METHODOLOGY

2.1 INTRODUCTION

Three documents provide the main input for the framework of this progress report.

Firstly, the *Roadmap for the analysis of the case studies* (deliverable D5.1) describes the necessary fieldwork in order to use and test the IDSS in the case studies in Antwerp (OMGEVING), Rotterdam (TNO), Stockholm (White Architects), Valencia (Bipolaire) and Warsaw (ARUP): stakeholder consultation and problem analysis, data collection, generating design alternatives etc. Within a general framework, deliverable D5.1 specifies the road maps for each of the case studies, however leaving room for specific case study evolutions and interactions and specific responses to these. As such, interactions of the ECODISTR-ICT project with the case studies were either intensified or slowed down according to the needs of stakeholders on the one hand and the stage of the development of the IDSS on the other.

Secondly, deliverable D1.2 *‘Stakeholders’ objectives, decision-making criteria and mutual interdependencies’*, mobilises a rapid actor-institutional analysis in each of the case studies of WP5, and develops an understanding of the key-issues in each neighbourhood (see also chapter 3 below). The deliverable provides a preliminary insight in the main actors (including weak actors), their interests, their problems/needs, and their 'logics' or 'institutional frames'. This supports organizing a process/debate regarding key-issues, ambitions, alternative futures and actions to take, in which mobilisation of decision-support software is useful. Moreover, from the rapid actor-institutional analyses, the range of stakeholder objectives and decision-making criteria regarding sustainable neighbourhood retrofitting is derived, which has been taken into account in developing the ECODISTR-ICT IDSS. These objectives and criteria serve as a stepping-stone to the identification of key performance indicators (KPIs) and software modules in WP3. Although the range of issues to be dealt with (not only energy related, but also environmental, social and economic) appeared to be broader than expected, some stakeholder objectives seem to be recurrent. Examples include the refurbishment of the existing housing stock in the district, efficient infrastructure management by energy providers, liveable public space supported by vital social infrastructure, improving the socio-economic situation of the district.

Thirdly, the IDSS’s functional and technical design (deliverables D4.1 and D4.2) outlines the interpretation of the decision-making process, which consists of two stages. Stage A - defining the ambition - includes four steps: (1) analyse the problem, (2) collect data, (3) assess the as-is situation, (4) define the to-be ambition. Stage B - supporting the decision - includes three steps: (1) develop alternatives, (2) assess alternatives, (3) compare alternatives. These steps have been implemented in the structure of the IDSS dashboard.
2.2 WP4-WP5 INTERACTIONS

To be able to test the IDSS in the case studies, the case study roadmaps needed to be connected with the decision-making process as modelled in the IDSS. Table 1\(^1\) makes this connection and provides an overview of the different steps in the design and use of the IDSS as well as the related fieldwork activities. It proved a valuable tool for the coordination of the technical support for the application of the IDSS in the case studies. It also serves as the methodological framework of this progress report and as such it guides the case study reporting and feedback towards the other work packages.

\(^1\) Earlier versions of the table are described in deliverable D4.5-D4.6 and D4.7. Current version can be consulted on https://esites.vito.be/sites/ecodistrict/WP4integrateddecisionsupportsystemTNO/Application_support/Ecodistrict-IDSS_technical_support_cases.xlsx
### IDSS specific actions (generic for all cases): *(source D4.234)*

**actions for research/knowledge institutes (TNO, CSTB, SP, VITO)**

**case study specific actions:** *(source D5.1)*

**actions for WP5-partners (OMG, TNO, SP, ARUP, BIP)**

<table>
<thead>
<tr>
<th>DEVELOPER / SUPPORT</th>
<th>TECHNICAL FACILITATOR</th>
<th>DEMONSTRATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT configuration</td>
<td>interaction and feedback to WPs</td>
<td>iterations (to first step or to another step)</td>
</tr>
<tr>
<td>feedback to WPs</td>
<td>complete screen 'Analyse problem': - define project area - define stakeholders - describe project</td>
<td>exploration, preparation</td>
</tr>
<tr>
<td>location of map (file)</td>
<td></td>
<td>ACTIONS:</td>
</tr>
<tr>
<td>Analyse problem</td>
<td></td>
<td>- literature study - interviews, surveys, workshops (depending on case and situation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GOAL:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- first definition of project area and key issues - identification of key stakeholders/actors - exploration of institutional dynamics</td>
</tr>
<tr>
<td>Distinguish new KPIs a) KPIs that can be calculated with IDSS modules b) KPIs that have to be calculated externally / inserted manually (e.g. qualitative KPIs)</td>
<td></td>
<td>set up of stakeholder cooperation format</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ACTIONS:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- identification of 'client' (problem owners) - (bilateral) contact with key actors - set-up of case study reference group (CSRG)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GOAL:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- set-up of stakeholder reference group as base for next step (i.e. identifying the participants of meetings in next step(s))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>definition of issues and KPIs with CSRG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ACTIONS:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- organisation of workshop with CSRG (results of IDSS not necessary but recommended)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GOAL:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- presentation of results of exploration (project area and identified issues) - definition of KPIs with CSRG (essential for module selection and data collection)</td>
</tr>
</tbody>
</table>

---

**IDSS specific actions (generic for all cases):** *(source D4.234)*

**actions for research/knowledge institutes (TNO, CSTB, SP, VITO)**

**case study specific actions:** *(source D5.1)*

**actions for WP5-partners (OMG, TNO, SP, ARUP, BIP)**

**DEVELOPER / SUPPORT**

IT configuration

- feedback to WPs

**TECHNICAL FACILITATOR**

- complete screen 'Analyse problem':
  - define project area
  - define stakeholders
  - describe project

**DEMONSTRATOR**

- exploration, preparation
  - literature study
  - interviews, surveys, workshops (depending on case and situation)

**GOAL:**

- first definition of project area and key issues
- identification of key stakeholders/actors
- exploration of institutional dynamics
<table>
<thead>
<tr>
<th>IDSS specific actions (generic for all cases): (source D4.234)</th>
<th>case study specific actions : (source D5.1)</th>
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<tr>
<td>actions for research/knowledge institutes (TNO, CSTB, SP, VITO)</td>
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<th>DEMONSTRATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDSS specific actions (generic for all cases): (source D4.234)</td>
<td></td>
<td>case study specific actions : (source D5.1)</td>
</tr>
<tr>
<td>inform the user about required data: - type of data (modules, visualization...) - level of detail - data format</td>
<td>inventory of required data - requirements for IDSS - requirements for stakeholders</td>
<td></td>
</tr>
<tr>
<td>data processing: - convert to right data format - editing/cleaning of received data - mapping of missing data (depending on identified KPIs see step A1 AND selected modules)</td>
<td>data mapping (listing of available data) - public resources - identification and consultation of key data owners</td>
<td></td>
</tr>
<tr>
<td>data generation (fill in the 'gaps' (= missing data)); technical support needed (e.g. input CSTB) - desktop research - fieldwork (photographs etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ensure the consistency/sufficiency of the data uploaded</td>
<td>upload the data that will be used for the calculation</td>
<td></td>
</tr>
<tr>
<td>management and implementation of default context scenarios</td>
<td>modify or create contexts insert required context data</td>
<td>definition of context data with stakeholders: - evaluation of default context parameters in IDSS - adjustment to local context (based on public resources or stakeholder consultation) =&gt; meeting/workshop (or part of other workshop)</td>
</tr>
<tr>
<td>Assess AS-IS</td>
<td></td>
<td>assessment of KPIs that cannot be calculated by the IDSS : - calculation in a separate module or through expertise</td>
</tr>
<tr>
<td>ensure stability of calculation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module</td>
<td>Description</td>
<td>Definition of ambition with stakeholders</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Define TO-BE ambition                       | - visualize AS-IS scores as reference point prior to KPI target values  
- insert target values of KPIs based on AS-IS scores and boundary conditions of the stakeholders  
- create additional contexts if necessary                                                                                                                  | ACTION:  
- organisation of workshop with CSRG (IDSS required to present results)  
GOAL:  
- presentation of AS-IS situation  
- set target values of KPIs  
(= TO-BE ambition)  
- formulation of possible contexts (decide on number of contexts to develop, formulation of chosen contexts/story)  
- anticipate on possible measures and alternatives                                                                                           | ACTION:  
- back-office work and meeting with relevant actors  
GOAL:  
- select relevant measures, generate design proposals (alternatives), re-evaluate previous items (KPIs, contexts etc.)  
- compose variants                                                                                                                                  |
| Develop alternatives                        | Inform the user about the list of measures in relation with the selected KPIs                                                                                                                                 | use and testing of variants in software in collaboration with relevant actor (e.g. designers, main client)                                                                                                                                                                                                                     |
| Administer alternatives; choose /modify contexts (if necessary), and make variants                |                                                                                                                                                                                                                                                                     | ACTION:  
- back-office work and meeting with relevant actors  
GOAL:  
- select relevant measures, generate design proposals (alternatives), re-evaluate previous items (KPIs, contexts etc.)  
- compose variants                                                                                                                                  |
| Support upload of data/design model         | Administer alternatives; choose /modify contexts (if necessary), and make variants                                                                                                                                                                                      | ACTION:  
- back-office work and meeting with relevant actors  
GOAL:  
- select relevant measures, generate design proposals (alternatives), re-evaluate previous items (KPIs, contexts etc.)  
- compose variants                                                                                                                                  |
| Ensure consistency of design-module         | Upload data/design models                                                                                                                                                                                                                                           | ACTION:  
- back-office work and meeting with relevant actors  
GOAL:  
- select relevant measures, generate design proposals (alternatives), re-evaluate previous items (KPIs, contexts etc.)  
- compose variants                                                                                                                                  |
| Assess alternatives                         | - run calculation modules for each selected variant  
- interpretation, recalculation and adjustments of calculated results (e.g. filtering of results, adjustments of context parameters, aggregation)                                                                                                                      | ACTION:  
- organisation of workshop with CSRG (IDSS necessary)  
GOAL:  
- presentation of the results of each variant compared to TO-BE ambitions  
- interpret KPI scores and target values in interactive session (to a certain extent)  
- assess if iteration is necessary and to which extent                                                                                                    |
| Ensure stability of calculation, stability of 'interaction' capacities   |                                                                                                                                                                                                                                                                     | ACTION:  
- organisation of workshop with CSRG (IDSS necessary)  
GOAL:  
- presentation of the results of each variant compared to TO-BE ambitions  
- interpret KPI scores and target values in interactive session (to a certain extent)  
- assess if iteration is necessary and to which extent                                                                                                    |
| Select best alternative                     | visualize the scores of AS-IS, TO-BE Ambition and the scores, the context and the alternative used in each variant using the MCMS-functionality                                                                                                                                 | ACTION:  
- concluding presentation or deliverable  
GOAL:  
- concluding model, presentation and/or report to summarize results (or 'recommendations') and that can support the decision-making                                                                                                                                  |
| Support for export-functionality            | export .pdf, report etc. for decision-makers                                                                                                                                                                                                                       | ACTION:  
- concluding presentation or deliverable  
GOAL:  
- concluding model, presentation and/or report to summarize results (or 'recommendations') and that can support the decision-making                                                                                                                                  |

Table 1 Interactions between IDSS and cases study actions
It is valuable to point out the following characteristics of the table:

- The generic term ‘end-user’ of the IDSS covers four different profiles. For every step, it needs to be indicated which role is responsible for which task. These profiles include:
  - (software) developer
  - ‘technical facilitator’, who is technically supporting the use of the IDSS in the case studies (the research institutes of WP1, WP2, WP3 and WP4)
  - ‘process facilitator’, who is supervising the case study development process, including the moment and type of meetings and workshops, the organisation and preparation thereof, the communication with software developers and with technical facilitator(s) (the urban planners and consultants of WP5)
  - stakeholder

Essentially, for each case study a team is formed, consisting of an urban-planning partner (‘process facilitator’, representing the WP5 case studies team) and a research institute (‘technical facilitator’, representing the WP4 developer team).

This also reveals some important aspects regarding the application of the IDSS in the case studies:

- **Iterative process.** The table is a scheme and not a chronological representation, as in reality the use of the IDSS will be an iterative process rather than a linear one. In every step, there are opportunities for the stakeholders to give feedback and to adjust the process when necessary, although limited to a certain extent (e.g. go to previous steps/further steps etc.).

- **Interaction.** The complexity of the fieldwork activities is dependent on the local situation i.e. the characteristics of the district (see for instance the actor-institutional analysis in deliverable D1.2). The available data, involved stakeholders and identified issues have an influence on the case study progress. Therefore, the process is rather ‘organic’ and some flexibility has to be taken into account. In contrast, the decision-making process as outlined in the IDSS’s design follows a rather rigid programmer’s logic (though it does not prevent an iterative, non-linear use of the IDSS as pointed out in previous bullet). Stakeholder workshops are the point of interaction between these two approaches.

- **Complexity.** Two different profiles of the ‘process facilitator’ and the ‘technical facilitator’ are distinguished currently. The question remains whether these two distinct profiles are required or that in the future it might be possible that one end-user could fulfil both competences.

### 2.3 Testing the IDSS

Although the start-up of the case studies was foreseen from month seven, all of the cases have - to different extents - already in month 1 to 6 contacted local stakeholders and taken initiative in connecting to local decision-making processes. In the second half of the first year, further steps in the collaboration with case study stakeholders have been taken. After the launch of the first version of the IDSS dashboard (end of year 1), demonstrations and feedback sessions for ECODISTR-ICT partners have been organised, as well as demo sessions for some of the stakeholders in Rotterdam, Valencia and Antwerp. As a result an order of IDSS testing was agreed on, which -due to case studies’ evolving conditions- shifted a few times during the second project year, but is now fixed as follows:

- **IDSS version 1.0** First version of the Prototype IDSS [D4.7, month 18]
- **Rotterdam** Case study 1 [Month 18-22], using IDSS version 1.0
· Valencia Case study 2 [Month 21-23], using IDSS version 1.1
· Stockholm Case study 3 [Month 24-27], using IDSS version 1.2
· Warsaw Case study 4 [Month 27-30], using IDSS version 1.3
- IDSS version 2.0 Second version of the Prototype IDSS [D4.8, month 30]
· Antwerp Case study 5 [Month 31-34], using IDSS version 2.0

Given this schedule, the IDSS was up till now fully tested in the Rotterdam and Valencia cases. As such, this deliverable D5.2 provides overviews of the processes for all cases, but more detailed lessons on the interactions with the software development only for Rotterdam and Valencia. In the next deliverable D5.3, lessons for the remaining case studies will be added.

2.4 CASE STUDY DISCUSSIONS

In this progress report, for each case study the case study process, lessons for software development, lessons for the use of the IDSS and lessons for the exploitation of the IDSS are described. Per case study the following elements are thus discussed.

2.4.1 IDSS version tested

This section explains which IDSS version was used in the case study and which software modules were implemented. The configuration of the IDSS differs for each version, but will typically consist of the following components:
- the Dashboard, which is the interface of the end-users to the IDSS;
- the Framework, which links the components of the system together; and
- the Modules. A Module is an independent functional part of the IDSS. Different types of modules can be connected to the IDSS, such as calculation modules, a visualization module and data storage module.

There are two modules that are mentioned frequently in this report, as they were used both in the Rotterdam and Valencia case:
- the Multi-Criteria, Multi-Stakeholder, Multi-Variant (MCMSMV) module: a module developed to assess and compare calculated results
- the Common Sense (CS) module: a module with GIS-visualization functionality

More detailed information about the IDSS, its components and modules can be found in the deliverables of WP4

2.4.2 Case study facts

Some important case study characteristics are summarized, including: location, area, inhabitants, functions, local partners, main issues, testing period, workshops.

---

2 For instance ECODISTR-ICT Deliverable D4.7 “Prototype of the Integrated Decision Support System Version 1.0”
2.4.3 **Case study process**

This section explains the process elaborated with stakeholders. It gives a general overview, including workshops, interviews, timeline, different steps, and briefly situates when the IDSS was mobilised and when it was not. The section may refer to the process as expected in D5.1. and D1.2. Some pictures or other graphics may support the description.

2.4.4 **Lessons regarding the development of the IDSS**

This section summarizes lessons for the software developers and collects the feedback for the other ECODISTR-ICT work packages. Quite some of the feedback was already given during the demos of the dashboard. The section includes general comments but also differentiates for the WPs as follows:
- lessons on scenario building blocks, generation of alternatives (WP1)
- lessons on data collection (WP2)
- lessons on calculation modules (WP3)
- lessons on the dashboard structure and features (WP4).

2.4.5 **Lessons regarding the use (and users) of the IDSS**

These are lessons for the (future) users of the IDSS. This concerns the use in workshops with the users, but also preparations and post-processing. When these sections are brought together for the different cases, they may serve as the basis for a manual for the IDSS. The section may include lessons on:
- the preparation of the IDSS
- the different tabs in the IDSS (analyse problem, collect data, asses AS-IS, define TO-BE, develop alternatives, assess alternatives, compare alternatives)
- different roles in working with the IDSS (‘technical facilitator’ i.e. the one in front of the computer, ‘process facilitator’ i.e. the chair of the meetings, different types of stakeholders, etc.)
- post-processing.

2.4.6 **Lessons regarding the exploitation of the IDSS**

This is done in WP6, as developed by ECODISTR-ICT partner Sigma Orionis. If applicable, lessons on the exploitation are summarized here.
3 OVERVIEW CASE STUDIES

3.1 SUMMARY OF RAPID ACTOR-INSTITUTIONAL ANALYSES AND CASE STUDY KEY-ISSUES

In deliverable D1.2 stakeholders’ objectives, decision-making criteria and mutual interdependencies were summarized. We repeat the summarizing table below (Table 2), providing a preliminary understanding of the key-issues in each case study. The latter are a starting-point for the definition of KPIs as well as software modules to be integrated in the IDSS (see Section 3.2 below).

<table>
<thead>
<tr>
<th>main actor groups</th>
<th>main structural drivers and barriers of transformation</th>
<th>main issues</th>
<th>main stakeholder objectives and decision making criteria²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotterdam</td>
<td>• private house owners, tenants, housing associations, architects, building companies, local authority, energy service company</td>
<td>• driver: Agreement ‘Lente-akkoord’ signed by housing association with local municipality to realize ‘green dwellings’. • creating affordable housing costs for tenants • barrier: Split incentive of energy efficiency measures • approval of tenants</td>
<td>• refurbishments of dwellings: quality of housing stock, return on investments, affordability for tenants, green labels, energy poverty, local agreement</td>
</tr>
<tr>
<td></td>
<td>• social housing association Havensteder, city planning department, local workers, schools, community groups</td>
<td>• driver: keeping high income households within the city of Rotterdam • Creating a liveable and attractive city • barriers: Unemployed families for generations • vicious circle: low incomes &gt; no energy measures &gt; high energy bills &gt; less money &gt; ....</td>
<td>• lifting socio-economic situation and health: collaborative investment strategy, core of housing activities, housing quality, employment, school attendance, social cohesion, use public buildings, energy poverty, jobs and unemployment, health habits</td>
</tr>
<tr>
<td></td>
<td>• energy network manager, local government, water board, energy providers, energy service companies (ESCO)</td>
<td>• driver: energy efficiency, CO2 reduction, Rotterdam Climate Initiative and Rotterdam Climate Proof • Overproduction of heat by energy activities in the harbour • barrier: Heat Law and Same as always principle (NMDA)</td>
<td>• infrastructure investments: energy poverty, sustainable energy production and consumption, affordability of tenants, water storage capacity</td>
</tr>
<tr>
<td><strong>main actor groups</strong></td>
<td><strong>main structural drivers and barriers of transformation</strong></td>
<td><strong>main issues</strong></td>
<td><strong>main stakeholder objectives and decision making criteria²</strong></td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------------------------------------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Valencia              | - neighbourhood association, private owners of housing units, local authority, research institute (IVE, Valencian Institute of Building) | - current regulation obliges that all neighbours agree before undertaking retrofitting of their building  
- no existence of housing cooperatives  
- lack of financing from banks (loans) to carry out renovation actions  
- price of energy has been doubled in the last 5 years  
- local authorities are conscious and might be a main driver for introducing the energy issue on the urban level  
- large-scale building retrofitting with EU funding | - poor quality of part of the building stock  
- lack of investment  
- inhabitants have no interest in energy efficiency  
- lack of well-thought financing systems to attack energy retrofitting | - increase awareness on energy-efficiency at the building level |
|                       | - public space is dominated by big avenues and cars (parked and running)  
- neighbours are concerned about the lack of common places, local public services and inter-associational actions  
- no investment in the public space (whose is it from?)  
- lack of public initiative to stimulate local commerce  
- ownership structure make transformation projects very complex  
- private-public partnerships to undertake renovation of the urban space | - deterioration of the public space  
- dominant presence of cars  
- lack of green areas and public squares  
- vacant ground floor commercial spaces that increase the feeling of deterioration  
- lack of local economic activity  
- low quality urban space: noise, traffic, few green areas, lack of activities on the ground floor  
- lack of spaces for pedestrians and bicycles. | - improving the sense of community  
- increase of diverse local economic activities  
- increase bicycle paths and “soft-traffic” connections between neighbourhoods  
- accessibility to green areas  
- increase of public transportation  
- reduction of presence of cars in the public space  
- number of urban transformation projects with an emphasis on reduction of air pollution and heat stress  
- number of new local commercial activities supported by financial programmes that are the result of a public-private-partnership agreement |

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<table>
<thead>
<tr>
<th>Main Actor Groups</th>
<th>Main Structural Drivers and Barriers of Transformation</th>
<th>Main Issues</th>
<th>Main Stakeholder Objectives and Decision Making Criteria²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockholm</td>
<td>• Local civil or community driven actors: tenants and apartment owners, local tenants association</td>
<td>• Withdrawal of service and municipal service</td>
<td>• Rent levels (affordability), service improvements (commercial, public transport), image-improvement of the area, housing flexibility within the area (a varied housing market - housing careers)</td>
</tr>
<tr>
<td></td>
<td>• Withdrawal of service and municipal service</td>
<td>• Physical separation and lack of connectivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Physical separation and lack of connectivity</td>
<td>• Unemployment and socio-economic segregation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The risk of rent increases</td>
<td>• Connectivity to surrounding areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Connectivity to surrounding areas</td>
<td>• Allowing housing careers within the area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Rent levels (affordability), service improvements (commercial, public transport), image-improvement of the area, housing flexibility within the area (a varied housing market - housing careers)</td>
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</tr>
<tr>
<td></td>
<td>• Unemployment and socio-economic segregation</td>
<td>• Allowing housing careers within the area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production</td>
<td>• Number of projects on energy renewal covering several building blocks in the same project</td>
<td>• Increase awareness on energy-efficiency at the building level</td>
</tr>
<tr>
<td></td>
<td>• Neighbourhood association, private owners of housing units, local authority, research institute (ive)</td>
<td>• Poor quality of part of the building stock</td>
<td>• Increase awareness on energy-efficiency at the building level</td>
</tr>
<tr>
<td></td>
<td>• Current regulation obliges that all neighbours agree before undertaking retrofitting of their building</td>
<td>• Lack of investment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No existence of housing cooperatives</td>
<td>• Inhabitants have no interest in energy efficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lack of financing from banks</td>
<td>• Lack of well-thought financing systems to attack energy retrofitting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (Loans) to carry out renovation actions</td>
<td>• Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Price of energy has been doubled in the last 5 years</td>
<td>• Number of projects on energy renewal covering several building blocks in the same project</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Local authorities are conscious and might be a main driver for introducing the energy issue on the urban level.</td>
<td>• Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Large-scale building retrofitting with EU funding</td>
<td>• Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Neighbourhood associations, city department of urban planning, urban planners, energy agency.</td>
<td>• Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production</td>
<td></td>
</tr>
</tbody>
</table>

- Current legislation does not allow for private electricity production for own use, which eliminates initiatives for PV investment.
- There is a monopoly of power production companies.
- Lack of public transportation.
- Physical barriers that create disconnection of the different parts of the neighbourhood.
- Urban district heating and cooling is being debated but with conventional energy sources.
- Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production.
- Number of projects on energy renewal covering several building blocks in the same project.
- Increase public awareness on energy-efficiency questions.

- Definition of feasibility studies on financial and technical questions of introducing urban heating and cooling with local energy production.
- Number of projects on energy renewal covering several building blocks in the same project.
- Increase public awareness on energy-efficiency questions.
<table>
<thead>
<tr>
<th>Municipal actors: municipal housing owner Telge Hovsjö, municipal energy provider Telge energy, municipal planning department</th>
<th>Lack of governmental funding schemes for retrofitting in combination with newly initiated legal framework pushing municipal housing owners to act as market players resulting in very limited investment options without risking high rent increases</th>
<th>Combatting ecological aspects and energy related issues in an area with strong socio-economic problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-economic segregation and high percentage of immigration within peripheral large scale multi-family areas</td>
<td>Retrofitting with very limited budget</td>
<td>Using the community within the retrofitting process</td>
</tr>
<tr>
<td>Housing densification as part of the renewal process</td>
<td>Continuous improvement of community spirit, including the community in the renewal process, local job creation, keeping investment costs low or in harmony with potential rent increases</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Private actors: contracted consultants and builders, owner of energy grid Fortum, local energy suppliers</th>
<th>Improvements in technical potential for energy reducing refurbishments, increased awareness on behavioural aspects connected to energy consumption, national and European energy and climate goals. Smart city aspects.</th>
<th>Implementation of new technology, also an increased interest from the grid owner in urban sustainability, potential show case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Profitability, energy consumption levels, connection to regional district heating network. Level of refurbishment and potential densification</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(semi) private/municipal/civic actors: local community centre Telge hub</th>
<th>Increased awareness of and methods to implement social sustainability within the planning and building process</th>
<th>Increased effort to create inclusive local decision making by the municipal housing owner Telge Hovsjö, high local unemployment, low service-levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low implementation of behavioural energy issues</td>
<td>Community building, local job creation, inclusive planning processes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>main actor groups</th>
<th>main structural drivers and barriers of transformation</th>
<th>main issues</th>
<th>main stakeholder objectives and decision making criteria²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warsaw</td>
<td>high investment costs of infrastructure networks. private development happening faster than the government can keep up. energy losses and infrastructure quality mixed ownership structure cheap price of fossil fuels. no metropolitan scale planning method, lack of policies.</td>
<td>the energy system of the case study area is fossil fuel based. an outdated utilities network, in which the majority of pipes needs replacing. The majority of the utility networks have been built in the 1960s and 1970s and most of them need modernization or replacing. This is a bottleneck in developing the area.</td>
<td>economic: costs per unit of energy, ROI, NPV, land value, grid stability environmental: energy consumption, energy production, renewable/ non-renewable split, energy efficiency, GHG emissions, land use, urban metabolism, energy label social: urban area density, housing density, solar exposure</td>
</tr>
<tr>
<td>public sector: energy providers, city authority private sector: users/ inhabitants, home owners, housings associations, developers, engineers, financial institution</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• not sufficient capacity and some areas without the energy transport system, creating a barrier in building / retrofitting offices / houses in terms of access to the areas. The energy transport system (predominantly electricity and gas) needs to be developed in order to cover new areas of slużewiec. There is no issue of producing the energy – since the energy consumption is decreasing due to retrofitting the houses and building the low-consumption offices, so the energy plants in Warsaw have spare capacity.

• land ownership issue (some plots have an unclear ownership status). In 1945 the polish government has adopted the legislation of nationalization of all private plots. The nationalisation was subject to compensation however in many cases the compensation hasn’t been paid and the owners (or heirs) claim to have rights to the property. These claims are usually is considered by court, what blocks the development. The Warsaw authority is continuously solving the issues, what opens new areas for development.

• the area is not fully covered by valid masterplans. The basis for development is a building permit, which is grounded in a valid masterplan. Most of the area of slużewiec is covered by valid plans but
there are still some areas for which this is not the case, which delays the investment process in many cases.

- the construction of more office buildings makes the area filled with cars. A possible solution is to promote mixed-use developments, which is now ongoing - more houses are being built.
- retrofitting the remaining old buildings

<table>
<thead>
<tr>
<th>main actor groups</th>
<th>main structural drivers and barriers of transformation</th>
<th>main issues</th>
<th>main stakeholder objectives and decision making criteria²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antwerp</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- individual house owners, inhabitants, landlords, housing support office, environment department, local contractors, craftsmen, network managers</td>
<td>- institutions of the Flemish housing market (construction and development sector, fiscal and tax policies, housing mortgage system, principle of ownership, building and planning regulations, DIY culture, ...)</td>
<td>- modernising buildings for all, lack of expertise, organisational capacity, building materials and techniques to renovate buildings according to modern energy standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- lack of interest in energy measures among landlords, slow refurbishment of rental houses and high energy bill for tenants</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- small-scale renovations due to lack of funds ('emergency buyers')</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- groups of inhabitants, community workers and agencies, decentralized city agencies, NGO’s, local actors, city planning department, architects, urban planners</td>
<td>- Antwerp (socialist) tradition in community development</td>
<td>- income, quality of public space, presence of green, cultural aspects, presence of social networks, availability of public services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Antwerp administrative restructuring and provision of public services</td>
<td>- private cooperative oriented professional actors: energy sovereignty, social justice, ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- socio-cultural patterns of diverse communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>main actor groups</td>
<td>main structural drivers and barriers of transformation</td>
<td>main issues</td>
<td>main stakeholder objectives and decision making criteria</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------------</td>
<td>-------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>urban regeneration programs, socio-economic reconversion (European and Flemish funds for urban regeneration)</td>
<td>energy poverty ('budget meters', ...), air pollution due to adjacent ring road, flood prone area</td>
<td>quality of public space and (energy) infrastructure, social justice, economic activities etc.</td>
<td></td>
</tr>
<tr>
<td>social housing corporation, private developers, cohousing groups, building groups, investors, city planning department, semi-public real estate agency, architects, urban planners, engineers, contractors</td>
<td>institutions of social housing (organisation of social housing companies, allocation of social housing units, local, regional and/or national social housing policies ...)</td>
<td>private market oriented professional actors: profitability, ... heritage value general upgrading of the area</td>
<td></td>
</tr>
<tr>
<td>network managers, mobility managers, public space managers, project developers, investors, energy providers, environmental city department, research institutes, engineering offices</td>
<td>energy production and distribution regulations (privatisation of providers, inter-municipal public distribution, specific gas/wind/PV/heat net regulations, EPC regulations, subsidies and tax deduction opportunities ...)</td>
<td>ownership, stewardship, control, management and maintenance of public space, collection of waste, management of open areas, community gardens decentralisation, modernisation and management of utilities</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Summary of the main stakeholders, structural drivers and barriers, issues and stakeholder objectives
3.2 SUMMARY OF CASE STUDY KPIs

Based on the case study key-issues above, KPIs for the case studies were defined. An overview of these KPIs guided the selection of priorities for software development and integration. The table below (Table 3) summarizes this selection. In Chapter 4, the case studies are further elaborated.

<table>
<thead>
<tr>
<th></th>
<th>Rotterdam</th>
<th>Valencia</th>
<th>Stockholm</th>
<th>Warsaw</th>
<th>Antwerp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main focus</strong></td>
<td>social housing renovation</td>
<td>public space</td>
<td>local involvement, inclusiveness</td>
<td>energy efficiency</td>
<td>social housing, (infrastructure, individual renovation)</td>
</tr>
<tr>
<td><strong>Key actors</strong></td>
<td>Havensteder, water board, city of Rotterdam</td>
<td>local community</td>
<td>building company</td>
<td>energy providers, housing association, transport planning department</td>
<td>Woonhaven city of Antwerp (planning department)</td>
</tr>
<tr>
<td><strong>Key performance indicators</strong></td>
<td>energy efficiency/performance (kWh/year)</td>
<td>renewable energy production (%)</td>
<td>return on investment/economic feasibility (€/year)</td>
<td>affordability for end users/inhabitants (overall housing cost/income)</td>
<td>availability of services (transport, shops, mixed use) (average distance?)</td>
</tr>
<tr>
<td><strong>Specific key performance indicators</strong></td>
<td>water retention (% surface permeability)</td>
<td>Biotope Area Factor (permeability of the soil)</td>
<td>Green Spaces per capita</td>
<td>Thermal Comfort</td>
<td>Life Cycle Analysis (reduction of the carbon footprint)</td>
</tr>
</tbody>
</table>
## Context/connection

<table>
<thead>
<tr>
<th>Rotterdam climate initiative</th>
<th>no existing initiatives to connect to (local catalyser)</th>
<th>Telge Hovsjö</th>
<th>Warsaw energy strategy (SEAP)</th>
<th>stadslab 2050</th>
</tr>
</thead>
</table>

## Data availability

| good availability | demographic and spatial GIS data available, energy use data not available | to be asked (probably good availability and quality of data) | data requested but expensive (to be further defined) | demographic and spatial GIS data available (not detailed) energy use requested (difficult to access) |

## Stage of renovation process

| early stage of planning process, renovation plans of the social housing company | no planning initiatives at all, ECODISTR-ICT as communication tool | social planning process by the building owners | no plans for renovation/ad hoc solutions | no existing planning process, renovation need for some building block in 5-10 years |

## Software specifications

<table>
<thead>
<tr>
<th>Rotterdam</th>
<th>Valencia</th>
<th>Stockholm</th>
<th>Warsaw</th>
<th>Antwerp</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Energy and LCA with VABI and PV potential tool + TNO tool</td>
<td>- Energy with Dimosim (test of coupling)</td>
<td>Planned:</td>
<td>Planned:</td>
<td>Planned:</td>
</tr>
<tr>
<td>- ROI with VABI assets policy</td>
<td>- LCA with SP module (Renobuild)</td>
<td>- Energy with full version of Dimosim and Strusoft tool</td>
<td>- ROI and affordability: SP LCC tool</td>
<td>- Energy with Dimosim</td>
</tr>
<tr>
<td>- Social and services by expert judgment and social indicator wheel</td>
<td>- Social and services with TNO Common Sense</td>
<td>- ROI: SP LCC tool</td>
<td>Social and services: not decided yet</td>
<td>- ROI and affordability: SP LCC tool</td>
</tr>
<tr>
<td>- Water KPI: manually inputting data, not linked to the module (S1)</td>
<td>- Green with the Berlin Version of the Biotope Area Factor</td>
<td>- Probably affordability, social &amp; services and green module</td>
<td>Mobility: ARUP simple excel tool and Vissim</td>
<td>Social and services: not decided yet</td>
</tr>
<tr>
<td>- Infrastructure by case study specific</td>
<td>- Heat stress – manually inserted - with Rayman model</td>
<td>- Daylighting maybe with PV panel tool or TNO tool</td>
<td></td>
<td>- Infrastructure: looking at Dimosim or use Rotterdam tool. If this is not enough, maybe the Retscreen tool or others</td>
</tr>
</tbody>
</table>

Table 3: Overview of the KPIs per case study
4 CASE STUDY REPORTS

4.1 RUBROEK, ROTTERDAM (THE NETHERLANDS)

4.1.1 Case study facts

| Location | Neighbourhood: Rubroek  
District: Kralingen-Crooswijk (“old North”)  
City: Rotterdam  
Country: The Netherlands |
|---|---|
| Area | 4,500 dwellings: (Figure 1)  
• 1940s-1950s privately owned apartment buildings (approx. 20%)  
• Low-rise social housing blocks dating from the late 1960s - early 1980s (approx. 80% of total) |
| Inhabitants | 7,600 inhabitants; many low-income or unemployed, ethnically segregated |
| Functions | Mainly residential; other functions in the area include elementary schools and recreational centre/retirement home |
| Local partners | • Housing corporation Havensteder, owns about 2,500 dwellings in the district  
• Electricity and gas network operator Stedin  
• Energy company and district heating network operator Eneco  
• Water board Hoogheemraadschap Schieland en Krimpenerwaard  
• Municipality of Rotterdam  
• Social initiative Buurtlab  
• Social initiative Hotspot Hutspot  
• Nursing home and community centre Middin Crooswijk |
| Main issues | • Physical deterioration of buildings (visual, energy performance) and public space, but the municipality and housing corporation have limited financial resources, so they need to prioritize strictly  
• Economically weak demographic, leading to (energy) poverty  
• Lack of social cohesion  
• Not resilient to climate change effects, especially with respect to water retention |
| Testing period | M19-21 (July – September 2015) |
| Workshops | 1. 27th of November 2014: define as-is and ambitions to-be (1)  
2. 12th of February 2015: define as-is and ambitions to-be (2)  
3. 30th of April 2015: develop alternatives for energy  
4. 30th of June 2015: demonstrate IDSS  
5. 22nd of September 2015: assess and compare alternatives; test in stakeholder discussion with IDSS in supporting role |
4.1.2 Configuration of the IDSS

The case was tested with IDSS version 1.0, which included the multi-criteria, multi-stakeholder, multi-variant (MCMSMV) module. All quantitative KPIs were calculated using the VABI module; for the qualitative KPIs expert judgement was used.

To support the multi-stakeholder discussion on the alternatives designed, a set of KPIs was defined in collaboration with the stakeholders and configured in the IDSS Dashboard. The final set is given in Table 4: Workshop 5 with the list of KPIs and used module. A distinction is made between KPIs calculated by modules and KPIs defined by expert judgement. The following calculation modules were used for these KPIs:

- VABI Policy: EPA software to calculate energy use, costs, benefits and CO2, with the option to take energy measures with respect to the current situation.
- TNO Solar Energy: software to calculate solar energy potential based on high-resolution geographical data.
<table>
<thead>
<tr>
<th>Type of KPI</th>
<th>Description as in the IDSS</th>
<th>Module used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantitative KPIs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial</td>
<td>Investment_costs_euro_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>Financial_gains_euro_year_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>Payback_period_years_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>EBIC_ratio_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>Building_related_energy_costs_euro_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>PV_kWh_year_dwelling_Rubroek</td>
<td>VABI</td>
</tr>
<tr>
<td>CO2</td>
<td>CO2_emission_kg_year_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td>Energy</td>
<td>Gas_use_m3_year_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>Electricity_use_kWh_year_dwelling_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td></td>
<td>Energy_label_Havensteder</td>
<td>VABI</td>
</tr>
<tr>
<td><strong>Qualitative KPIs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial</td>
<td>Property tax value_Havensteder</td>
<td>Expert judgement: Average property tax value of a Havensteder dwelling in Rubroek</td>
</tr>
<tr>
<td>Water</td>
<td>Water drainage and storage capacity</td>
<td>Expert judgement: The extent to which water retention and drainage capacity for Rubroek is sufficient</td>
</tr>
<tr>
<td></td>
<td>Green index</td>
<td>Expert judgement: The extent to which the local green areas contribute to a better living environment in Rubroek</td>
</tr>
<tr>
<td>Social</td>
<td>Social cohesion</td>
<td>Expert judgement: The extent to which there is social cohesion in Rubroek</td>
</tr>
<tr>
<td></td>
<td>Affordability_Havensteder</td>
<td>Expert judgement: The extent to which dwellings in Rubroek are affordable for the target group</td>
</tr>
<tr>
<td></td>
<td>Satisfaction</td>
<td>Expert judgement: The extent to which the residents in Rubroek are satisfied with their neighbourhood</td>
</tr>
<tr>
<td></td>
<td>Comfort level_Havensteder</td>
<td>Expert judgement: The extent to which the residents of Havensteder dwellings are satisfied with the comfort level of their home</td>
</tr>
<tr>
<td></td>
<td>Awareness</td>
<td>Expert judgement: The extent to which the residents of Rubroek are aware of their energy use and the role of their own behaviour therein</td>
</tr>
<tr>
<td></td>
<td>Information</td>
<td>Expert judgement: The extent to which the residents of Rubroek receive feedback on the energy use and the role of their own behaviour therein</td>
</tr>
<tr>
<td></td>
<td>Self-organizing ability</td>
<td>Expert judgement: The extent to which the residents of Rubroek are able to self-organize, for example coordinated projects to make the neighbourhood more sustainable</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>Expert judgement: The extent to which children in Rubroek are educated in sustainability issues in school</td>
</tr>
</tbody>
</table>

Table 4: Workshop 5 with the list of KPIs and used modules

Results of these modules were not only incorporated in the dashboard (KPI scores for the different variants) but partly also geographically visualized in the TNO Common Sense framework. Examples of this data, but also of other relevant data as visualised in the Common Sense framework is shown in Figure 2.
Figure 2: Graphs A-D of the collected data on the as-is situation during Workshop 1

From top left, clockwise: (A) current energy use as modelled by the Vesta model (owned by Planbureau voor de Leefomgeving); (B) current energy label as modelled by Vesta; (C) overview of different heat sources to the Havenstede building stock; (D) current energy label as reported by Havensteder to VABI. The charts are made by VABI software, the maps are screenshots from the interactive Common Sense framework.

The results (ambitions, KPI scores for the As Is situation and the 5 alternatives) as configured in the Dashboard were also visualised in the Multi-Criteria Multi-Stakeholder Multi-Variant (MCMSMV) module by VABI. The MCMSMV overview was designed to support decision-making by intuitively visualizing the (M-C, M-S, M-V) results. Examples for Rubroek are shown in Figure 3 and Figure 4.
Figure 3: Overview of the as-is situation, compared to the to-be situation in the MCMSMV module

The selected KPI values are represented per stakeholder. The dots refer to the weight the stakeholders gave, the colour represents the score (red is low, dark green is high).
Figure 4: Overview of the alternatives for the KPIs of the housing corporation

The as-is and to-be scores are on the left. The dark grey bars denote the ambition level.

4.1.3 Case study process

Five workshops were organised in this case study, see the following table for an overview. The ambitions of the attending stakeholders - as gathered during the workshops - are summarized in Table 6. In these workshops, five alternatives were designed (Table 7). Several workshop techniques were applied to explore and further specify the alternatives and their impacts on the different stakeholders.
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Goal</th>
<th>Stakeholders</th>
<th>Outcomes/remarks</th>
<th>IDSS Steps</th>
</tr>
</thead>
</table>
| November 2014 | • Inventory opportunities and how to achieve them  
• Analyse interests of stakeholders | Havensteder, Stedin, water board, municipality, Buurtlab, Hotspot Hutspot, Middin | • Ambitions of stakeholders for the case study area (i.e. a liveable, sustainable, climate-adaptive Rubroek): see Table 6  
• Havenstedt KPIs:  
  o Energy label (C or higher)  
  o Renewable energy (%)  
  o Feasibility for the housing corporation (return on investment)  
  o Affordability for residents (total cost of housing)  
• See  
  Figure 2 for information on the as-is situation.  
• Include KPIs for other themes than energy (water, social)  
• Discussion on the usefulness of an IDSS-like instrument in decision making | As-is To-be  
IDSS used: N |
| February 2015 | Zoom in on:  
• Water  
• Value creation  
• Social aspects  
• Energy infrastructure | Havensteder, Stedin, water board, municipality, Buurtlab, Hotspot Hutspot, Eneco | • Stedin updated ambition: large renewal of gas infrastructure planned in this area for the coming decade – window of opportunity for district heating?  
• The workshop had a diverging character, partly because of new people entering the group. Although the minutes of the previous session had been shared with them, it proved difficult to introduce them smoothly in an already ongoing process.  
• The desired result of this session were KPIs for the social domain, water and energy infrastructure, but eventually we didn’t get beyond analysis:  
  o Social: the possibility for a downturn seems larger than the upward potential.  
  o Water: to increase climate adaptation, small measures with residents (e.g. tile out, plant in) need to be combined with large scale measures (e.g. sewer renewal)  
  o Energy infrastructure: barrier for the district heating option is that 70% of the residents need to approve, while this option does not provide them any clear benefits | As-is To-be  
IDSS used: N |
| April 2015    | • Converge energy options  
• Investigate possible decisions related to energy | Havensteder, Stedin, Eneco, municipality | • Ambitions and the “Valencia-KPIs” were reaffirmed  
• Participants built up an interdependency scheme and detailed the decisions belonging to four alternatives (Table 7: Final list of alternatives and Table 8):  
  o Gas infrastructure is replaced by gas infrastructure (Business as usual - BAU)  
  o Gas infrastructure is replaced by district heating  
  o A canal is added (for climate proofing the area)  
  o A particular housing complex is extensively renovated to an A++ label  
• Additionally social aspects, such as citizen participation in the case of district heating and/or energy efficiency, and quality of life may be taken into consideration.  
• Other remarks:  
  o The importance of geographical data: i.e. replacing a branch of the sewer system is a different type of opportunity than replacing the main sewage line | Develop alternatives  
IDSS used: N |
This session generated a lot of feedback on the layout of the IDSS, without really going in-depth into the case. These remarks were translated into the IDSS by WP4. Remarks were:

- It is easier to decide upon a “sufficient” score than on a “bad” score.
- Make the scales easy to interpret: i.e. the green and right side of the scale is good; red and left side is always bad, even if the “good” score has a low absolute value (inverse scale).
- The MCMSMV module contains a huge amount of information, which is useful for key stakeholders. For residents the common sense maps are much more appealing.
- Make it a purely iterative process, no shortcuts and converge towards visualising conclusions. Keep the process and information simple, understandable and clear.

The stakeholders selected 5 KPIs and filled in their ambition and priority levels for their KPIs (see Table 4 for the full list). Results of 5 alternatives (see Figure 3 and Figure 4) were shown and discussed:

- Why have you selected these KPIs?
- Which alternative (or combination of alternatives) do you like best?
- How can the alternative be improved?

It was concluded that PV and insulation measures were no-regret and that they could be combined with e.g. extending the heat network, with affordability as boundary condition. Moreover, work needs to be done on the border with the social domain to raise awareness (e.g. combine with smart meters) to win over the hearts and minds of the residents. Stakeholders need each other in order to create mutual and societal benefits.

Possibilities for continuation of the cooperation between the stakeholders include investigation for a so-called “green deal”, where the local coalition of the willing would ask the national government for exemption on certain rules and regulations in the living lab Rubroek, in order to build a business case for extending the heat network. For this to work, it is essential that Eneco joins the coalition.

Possibilities to create an exchange between cases: for example Rotterdam and Antwerp are quite near to each other and deal with similar issues. The Rotterdam housing corporation is very open to a dialogue with stakeholders in Antwerp.

Table 5: Table about the case study process of the Rotterdam case
Organisation | Ambition
--- | ---
Grid operator Stedin | To investigate how Stedin can contribute to the development of Rubroek. What is wise from the overall Dutch perspective? There are many neighbourhoods like Rubroek. The system of socializing infrastructural costs only works when distributed over many people!

Housing corporation Havensteder | A nicer, better living environment for residents

Housing corporation Havensteder | To realize a nicer neighbourhood, together with partners in the area. Pool resources for a better and cheaper cooperation. 80% label C, affordability and a better score on the social index are important.

Housing corporation Havensteder | How much money is transferring in and out of this district, for example in the form of unemployment benefits/social assistance? What can be gained by making better choices together?

Waterboard Schieland en Krimpenerwaard | City as a sponge, more local buffer capacity for extreme weather (in the form of retention and infiltration of rainwater)

Municipality of Rotterdam/Versnelling 010 | A more sustainable neighbourhood through good cooperation. This includes renewable production, energy efficiency, water/climate, lower energy costs, better public space, comparable or better score on the social index

Social initiative Buurtlab | A physically and socially healthy neighbourhood (greening, play areas outdoors, self-reliant residents)

Municipality of Rotterdam | Maintaining status quo and seizing opportunities

Municipality of Rotterdam | Eventually more diversification in the housing stock (long-term)

Municipality of Rotterdam | Sustainable energy in Rubroek

Municipality of Rotterdam | Climate proof Rubroek (visible and together with partners)

Nursing home and community centre Middin Crooswijk | Good cooperation between organizations

Social initiative Hotspot Hutspot | Rubroek is the fourth location for this initiative, to become self-reliant and self-sufficient

Eneco | Sustainable energy for everyone, including Rubroek. A business case for Eneco as well as costumers (MJ, €). Measures include e.g. labels, district heating, PV, smart meters.

Table 6: Workshop 1: Ambitions of the stakeholders (including updates from Workshop 3)

<table>
<thead>
<tr>
<th>Name of alternative</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business as usual (BAU)</td>
<td>The natural gas grid is replaced with a new natural gas grid; Havensteder continues replacing individual boilers</td>
</tr>
<tr>
<td>District heating</td>
<td>The natural gas grid is replaced with a district heating network.</td>
</tr>
<tr>
<td>PV</td>
<td>PV cells are put on roofs and these are paid back through an energy service company business model (e.g. together with Eneco)</td>
</tr>
<tr>
<td>Warande</td>
<td>The grassy patch in the street “Warande” becomes a canal, in combination with other water retention and storage measures</td>
</tr>
<tr>
<td>Intensive renovation</td>
<td>The Hugo de Groot complex is intensively renovated towards a zero-energy building</td>
</tr>
</tbody>
</table>

Table 7: Final list of alternatives with their description
Table 8: Workshop 3 to unravel the rationale and decisions within alternatives (example)

4.1.4 Lessons regarding the development of the IDSS

Since the Rubroek case was the first case in the ECODISTR-ICT project, many of the lessons learned regarding the development of the IDSS in the earlier stages of the case were immediately translated into WP4 actions. Through case-driven intensive software development workshops (scrum) and multiple testing within the project team (dry-runs) and with the session-organizing stakeholder, the case has been instrumental in shaping the first version of the IDSS. An important step therein was the IDSS demo feedback session with the stakeholders in June 2015. All these developments have been documented in the deliverables of WP4. In September 2015 a live testing of the IDSS with the stakeholders took place. The lessons learned from the live testing were as follows.

Dashboard structure

- Stakeholders had no additional comments on the dashboard structure.
**Analyse problem**

- The stakeholders were asked to choose 5 KPIs and give an ambition score and weight for these 5. All others had to be given a weight of 0 manually. It would be more user-friendly to give every indicator a default weight of 0, so only the values of the chosen KPI selection would have to change. Other selection mechanisms (i.e. dividing 10 weight points over all KPIs) can also be considered.

**Assess alternatives**

- The MCMSMV module displays either, for each alternative the scores of the KPIs for all stakeholders, or for each stakeholder the scores of the KPIs for all alternatives. At the moment, there is no overview graph including the weighted total scores for all stakeholders on all alternatives. This could be added as an overview graph in the MCMSMV module, giving one overview of KPI scores for all alternatives and all stakeholders, to support the discussion.
- The connection between the Dashboard and the MCMSMV module was not functioning properly. A stable connection would create the opportunity to quickly integrate stakeholder information on-the-fly. Also, the information was not always saved and had to be re-entered to the Dashboard. The technical facilitator saved the situation.

4.1.5 Lessons regarding the use (and users) of the IDSS

**4.1.5.1 Preparing the ground**

**When to mobilise the IDSS**

- The IDSS is a decision-support system and should only be used where it can have added value. That implies that some preparatory work needs to be done getting the decision-making process going: analysing the problem(s), sharing ambitions and discussing alternatives. The process steps developed can also be helpful in bringing some structure in the sometimes chaotic process of decision-making in a context with many stakeholders and diverging interests, which may be of use in the early steps without the IDSS.

**Working with stakeholders**

- The interaction with partners from the social domain requires specific attention. The social partners were not used to work with models or data in a developmental stage. The content of the sessions was sometimes too abstract for them to keep being motivated. Although it was a conscious decision to involve the social partners from the start, it might be taken into consideration to add the social partners a bit later in the process when the case is a bit more tangible and concrete. Moreover, it is yet another argument for having two sessions in a concise time period. It is up to the facilitators to make sure that the social domain is adequately represented in the discussion, KPIs and alternatives.
- Once the IDSS is fully developed, it is recommended to keep momentum by keeping the process compact: i.e. one session for discussing ambitions, as-is and developing (conceptual) alternatives, and one session about a month later to reflect on results and have further
discussion. In the Rubroek case, there was approximately a year between the first and the last session with several contact moments in between. This was also a consequence of the IDSS still being developed and the fact that the case itself is complex and a so-called “messy” problem: there is no easy alternative and stakeholders need each other to create business cases and organize support. Still, one year is a very long period to keep everyone attentive and motivated. In addition, a more compact process also limits the risk of new people entering the stakeholder group.

- If new people enter the stakeholder group, it is recommended to pay extra attention to them, preferably in the form of additional bilateral meetings to introduce these new stakeholders in the process and run workshops as smooth as possible. This will benefit the case as well as the stakeholders.
- It is recommended to keep homework for the stakeholders to a minimum and have fall-back options in case the stakeholders don’t contribute as much as expected. In Rubroek, it took about 15 minutes of the interactive workshop for the stakeholders to set their ambitions and weights.

**Facilitator roles**

- The facilitators should be able to explain the KPI values for all alternatives and the as-is situation. For example, when district heating is being considered, the assumed heat source assumed matters for the CO2 – footprint.

**Making KPIs**

- KPIs need to be formulated very precisely. For example what is considered to be affordable may differ between rich and poor people. Moreover, all stakeholders should be properly aware of the definitions: affordable for example may also be interpreted as “affordable for the housing company”.
- The KPIs can only point into one direction, while measures can have trade-offs. For example a larger water area is good for water retention desired by stakeholder A, but is bad for children’s safety which can be a condition for stakeholder B. A solution could be to further split up the indicator: water buffer volume (retention) and access to open water (safety). Or a high property tax value can be an asset for the municipality, but a minus for the property owner who needs to pay the tax.

**Develop alternatives**

- It should be kept in mind that the stakeholders themselves may also learn a lot during the decision-making process. This may positively or negatively affect how they see alternatives. In the Rubroek case some stakeholders became more and more negative about the district heating alternative the more they understood that this does not necessarily have a positive effect on the energy bills of residents of the area. However, it is advised to keep all options open – other stakeholders may benefit from this option and may create a return cash flow into the area. By eliminating this alternative altogether, that type of synergies would be missed.
4.1.5.2 Using the IDSS

Adjusting KPIs, setting KPI values and weights

- In the September 2015 session, using the IDSS for making decision-making criteria explicit and transparent per stakeholder, really helped to move the discussion up from ‘yes, sure, we all want the best for everybody’, to ‘this is what is really important for my organisation’.
- **A total of five KPIs per stakeholder** is enough: it forces the stakeholder to choose, prevents information overload and retains power of distinction. This also has a very practical dimension, since 5 KPIs is what can maximum be projected on a screen, enabling a complete visual overview without having to scroll down.
- The five main KPIs per stakeholder with **priority and ambition levels**, were a **good starting point for the discussion** on what each stakeholder wanted to achieve in the district. Each stakeholder was able to tell a clear and focused story, based on the five selected KPIs.
- Investment costs were assumed to be zero in the as-is situation, while this may not be the case in practice (e.g. maintenance investments will continue). It might be better to define a Business-as-usual (BAU) alternative (‘doing what the stakeholders would have done without this initiative’), rather than an as-is alternative (‘doing nothing’).

Setting ambitions

- Ambitions of all stakeholders appeared to be much more fluid than was expected beforehand. Or rather, everyone became enthusiastic when talking about their ambitions but had difficulties when they were asked to substantiate how this would lead to follow-up steps. Therefore, instead of setting the ambitions once and working from there, it proved very relevant and helpful to **start each session with a short roundtable** to verify the ambitions and/or get an update on changes, which also put everyone in the right mind-set for the rest of the workshop.

Visualizing and discussing alternatives

- Dry-runs within the project team before the final session showed no clear differentiation between the alternatives: all alternatives had an overall score between 5 and 6. There were 2 reasons:
  - A lot of KPI values were unaltered by a certain alternative, i.e. solar panels didn’t impact the gas related KPIs, thereby influencing the mean scores.
  - Several KPIs that were changed, did not change much on their 1 to 10 scoring scale. As a solution, the number of KPIs was reduced to a maximum of five per stakeholder. Also, the **scales of the quantitative KPIs were adjusted** such that the spread between the alternatives and as is situation resulted in a spread in their associated 1-10 scores. After these changes, differentiating scores between alternatives became visible, both in the overview and in the overall score.
- In the September session, the geographical details were not requested by the stakeholders. This may be a coincidence, because in earlier sessions the stakeholders appeared to be more interested in the maps than in the 1-10 scores. Or perhaps the maps were a good match to earlier stages of the process and less relevant in this phase.
• An overall score based on all KPIs did not prove to be of much help in the discussion. What did help the discussion forward, was the score of selected KPIs per alternative per stakeholder.

4.1.5.3 Post-processing

• The IDSS has been applied successfully for supporting the group process of the stakeholders committed to change in Rubroek.

• The software is close to being user-friendly enough to be used in sessions by the process facilitator and the stakeholders, with only little help from the technical facilitator.

• Gathering and preparing the district data for the as-is situation and the alternatives, predefining relevant KPIs and connecting those to calculation modules, and finally calculating the KPI scores for each alternative, remains homework for the (technical) facilitator. Therefore, there should always be two sessions: one on setting the goals, defining the alternatives and relevant KPIs and one on discussing the results and agreeing on decision-making steps.

4.1.6 Lessons regarding the exploitation of the IDSS

The ECODISTR-ICT IDSS supports decision-making on renovation of neighbourhoods in a process with multiple stakeholders, with a first focus on energy-efficiency. The combination of hard (energy use) and soft (awareness) aspects that can be integrated in one flexible tool and the insight gained into decision-making criteria of other stakeholders makes it unique and versatile. The Rotterdam case, in which valuable steps towards a more sustainable neighbourhood have been made, may be the first case of many applications of both the software and the process developed.
## 4.2 Campanar, Valencia (Spain)

### 4.2.1 Case study facts

| Location          | Neighbourhood: Campanar  
|                  | District: Campanar  
|                  | City: Valencia  
|                  | Country: Spain  
| Area             | approximately 14 ha *(Figure 5)*  
|                  | 1,616 residential units divided in 53 buildings (average surface of 100 m²)  
|                  | divided by big avenues and with a lack of identity:  
|                  | • 80% apartment blocks, built during the 1970-1980  
|                  | • The rest (20%) of apartment blocks were built either before 1970 or after 1990  
|                  | • one commercial building, which is not an apartment block  
| Inhabitants      | 4,079 inhabitants; medium-income; 70% active population, 20% older than 65 years old; 10% of foreign population; medium-income  
| Functions        | Mainly residential, on the ground floor mainly commercial activities and garage accesses, other seven floors are mostly residential.  
|                  | A commercial centre, schools or social centre are found in the surroundings.  
|                  | Playgrounds can be found in the existing two large green spaces.  
| Local partners   | • Regional Government – Department of Housing, Territory and Infrastructures  
|                  | • Regional Government – Department of Urban Regeneration  
|                  | • Municipality of Valencia – Department of Urbanism  
|                  | • Municipality of Valencia – Department of Parks and Gardens  
|                  | • Municipality of Valencia – Department ICT and Communications  
|                  | • InnDEA Foundation – R&D and New Technologies  
|                  | • Valencian Institute of Buildings, IVE  
|                  | • IVACE Energy Agency of Valencia  
|                  | • Neighbour’s Association of Campanar  
|                  | • Public Participation – Fent Estudi  
| Main issues      | Several physical characteristics to take into account, which determines the actors that need to be involved.  
|                  | • Privately owned housing units in apartment buildings. No existence of housing cooperatives.  
|                  | • Poor quality building blocks. Some buildings are obsolete and need to be renovated.  
|                  | • Lack of investment due to profound economic crisis. Lack of small commerce and abundance of big malls, which are located in the surrounding area. This situation generates less activity in the neighbourhood.  

- Neighbourhood barriers (lack of social interaction)
- Poor quality of the public space. High density of buildings and infrastructure leaving less space for other options. The public space is mainly dominated by cars and lacks green areas.
- Strong heat stress during summer limits the use of the public spaces

<table>
<thead>
<tr>
<th>Testing period</th>
<th>M 21-23 (August – October 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshops</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>30th January 2014: First definition of the project area and key issues, identification of key stakeholders and exploration of institutional dynamics</td>
</tr>
<tr>
<td>2.</td>
<td>17th May 2014: Workshop with the Neighbours (1) to define as-is and to-be</td>
</tr>
<tr>
<td>3.</td>
<td>31st May 2014: Workshop with the Neighbours (2) to define scenarios</td>
</tr>
<tr>
<td>4.</td>
<td>20th June 2014: Set up of the Case Study Reference Group (CSRG), discussing the main issues and IDSS demo</td>
</tr>
<tr>
<td>5.</td>
<td>14th May 2015: Presentation of results of exploration (project area and identified issues) and the definition of KPIs with CSRG</td>
</tr>
<tr>
<td>6.</td>
<td>17th September 2015: defining energy and LCA scenarios (1)</td>
</tr>
<tr>
<td>7.</td>
<td>24th September 2015: defining green and heat stress scenarios (2)</td>
</tr>
<tr>
<td>8.</td>
<td>14th October 2015: defining the weights and ambitions (1)</td>
</tr>
<tr>
<td>9.</td>
<td>15th October 2015: second definition of the weights and ambitions (2)</td>
</tr>
<tr>
<td>10.</td>
<td>20th October 2015: final demo session</td>
</tr>
</tbody>
</table>

Figure 5: Case study area (white outline), belonging to the district of Campanar (red outline); focus on the case study area

4.2.2 Configuration of the IDSS

For this case study the IDSS Version 1.1 was used. The dashboard includes several modules for the calculation of the KPIs, set for the case study of Valencia. Following, there is a list of the modules with a brief description and the KPIs calculated in each module.
1. Energy Module (Dimosim)

This module has been partially integrated (S3 solution): calculations are externally done and only visualized in the dashboard. The module gives an overall result per district, as well as a map including the results per building for each KPI. The calculations have been made outside the dashboard and the results are introduced through a geojson file, which contains all data results. The KPIs that have been calculated for the Valencia case study are the following:

- Total Energy Consumption (kWh/m²) (District and Building Level)
- Total Energy Consumption for heating (kWh/m²) (District and Building Level)
- Percentage of Renewable Energy (%)

2. LCA Module (Renobuild)

This module has been fully integrated (S4 solution). A calculation tool (Renobuild) is introduced in the IDSS to perform calculations, such that data can be introduced through the dashboard. For this case study, the KPI that has been calculated is the Change of Global Warming Potential per heated area (tonnes of CO2-emissions).

3. Green Module (Berlin version)

The module is fully integrated in the dashboard (S4), which means that the data can be introduced manually into the dashboard. The Biotope Area Factor (BAF), which refers to the permeability of the soil, was calculated with this green module. The module is based on an already existing tool that calculates the BAF, which was developed for Berlin.

4. Thermal Comfort Module (Rayman Model)

This module is not integrated in the IDSS, and it is an S2 solution. The calculations have been made outside the dashboard and the results have been manually inserted. The KPIs that were calculated with the Rayman Model, are:

- Heat Stress in Summer (PET Index, ºC)
- Cold Stress in Winter (PET Index, ºC)

The Rayman model is an already existing tool – developed by Dr. Matzarakis in Germany - for the modelling of “mean radiant temperature” and “thermal environment of humans” in specific measuring points. There is extensive literature and experience in the use of the tool.

5. Social Services visualisation (Common Sense)

This module uses the TNO software Common Sense (CS) in order to visualize the collected social services data in a map on the dashboard. This is an S3 solution. Data visualization has been prepared

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4 More information on: http://www.mif.uni-freiburg.de/rayman/
outside the IDSS, but the visualization itself is integrated in the IDSS. This module has been used to visualize the following KPI:

- **Proximity of the population to basic services (% population covered)**


The MCMSMV module is not fully incorporated, but linked to the dashboard. This is an S3 solution. The module does not calculate a specific KPI, but it is essential for comparing alternatives and visualizing results for different stakeholders.

7. Manual insertion

In the process, there has been one KPI, which has been inserted manually. This KPI has been calculated outside and the results have been introduced manually (S1 solution):

- **Green Spaces per capita (m² of green space/person)**

4.2.3 **Case study process**

Several meetings and workshops were organized in this case study for the preparation of the case and for the decision-making process. The process followed the roadmap elaborated in D5.1, even though the process has not been linear but iterative.

In general, the following steps have been taken, which are further detailed in the table below.

1. **Preparation of the case study:**
   - involve stakeholders: set up Case Study Reference Group (CSRG)
   - actor-Institutional Analysis: identify issues and problems and prioritize (identify KPIs)
   - collect general data on the case study: as-is situation is analysed.

2. **Elaboration of interactive (energy) planning process:**
   - generate proposals to improve the main issues (KPIs) identified: develop scenarios
   - collect data to calculate and evaluate these proposals (testing the prototype of the ECODISTR-ICT software, or–when not yet available– alternative models)
   - discuss the results with the CSRG.

3. **Final evaluation:**
   - Questionnaires and workshop to draw conclusions and recommendations on the software.

See the following table for an overview:
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Goal</th>
<th>Stakeholders</th>
<th>Outcomes/remarks</th>
<th>IDSS Steps</th>
</tr>
</thead>
</table>
| 30th January 2014 | • Presentation of the ECODISTR-ICT project  
• Definition of project area and key issues  
• Exploration of institutional dynamics          | Regional Government, InndeA, Campanar Neighbour’s Association, Fent Estudí  
Total attendees: 7 participants | The intention of this workshop is to present the project to the authorities to get their support, as well as to define the project area and carry out an exploration of institutional dynamics. | Preparation of the case study |
| 17th May 2014 (Senior Centre of Campanar) | • Identify main issues for the neighbours  
• Generate future scenarios                     | Campanar Residents Association, citizens, Fent Estudí, architects  
Total attendees: 15 participants | The intention of the workshop was to present the ECODISTR-ICT project to the Campanar Residents Association as well as to other interested citizens, and to collect their perception on the present and possible future of the district of Campanar.  
The event was held at the Senior Centre of Campanar and lasted 4,5 hours. It consisted of a brief project presentation and a work session in groups with the aim to identify the main issues in the neighbourhood and to generate two scenarios:  
• Positive scenario in which the neighbour’s desires will take place.  
• Negative scenario, in which the neighbour’s fears occur.  
For this event Bipolaire collaborated with Fent Estudí, who coordinated and prepared the workshop. The methodology used at the workshop is an adaptation of the EASW (European Awareness Sustainability Workshop), which was elaborated by the Danish Institute of Technology and further developed by several works of the DG XIII European Commission, in the framework of the programs VALUE II and INNOVATION. This method has been developed in recent years in more than 50 European cities with similar objectives: how to define a more sustainable future for the city with the contributions of its inhabitants. (See video: http://vimeo.com/96190691) | As-is To-be |
| 31st May 2014 (Senior Centre of Campanar) | • Workshop with the Neighbours (2) to define the scenarios             | Campanar Neighbour’s Association, citizens, Fent Estudí, architects  
Total attendees: 20 participants | The objective of the second workshop with the residents was double: to reflect and draw conclusions on the previous meeting, and to build proposals for a better neighbourhood. The event lasted 4 hours, in which several working groups were established and assisted by a person of the workshop organization. Each group elaborated a poster with proposals, which were presented by each team at the end of the workshop. Each participant voted for the most convincing proposal. As a result, the most voted proposals were these two:  
1. Finding our space. This proposal focused on generating more public and open spaces and on making use of abandoned spaces. | To-be |

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2. Recover the sanitary use of the abandoned building of the former hospital. The hospital was located in Campanar before being relocated out of the city. The neighbourhood lost vitality, dynamism and jobs that generated this large health complex.

For this event, as well as in the first workshop, Bipolaire collaborated with the team Fent Estudi (www.fent.es), which coordinated the workshop successfully. *(Video summary of the workshop: http://vimeo.com/98363105).*

Main objectives are:

- improve inter-associative and inter-generational relationships
- improve neighbourhood identity
- improve social fabric (occupation, income, level of studies, ...)
- valorise the historical and cultural heritage
- improve building stock (building age, condition, occupation)
- access to social services
- strengthen commercial fabric and economic activity
- pacify traffic
- remove architectural barriers and improve accessibility
- accessibility to green areas
- affordable energy retrofitting
- Return of Investment (ROI) and affordability
- thermal stress, air quality and acoustic stress

| 20th June 2014 (Regional Government Building) | Present case study | Regional Government, Municipality: Department of Urbanism, Municipality: Department of Parks and Gardens, Energy Agency, InnDEA foundation, SERTIC municipal service of ICT, Valencian | A first meeting with the institutions and authorities of Valencia was held with the following objectives:
- Short presentation of the ECODISTR-ICT project and the project area (as-is situation)
- Discuss on the main issues of the project area and general issues during the process of urban transformation
- Identifying the main stakeholders involved in the process of sustainable urban transformation
- Demo on the first prototype of the ECODISTR-ICT tool |

IDSS used: Y
### Institute of Building, Fent Estudi

<table>
<thead>
<tr>
<th>Total attendees: 10 participants</th>
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The following general questions were also discussed:

1. Neighbourhood transformations: Are they generally integrated or partial?
2. Who are the main actors/stakeholders? What are the interest of each one?
3. When does each actor enter in the process? During the project definition, execution, etc.?
4. Is it possible to define primary and secondary stakeholders?
5. How are such projects financed: European level, national, regional, local level, public-private partnership?
6. If you want a “sustainable” transformation, what are the aspects discussed/worked: environmental, economic, social?
7. Is it common to work with indicators and/or software to set goals?

The following feedback and information was gathered:

- Future of the project: the question of future maintenance of the platform has arisen regarding to the durability of the project.
- Users of the tool: There is a general opinion that the tool will mainly be useful for both local technicians (administration) as well as free professionals (architects and engineers). It is not believed that the tool is for all audiences due to the technical content.
- Software: the complexity of the neighbourhoods is discussed and questioned the functionality of the ECODISTR-ICT in the same way for different types of neighbourhoods (Old Town, expansion, etc.) tool. Campanar -as a complex and diverse neighbourhood- can be subdivided into areas in order to develop in each one ad-hoc strategies.
- Three successful earlier examples of urban transformation in the city of Valencia and surroundings are discussed. The transformation of the neighbourhoods of both Ruzafa and Velluters, as well as one neighbourhood in the north of Alicante. Common themes in these examples are the degradation of buildings, social issues, and energy saving.
- The main stakeholders involved in urban renovation processes are mentioned and identified: regional government departments (health, Education, etc.); Municipality departments of Urbanism, Housing, Wellbeing, Mobility; ESCOs; Energy providers; Financial Institutions; public-private partnership.
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Details</th>
</tr>
</thead>
</table>
| 30th January 2015 (Regional Government Building) | - Set up Case Study Reference Group  
- Identify main issues or KPIs  
Total attendees: 4 participants |
| 14th May 2015 (Regional Government Building) | - Presentation of results of exploration (project area and identified issues);  
- Definition of KPIs with CSRG  
Total attendees: 13 participants |

- District Heating: profitability is found if the buildings use this heating system or if there is a commitment on the part of citizens in use. It is also interesting for large buildings where energy consumption is guaranteed, such as hotels, banks, offices, etc. Otherwise, as in the case of one example in Barcelona, it does not work.

This was a short meeting in order to set up the CSRG and to gather information in order to carry out an analysis of the project area in order to identify main urban issues.

The main objectives of the meeting were:
- Set up the CSRG *(Table 10)*
- Identify objectives or indicators, which are specific to the area or general in order to analyse the area: mobility; situation of housing stock (building age, condition, occupation...); situation of the social fabric (occupation, income level studies, etc.); situation of vehicle stock; public facilities in the area; economic activity.

The workshop main objectives and outcomes were:
- Presentation of the exploration results on the area of study (main issues)
- Collaborative activity to identify KPIs for the project area *(Figure 6)*
- Define priorities and future objectives (ambition)

From this meeting the KPIs to test in the case study of Valencia were defined:

- Energy:
  - Total Energy Consumption (kWh/m²) (District and Building Level)
  - Total Energy Consumption for heating (kWh/m²) (District and Building Level)
  - Percentage of Renewable Energy (%)
- Green:
  - Biotope Area Factor (Soil permeability)
  - Green space per capita (m²/person)
- Thermal Stress:
  - Heat Stress (PET Index in degrees Celsius)
  - Cold Stress (PET Index in degrees Celsius)
- Social Services:
  - Proximity of the population to basic services (% population covered)
- LCA:
| 17th September 2015 (Regional Government Building: Energy Department) | Define Energy and LCA Scenarios (1) | IVACE Energy Agency | An internal meeting with the stakeholders, who are experts in energy was held with the aim to define design alternatives and define scenarios. Three scenarios were proposed: a conservative scenario, a standard scenario and an optimistic scenario. The ambitions were also established for each scenario.

1. Conservative Scenario: This represents the future scenario if the context doesn't change, and the process is not motivated by a serious urban transformation process. There will be financial aid to encourage inhabitants to retrofit windows, boilers and to building communities to improve their building envelop. In this case the following changes are envisioned:
   - 20% of the windows of all buildings will be changed randomly for new windows that perform better
   - 20% of domestic boilers are also changed randomly for high efficiency condensing boilers
   - Some buildings around 50 years old need to be retrofitted and will renovate completely their envelop (façades and roof).

2. Standard Scenario: This represents a future scenario in which there is a motivation for energy retrofitting, even though the financial measures and the possibilities to improve the district are limited. In this case:
   - 30% of the windows of all buildings will be changed randomly for new windows that perform better. | Develop alternatives
Ambitions
IDSS used: N |

- Change of Global Warming potential per heated area (tonnes of CO2 saved)

The ambitions are:
- Affordable energy retrofit of the district
- Increase the ratio of renewable energy in the area
- Increase soil permeability and soil hydration
- Increase access to green areas
- Improve area wellbeing
- Access to social services
- Reduce heat stress
- Reduce carbon footprint

Total attendees: 5 participants
- 30% of domestic boilers are also changed randomly for high efficiency condensing boilers
- Some buildings will be retrofitted and will renovate completely their envelopes (façades and roof), as well as they will introduce solar thermal units on the roof for heating domestic hot water (DHW).

3. Optimistic Scenario: This scenario represents a hypothetical scenario in which there is the possibility to carry out important energy retrofitting measures (Figure 7):
- 30% of the windows of all buildings will be changed randomly for new windows that perform better.
- 30% of domestic boilers are also changed randomly for high efficiency condensing boilers
- Some buildings will be retrofitted and will renovate completely their envelopes (façades and roof), as well as they will introduce solar thermal units on the roof for heating DHW.
- Three building blocks will install a common (for all housing units in the building block) heat pump and cooling machines.
- There is one group composed of three buildings, which install a common biomass pellets boiler for heating.

| 24th September 2015 (Municipality Facilities: Department of Parks and Gardens) | Define Green and Heat Stress Scenarios (2) | Municipality: Department of Parks and Gardens | Total attendees: 4 participants | An internal meeting with the stakeholders -who are experts in urban green- was held with the aim to define alternatives and scenarios. A conservative scenario and an optimistic scenario were established, together with the ambitions for each scenario. 1. Standard Scenario: This scenario is realistic and feasible:  - Green areas will be increased, and therefore the area of permeable soil.  - Approximately 20% of buildings will introduce green roofs.  - All parking spaces will replace their surface material for a semi-open material, which allows some permeability. 2. Optimistic Scenario: This scenario is also feasible, but more financial measures need to be mobilised:  - Green areas will be increased as much as possible and some water surfaces will be created in order to increase the area of permeable soil. | Develop alternatives Ambitions | IDSS used: N |
- All buildings will introduce green roofs, improving not only the biotope area factor but also the aesthetics of the area and the urban climate.
- All parking spaces will replace their surface material by a semi-open material, which allows some permeability.
- Some streets will replace the impermeable concrete surface by porous concrete material, which increases the soil permeability.

14th October 2015 (Regional Government Building: Energy Department)

- Weight and Ambitions (1)
- Total attendees: 5 participants

An internal meeting was held with the energy experts in order to assess the weighting of KPIs and to define ambitions. This meeting was held in order to prepare the final demo session. They spent time looking for realistic ambitions and to deliberate about the importance of KPIs in order to assign weights. To keep the process simple for the demo session, the stakeholders had to select only 5 KPIs. The outcome is the following:

- Total Energy Consumption (kWh/m²). Weight: 5 / Ambition: 70kWh/m²
- Total Energy Consumption for heating (kWh/m²). Weight: 3 / Ambition: 40kWh/m²
- Percentage of Renewable Energy (%). Weight: 5 / Ambition: 25%
- Proximity of the population to basic services (% population covered). Weight: 2 / Ambition: 100%
- Change of Global Warming potential per heated area (tonnes of CO2 saved). Weight: 4 / Ambition: ? (Stakeholders did not have enough data to set an ambition)

15th October 2015 (Municipality Facilities: Department of Parks and Gardens)

- Weight and Ambitions (2)
- Total attendees: 4 participants

The weighting of KPIs and the definition of ambitions were decided in another internal meeting, this time with the urban green experts in order to prepare for the final demo session. They had to explain the motivation to assign specific weights and ambition values. Again, the stakeholders had to select 5 KPIs. Mainly green KPIs were chosen and they explained that this is directly linked to better public space and therefore lowering energy needs for cooling. The outcome is the following:

- Biotop Area Factor (Soil permeability). Weight: 5 / Ambition: 0,4
- Green space per capita (m²/person). Weight: 2 / Ambition: Not a specific number
- Heat Stress (PET Index in degrees Celsius). Weight: 5 / Ambition: 35ºC
- Cold Stress (PET Index in degrees Celsius). Weight: 1 / Ambition: 10ºC
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
<th>Description</th>
<th>IDSS used</th>
</tr>
</thead>
</table>
| 20th October 2015   | Final Demo Session             | Regional Government, Municipality: Department of Urbanism, Municipality:  | The final demo session was focused on the process and the ECODISTR-ICT tool rather than on specific calculation results. All stakeholders were represented and were motivated to see results. The meeting was structured in four parts and two collaboration activities, as follows:  
- PART 1: Brief Introduction to the project ECODISTR-ICT and case study of Valencia (KPIs that have been tested, scenarios planned)  
  - Collaborative Activity 1: weighting and set ambitions. A form was given in groups representing the stakeholders. Once weights and ambitions were set, each group had to explain to the rest of the CSRG their motivation to assign those values.  
- PART 2: Live DEMO (online), online demonstration on the use of the ECODISTR-ICT tool. Results of the case study Campanar (As-is, To-Be and Alternatives)  
- PART 3: MCMSMV module: comparisons  
  - Collaborative Activity 2: Give feedback on the case study and on the tool. Feedback form to collect feedback from each stakeholder.  
- PART 4: Conclusions and closure.  
  The lessons learned and outcomes of the final demo are collected and summarized in the next sections of this Deliverable. | Y         |

Table 9: Table about the case study process of the Valencia case
Regional Government. Department of Housing, Public Works and Territory
Regional Government. Department of Urban Regeneration
Regional Government. Department of Urban Regeneration
Municipality. Department of Urbanism
Municipality. Department of Urbanism
InnDEA Foundation
IVACE Energy Agency of Valencia
IVACE Energy Agency of Valencia
IVACE Energy Agency of Valencia
IVE. Valencian Institute of Building
Municipality. Department of Parks and Gardens
Municipality. Department of Parks and Gardens
SERTIC. Service of City Data
Fent Estudi. Public Participation
Fent Estudi. Public Participation
Campanar Neighbourhood Association

Table 10: Case Study Reference Group (CSRG)

Figure 6: Photos of the workshop in May 2014 with the residents and Campanar Residents Association: problem analysis and ambitions

Figure 7: Maps of Campanar about the optimistic scenario for the different KPIs
4.2.4 Lessons regarding the development of the IDSS

The case study of Campanar used a version of the IDSS, which is still in a development process. Nevertheless during the use of the IDSS for the case study, we learned new lessons on how to improve it.

1. WP1. Lessons on scenario building blocks, generation of alternatives.
Generation of alternatives is easy to implement in the dashboard. No comments on this section.

2. WP2. Lessons on data collection
Data collection has not been an easy task. One of the reasons was the lack of knowledge on the data that need to be collected and the format needed. For the next cases, it is suggested that templates and lists of data with examples are developed for each module. Another suggestion is the import of data. At the moment, for the fully integrated modules, data have to be inserted manually. This is not user-friendly and it does not prevent making mistakes. It is suggested that templates are prepared in advance and this could be uploaded in the dashboard. This would ease the task of the facilitator as well as prevent “writing” mistakes.

3. WP3. Lessons on calculation modules
   - More KPIs should be included: For the case study of Valencia only a few KPIs were developed. Urban renovation processes are complex and therefore need to include many different objectives and KPIs. This was one of the main suggestions from the stakeholders. They were missing important KPIs such as those related to socio-demographics, costs and management.
   - Control on editing the alternatives: Stakeholders overall found the ECODSTR-ICT tool very interesting and useful. One major concern was related to the control of editing alternatives.
   - Visualization: All features regarding visualization in a map and implemented in the dashboard were highly appreciated by stakeholders, such as energy consumption per building or social services in the area. This type of information gives not only a result but also allows to visualize the needs of buildings to be retrofitted before, or which social services are not in a radius of influence. In this case, it is not only about giving a final result but also providing a tool to make decisions.
   - Use of modules:
     - LCA and Green modules are fully integrated and are easy to use. These modules can be easily implemented and further tested in next cases.
     - Dimosim - used for energy calculations - is not yet integrated. This causes lack of control as some data inconsistencies were shown and the facilitator was not able to edit the import of data. This should be further developed so that the following cases are able to let the data be introduced by the facilitator.
     - Rayman model - used to calculate heat stress - is a very complicated module, which does not allow to enter properties of, for example, pavement and façade surfaces, which are very important to modify urban climate. The results from the Rayman module had to be modified manually with the help of an expert in the subject.
The module TNO tool “Common Sense” - used to visualize social services - is not able to calculate distances and indicators. The visualization was useful for the process and debate with stakeholders. The introduction of this module is very interesting also for future case studies, as many information can be visualized and differentiated by layers.

4. WP4. Lessons on the dashboard structure and features

Some general comments that are already been suggested in the online fora that are used by the developers are also included here:
- Some buttons are not working yet (Back buttons)
- Problem with the name of the data file uploaded: It stores last data input and this is confusing as it is not possible to know which file has been used for the calculations.
- Once in a while the server fails and calculations cannot be made.

Specific comments on the dashboard are also included here:

**Dashboard Structure:**
The structure is easy to follow and clear. A suggestion for the first screen of the IDSS: when we enter the dashboard we see the process that we have been working on or we can start a new process. If we click on the top left title of the already started process, the IDSS asks if we want to delete the process. If you click this by mistake there is no chance to recover the processed data. There should be a repeating question “Are you sure you want to delete the process?” in order to avoid clicking on this by mistake.

**Analyse problem:**
OVERVIEW: In the visualization of the district area map, it would be beneficial to give the possibility to edit the district boundary and assign a different colour and line weight, as it is difficult to see the area. The possibility of zooming in and out of the map with the mouse wheel is also interesting as many drawing software (AutoCAD, Photoshop, etc.) use this functionality and the user might be accustomed to that.
SELECT KPIs: It would be handy that the database is structured by themes, as it is difficult to find the indicators to be used. Once selected, it would be good that the colour of the indicator in the database changes so that the user knows it has already been selected. The possibility to edit existing indicators and to add new ones are very useful.

**As is:**
It is very interesting to visualize the scores in a bar. Sometimes the results are not shown in a proper way, for example the ‘Thermal Stress in summer’ indicator.

5 https://github.com/ecodistrict
be able to select KPIs that are not possible to visualize. The optimal solution is to develop the IDSS so that all indicators can be shown in a map. This is a very interesting feature for users.

To Be:
No comments, as it is easy and clear to work at this step.

Develop Alternatives:
No comments, as it is easy and clear to use. The “Back” button does not work on this screen and has to be fixed.

Assess Alternatives:
This step is clear. It may be a good idea to include here the “Map” functionality to visualize results. Another possibility is to create a new “Screen” in order to visualize all scenarios (as-is, alternatives) in the same map.

Compare alternatives:
This “screen” is not functional at the moment and for this reason the MCMSMV module is in use. It is not user-friendly at this point, given that the software needs to be previously installed on the computer. It is therefore not an open source tool. This needs to be fixed during the further development of the tool. Furthermore, the MCMSMV module is still difficult to interpret and to compare results, as each stakeholder selects different KPIs. A possible solution is to create a consensus platform in which stakeholders have to agree on the KPIs that need to be used during the process. During the demo session in Valencia, the stakeholders stressed the relevance and importance of other – not-selected by them - KPIs, after hearing the explanation and persuasion of other stakeholders why they selected certain other KPIs.

4.2.5 Lessons regarding the use (and users) of the IDSS

4.2.5.1 Preparation of the IDSS
An urban renovation process starts by defining the area of study, analysing the main issues and setting objectives and choosing strategies to achieve them. These steps have been achieved during workshops with stakeholders. From the beginning, the Valencia case study has had a strong support from all types of stakeholders (institutions and residents), who have actively participated in different workshops.

In the case study of Campanar, the process was facilitated by Bipolaires architects with the support of other ECODISTR-ICT partners for KPIs definition, data processing, calculations, and programming. The table below (Table 11: ) provides an overview of the technical facilitator, process facilitator and developer involved in each of the modules during the case study:
Table 11: Different facilitators and developers according to the modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Technical Facilitator</th>
<th>Process Facilitator</th>
<th>Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY MODULE</td>
<td>Olivier Tournaire</td>
<td>Blanca Pedrola</td>
<td>Peter Riederer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bruno Sauer</td>
<td></td>
</tr>
<tr>
<td>LCA MODULE</td>
<td>Blanca Pedrola</td>
<td>Blanca Pedrola</td>
<td>Anna Boss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bruno Sauer</td>
<td>Johannes Markström</td>
</tr>
<tr>
<td>GREEN MODULE</td>
<td>Blanca Pedrola</td>
<td>Blanca Pedrola</td>
<td>Carl-Magnus Capener</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bruno Sauer</td>
<td>Johannes Markström</td>
</tr>
<tr>
<td>HEAT STRESS MODULE</td>
<td>Olivier Tournaire</td>
<td>Blanca Pedrola</td>
<td>No integration of the already existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bruno Sauer</td>
<td>software Rayman Model, developed by Dr.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Andreas Matzarakis</td>
</tr>
<tr>
<td>SOCIAL SERVICES MODULE</td>
<td>Reinier Sterkenburg</td>
<td>Blanca Pedrola</td>
<td>Reinier Sterkenburg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bruno Sauer</td>
<td></td>
</tr>
</tbody>
</table>

This was a complex process in which coordination, data collection and preparation of workshops with stakeholders had to be made in parallel. As in real urban renovation processes, the case study process is not linear but iterative. The steps can be summarized as follows:

- Setting up CSRG
- Identifying main issues of the case study area (analyse problem)
- Defining KPIs and give priorities (select most important KPIs)
- Data collection
- As Is situation
- To Be situation (weight and ambition)
- Developing alternatives
- Assess alternatives
- Compare alternatives

The workshops were prepared with the objective of setting the CSRG, identifying main issues of the area, selecting KPIs to be calculated, assigning a weight and ambition for each one and developing alternatives. The workshops’ preparations and outcomes can be found in the ECODISTR-ICT share point:


For the calculation and assessment of both, the as-is situation and the alternatives, data had to be collected. For each module, different data were specified. All data collected can be found on the ECODISTR-ICT share point:


Here we summarize the most important data collected:

- Energy Module:
  - Building Properties (U values, Window ratio, age of building, heating and cooling systems, energy type, etc.
  - CAD files with building outline, height of building, building ID.
- **Heat Stress:**
  - Geometry of trees (trunk diameter, trunk height, crown diameter, total tree height)
  - Tree species
  - Obstacles: buildings, trees, shading structures
  - Fisheye images
  - Albedo
  - Position of the points where calculations are done

- **Social Services:**
  - Type of activity for commercial services
  - Type of public facility (Health, Education, Wellbeing, Culture, etc.)
  - Geographical coordinates

- **Green:**
  - Area of permeable and semi-permeable soil
  - Area of semi-open soil
  - Area of sealed surfaces
  - Area of green roofs
  - Rainwater runoff area

- **LCA:**
  - District properties and calculation period (electricity mix, primary energy use of district heating)
  - Building properties (heated area, heat source before renovation)
  - Renovation options applicable to buildings (annual heat demand after renovation, change heat source, life of product, change of insulation material, change of façade system, change of windows, change of building radiators, etc.).

Once data are collected, **calculations** can be done **for the as-is situation as well as for the alternatives**. KPIs that are not integrated, had to be calculated outside the dashboard:

- Energy Module (Dimosim): Calculations are done outside the dashboard, but the data results can be uploaded using a geojson file. The results can be visualized in a map in the dashboard.
- Heat Stress (Rayman Model): Calculations are done outside the dashboard and manually introduced in the dashboard
- Green Space per capita: Calculations are done outside the dashboard and manually inserted.
- Social Services (TNO Common Sense): only visualization of data has been possible. The maps have been prepared outside the dashboard using the TNO tool “Common Sense”.

**Some KPIs were fully integrated**, and therefore the data had to be introduced in the dashboard.

- LCA module (Renobuild) *(Figure 8)*
- Biotope Area Factor (Berlin Version)
Figure 8: Example of the screen for data input in the LCA module

4.2.5.2 Post-processing

Once data are collected and calculations have been made, it is possible to visualize the results on the dashboard in coloured bars. The bars have three colours: dark grey (excellent benchmark), light grey (sufficient benchmark) and a colour (green, yellow or red) of the calculation result. The colour (green, yellow or red) gives an idea how far or close we are to the established benchmarks, which have been edited at the beginning of the process by an expert in the field.
For example, for the KPI “Biotope Area Factor” shown in Figure 9, we see that the calculated score is 0.13, which is shown in orange. This means that we are relatively far from the 0.3 score set as sufficient, and from 0.5 set as an excellent score.
Figure 9: Example of assessment of results

The visualization of the results for the as-is situation as well as for the alternatives is the same. For some KPIs, it is possible to see results in a map (Figure 10 and Figure 11):

Figure 10: Map showing energy calculation results
Figure 11: Map that shows the results on KPI “proximity of the population to basic services”

According to the stakeholders, the visualization of data was very helpful to make decisions. After assessing the as-is situation and the alternatives, it is possible to compare alternatives. At the moment the MCMSMV module sends data from the dashboard to an external software that shows interpretable results.

4.2.6  Lessons regarding the exploitation of the IDSS

The final demo session in Valencia held on the 20th of October 2015 had a twofold objective: on the one hand learning about the possibilities for urban renovation in the case study of Campanar, and on the other demonstrating how the tool is used. Feedback was collected from stakeholders in order to improve the development of the tool.

A summary of the main feedback and suggestions from the stakeholders are:

- The IDSS is overall very interesting. It is valuable to make integrated decisions and visualize results on a user-friendly interface. Some stakeholders claim that it could replace large Excel-files used for the analyses of scenarios. The visualization in maps is especially useful for urban planning.
- **More KPIs need to be included** in order to be a really useful tool. Urban renovation processes are complex and therefore different issues need to be taken into account in parallel. There is a common wish to include KPIs related to socio-demographic data, costs and management.
- The possibility of editing alternatives and scenarios themselves is interesting.
- Not only the **comparison between the as-is situation and alternatives** for renovating one area is compelling, but also the **possibility to select different areas and compare their as-is situations** is useful to identify which areas in the city need urgent renovation measures.
- The IDSS is a very **clever tool for communication between stakeholders**. Participants claimed to have gained a **better understanding of the importance of KPIs**, which are not in their area of expertise once they discussed the selection of KPIs by other stakeholders. Therefore, transparency on KPIs is very valuable in the discussion.
- **Other representations for the MCMSMV module were suggested.** For example the inclusion of all KPIs in order to be able to **compare between stakeholders**.
4.3 **Hovsjö, Stockholm (Sweden)**

4.3.1 **Case study facts**

| **Location** | Neighbourhood: Hovsjö  
City: Södertälje (approximately 30 km southwest of Stockholm)  
Country: Sweden |
| **Area** | 2.200 dwellings:  
• 1.600 owned by the municipality, via the housing company Telge Hovsjö.  
• The rest (600) are privately owned, via a tenant owned association  
Most inhabitants live in eight storeys, multi-family houses built in the 1970s. There are also one storey terraced houses in Hovsjö. |
| **Inhabitants** | circa 6.000 people; many low-income or unemployed, ethnically segregated |
| **Functions** | Residential area with elementary school, retirement home and a church. There is also a small centre area with a few shops. |
| **Local partners** |  
• Housing company Telge Hovsjö AB  
• Telge energy (if possible)  
• Hovsjö Hub (social initiative connected to Telge Hovsjö) |
| **Main issues** |  
• buildings in need of renovation  
• economically weak population  
• the area is quite remote and separated from the city of Södertälje  
• violent history of criminality |
| **Testing period** | M18-26 (June 2015 - February 2016) |
| **Workshops** |  
1. 16th of June: Define as-is and ambitions to-be  
2. 23rd of October: Redefining the above |

4.3.2 **Case study process (Month 24-26, using IDSS version 1.2)**

The Stockholm case has always been very dependent on the housing company of Telge Hovsjö. This year has been quite a turbulent time in the company as the head of property and development left the company early this year. The CEO of Telge Hovsjö took over as the case contact person, but he was very occupied with other business. At last the project team managed to meet with him and the CEO also participated later on in a workshop in Hovsjö. In this process the CEO revealed that he was going to change employer and that a new CEO would be appointed in September.
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Goal</th>
<th>Stakeholders</th>
<th>Outcomes/remarks</th>
<th>IDSS Steps</th>
</tr>
</thead>
</table>
| 16th June 2015      | • Information session about the case study                            | Former CEO Telge Hovsjö, Hovsjö Hub, SP          | • Introduction to the project with information about the history and development of the district (by the CEO)  
• Hovsjö is a problematic area with a lot of youth criminality, but this has improved recently due to citizen involvement and ongoing discussions  
• On a map (Figure 12: Map used in the first workshop to identify different areas)  
• The pink boxes mark locations where new buildings have been discussed. Different areas were identified, related to energy. There should be plans for the future to renew the area with more multifamily houses, but this is a municipal question.  
• Two alternatives were of interest, looking from an ECODISTR-ICT point of view:  
  1. Proceeding with the suggestions from the energy audits  
  2. Building new multifamily houses on top of the parking houses  
• Different KPIs were discussed: affordability is of course of great interest in this area.  
• A demo of the IDSS tool was made by White to show how this will function in reality. The MSMCMV-module did not work for demonstration. | (Case study description)  
Problem analyse  
As-is  
To-be  
IDSS used: N |
| 23rd October 2015   | • To restart and fix the project with the new CEO                    | New CEO of Telge Hovsjö                           | • The ideas for the future by the new CEO were discussed and the question rose if the outcomes of the first workshop were still relevant. The meeting was an opportunity to discuss and plan the rest of the case study.  
• There is a big focus on garbage. The housing company wants to introduce separation at source. Two multifamily houses are testing it at the moment, but the idea is that the whole district will follow eventually if it is successful. This aspect has to be included in the case study and can be an alternative. The impact on the KPIs can be analysed and research has to be done about the possibility to connect any module to it.  
• The timeframe was discussed as there is a delay. New workshops were proposed. | (Case study description)  
Problem analyse  
As-is  
To-be  
IDSS used: N |
| 16th November 2015  | • Case study visit                                                   | All partners                                     | • Stockholm meeting                                                                                                                                                                                                                                                                                                                                                                             |
| December 2015       | •                                                                              |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                  |
| February 2016       | •                                                                              |                                                  | • Final workshop                                                                                                                                                                                                                                                                                                                                                                               |

Table 12: Table about the case study process of the Stockholm case
Figure 12: Map used in the first workshop to identify different areas

The pink boxes mark locations where new buildings have been discussed.

The challenge will be to get stakeholders on board. A suggestion is the chairman of the board for Telge Hovsjö who is also interested in urban development in the area. We also want to involve a representative from the Södertälje municipality.
### 4.4 Służewiec Przemysłowy, Warsaw (Poland)

#### 4.4.1 Case study facts

| Location | Neighbourhood: Służewiec Przemysłowy  
|          | District: Mokotów  
|          | City: Warsaw  
|          | Country: Poland |
| Area     | approximately 2.6 km² (*Figure 13*)  
|          | a mixed-use area:  
|          | - In the past an industrial area with many factories, dating from after the Invasion of Poland (1939) and World War II  
|          | - last 6 years: many big factories transformed into offices, the area is now retrofitting into modern office/residential district with other complimentary services (shopping centre, cinema, medical facilities etc.). |
| Functions| Residential, offices, retail, education, small scale secondary industry (automobile mechanics), medical, parking area |
| Local partners | City transport planning department  
|          | Private developer (Jones Lang LaSalle)  
|          | Engineering firm (Arup) |
| Main issues | High energy losses due to an outdated utilities network  
|          | insufficient capacity of energy and transport network  
|          | public space dominated by many parked private vehicles, including areas not designated as a parking area  
|          | unclear landownership status of some plots  
|          | no urban visions or masterplans for the area by the city authority  
|          | ongoing office/residential construction despite traffic congestion issues.  
|          | relatively high energy consumption due to an old building stock, many old (60’s, 70’s, 80’s) residential buildings  
|          | area supplied by a fossil fuel based energy system |
| Testing period | M28 – M30 (March 2016 – May 2016) |
| Workshops | 1. Define as-is ambitions to-be  
|          | 2. Develop alternatives for energy  
|          | 3. Demonstrate IDSS  
|          | 4. Assess and compare alternatives; test in stakeholder discussion with IDSS in supporting role |
Figure 13: Case study site within the Służewiec Przemysłowy neighbourhood, Warsaw

(Source: OpenStreetMap, 2015; World Imagery, 2015). The pink areas represent commerce, yellow and orange are the parking spaces and infrastructure.

4.4.2 Configuration of the IDSS

For the Warsaw case the modules as defined in Table 3: Overview of the KPIs per case study are planned to be used. A module has been defined as a an independent functional part of the IDSS and can consist of several coherent components (e.g. calculation model, IMB client, data storage, assessment of variants visualization) see Deliverable D3.2 for an overview of all envisioned modules.

1. Mobility module

The main issues related to mobility are that: there are too many private vehicles that dominate the public space (Figure 14), there are long traffic congestions during peak hours because the capacity of the road network is not able to handle the demand (Arup, 2014), and mobility is almost completely dependent on fossil fuels (IEA, 2012) leading to high carbon emissions. This makes transport into and out of the district inefficient in terms of time and energy performance.
Currently the transport planning team of the city is working on increasing the capacity of access to the area. The aim of the module is to give an indication on how renewal solutions selected by stakeholders would affect the modal split of the district, this is elaborated further below. The renewal solutions list includes solutions which could help tackle the above mentioned mobility related issues while improving the energy efficiency performance of the district.

The approach for the development of the mobility module has been split into four stages: (i) determine the Baseline, (ii) determine possible renewal solutions, (iii) determine the impact of the renewal solutions on the modal split, and (iv) connect the module with the IDSS. An overview of the approach has been visualised in Figure 15. At the moment the first two stages have been completed and are described in the following chapter. The results of these stages have been included in the following paragraph. It is planned to work on the two remaining stages: impact and IDSS connection. In terms of the next steps Arup will work on determining the impact of renewal solutions on the modal split. Conclusions cannot be drawn at this moment because the work is still in progress.

The module would ideally indicate the following KPI:

- **Modal split before and after (%/mode)**
2. Energy module

The existing energy distribution system is outdated and hence inefficient. The achievement of a completely renewable energy district requires a change in the way energy is currently distributed in the district. A more flexible, decentralized and efficient network is necessary. A low temperature district heating network (LT-DHN) is an option as it is compatible with the penetration of renewable energy sources. The plan is to be able to allow the comparison of different types of collective energy systems and the influence they have on the proportion of renewable energy consumed within the site.

The module would ideally indicate the following KPIs:

- energy efficiency/performance (kWh/year)
- renewable energy production (%)
- return on investment/economic feasibility (€/year)
- affordability for end users/inhabitants (overall housing cost/income)
3. Green building module

This module has been requested by the stakeholder Jones Lange LaSalle (JLL). JLL is involved in developing new buildings in the area. As part of this, the BREEAM label is used to validate the grade of sustainability of their developments. They would like to know which renewal solutions would contribute to their BREEAM label and if so how much credits the renewal solution could potentially conduce. The plan is to include solutions in the renewal solutions list of an urban scale that complement the BREEAM label of an urban and buildings scale. The module should then support the translation of solutions into BREEAM credits. The module would ideally indicate the following KPI:

- BREEAM credits of renewal solutions

4. Availability of services

The availability of services module is envisioned to cover a broad range of facilities, including: general services (public facilities, shops, etc.), green spaces, safety, employment, health. For the Warsaw case the focus within this module lies on green spaces. The European Commission and Arup are interested to understand how Nature Based Solutions (NBS) could contribute to improving sustainability of a district. Arup is interested in the link between NBS and the improvement of energy efficiency. The plan is to use the module that has been developed for the Valencia case and see how it could be used for the Warsaw case. It might be modified a bit depending on the applicability of the module to the Warsaw case study. The module would ideally indicate the effect on the energy consumption of the district.

The module would ideally indicate the following KPIs:

- m² of green space
- green factor.

4.4.3 Case study process (Month 27-29, using IDSS version 1.3)

The Council of Warsaw has adopted the Sustainable Energy Action Plan (SEAP) for Warsaw (Warsaw, 2013). The SEAP is the first document of this magnitude that presents an integrated approach to energy management at the level of Warsaw local government. The focus of the Warsaw case study lies on private developments, improving energy efficiency and how this can contribute to the SEAP. The Służewiec Przemysłowy neighbourhood is a mixed-use area located south of the Warsaw city centre. The district has been selected as the case study site due to the issues the area is facing and the FP7 ECODISTR-ICT research objectives. Preparation for testing has started and interviews with stakeholders have been held, which are represented in the table below.
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Goal</th>
<th>Stakeholders</th>
<th>Outcomes/remarks</th>
<th>IDSS Steps</th>
</tr>
</thead>
</table>
| December 2013 - May 2014 | ● Problem analysis            |                                                   | ● Identifying the main issues  
● Many new private developments are taking place in the area. The retrofit of old buildings is happening. The occurring changes are mainly of a building scale, but the issues identified in the neighbourhood are also related to the urban scale *(Figure 16)*. It would therefore be relevant to study and understand how interventions of an urban scale could benefit the stakeholders and improve energy efficiency of the neighbourhood.  
● Stakeholder analyses: essential data for the case study, the role of every stakeholder, the use of ECODISTR-ICT, potential partners, etc. | Problem analysis IDSS used: N |
| September – November 2014 | ● Analysis of stakeholders  
● Interviews with stakeholders  
● Determine relevant modules  
● Determine approach | Warsaw transport planning department, Jones Lang LaSalle, Arup | ● Interviews with stakeholders  
● Guided site visits  
● Possible renewal solutions within remit of stakeholders | Problem analysis As-is IDSS used: N |
| December 2014 - January 2015 | ● Data collection for mobility module | Warsaw transport planning department | ● Traffic counts have been done (on the 11th of December 2014) in order to determine the baseline traffic. A division has been made between private and public transport, including an estimation of their occupancy. Under private transport the following modes have been classified: a motorcycle, a car, a van, a truck or a multi-truck. In the case of public transport a distinction is made between busses and trams. During four hours (6.00-10.00 AM) traffic counts had been conducted on selected cross-sections of the road *(Figure 17)*. Public transport in the district is provided directly by rail, bus and tram lines. Main public transport corridors are Wołoska Street and Marynarska Street. The traffic counts of the public transport service of the district are presented on  
● *Figure 18*. There are also public bike stations, but at the moment of traffic counts these were out of order.  
● Modal split of as-is situation, done by using the Warsaw Visum model of 2012. The modal split (or modal share) is the percentage of travellers using a particular type of transportation or number of trips using said type. The modal split for the analysed region includes individual and public transport *(Figure 19)*. Pedestrians | Collect data IDSS used: N |

6 Four-door busses (e.g. Solaris 18, Man NG 313), three-door busses (e.g. Solaris 12), and short three-door busses (e.g. Solaris 10)  
7 One-space tram (e.g. Pesa Swing), two-coach tram, and three-coach tram.
and cyclist are not mentioned in the model. A distinction is made between three types of modal splits:
1. origin modal split: indicates the modes used by traffic leaving the district
2. destination modal split: split indicates the modes used by traffic entering the district
3. city modal split: indicates the different modes used within the city for all transport.

June 2015
- Defining KPIs

List of KPIs linked to stakeholders and modules

As-is
To-be
IDSS used: N

- Planned preparation for testing

Warsaw transport planning department, Jones Lang LaSalle, Arup

Division in data typology in order to link data types, indicators and fields of interest:
- GEOMETRIC AND SEMANTIC MODELLING OF BUILDING (volume, area, orientation);
- BUILDINGS QUANTITIES AND RELATED STATISTICS (type of housing, materials, U value, roof shape, PV system technology, window glazing);
- SOCIO-ECONOMIC DATA (age, income, unemployment, family type);
- BUILDINGS USAGES (heating system, number of rooms, cooling system, water heating, ventilation, energy demand, energy cost);
- CLIMATIC DATA (humidity, air temperature, solar irradiance, rainfall, wind speed and direction)

Collect data
IDSS used: N

March – May 2016
- Data collection for other modules
- Stakeholder workshop
- Testing of case
- Final workshop

All partners

Data collection
3D model
Usage of IDSS

Collect data
As-is
To-be
IDSS used: Y

Table 13: Table about the case study process of the Warsaw case
Figure 16: Estimated greenhouse gas emissions reduction per sector in 2020 for Warsaw (EUMayors, 2015)

Figure 17: Analysed area with traffic counts for private transport (Openstreetmap, 2015)

Figure 18: Analysed area with traffic counts for public transport and public bike stations (Veturilo, 2014)
Figure 19: Origin and destination modal splits of the district and average modal split of the city

Further Approach

In order to support the SEAP of the city the focus for the Warsaw case is energy efficiency, and indirectly to tackle the energy trilemma (energy security, energy equity, and environmental sustainability), therefore an analysis of the energy system of the business-as-usual (BAU) case will need to be undertaken (as indicated in Figure 20). The energy balance of Poland (IEA, 2012) illustrates the dependency on fossil fuels (majority oil and coals) and the importance of oil for the transport sector and coal for the electricity generation in Poland.

Figure 20: Energy balance in Poland (IEA, 2012)

In order to come to a coherent innovative future a preliminary vision for the energy system of the site has been formulated. The vision will need to be discussed with the stakeholders. The components of this vision are based on the work that has been done for task 2.5. The purpose of
task 2.5 was to identify different possible renewal solutions of a building and district scale and structure these in a database (DB) file which contains the relevant properties of these solutions (thermal properties of insulation, efficiency of boilers, etc.).

For the case study the goal is to work towards an urban system that allows a completely renewable energy district that supports the objectives of the research. In order to achieve such a goal a conversion of the infrastructure of the system is required. A schema of the new infrastructure is visualised in Figure 21 below. The intention is to ensure that the components that make this new infrastructure possible are part of the solutions which the stakeholders could influence and that these components could stand independently but could operate collectively. It might be possible that not all identified renewal solutions can be influenced by the stakeholders in these cases the intention is to inspire the stakeholders to aim for innovative solutions.

The energy vision is aligned with the Heat Roadmap for Europe 2050 (Aalborg University, 2013). The new system improves efficiency by reducing the system temperature, reduces carbon emissions by facilitating local penetration and storage of renewable energy in addition to existing conventional coal and gas fired plants, uses nature based solutions to reduce energy demand and supports more sustainable forms of transport.

![Figure 21: Schematic representation of the transition strategy for the Warsaw case study](image-url)
### 4.5 Kiel, Antwerp (Belgium)

#### 4.5.1 Case study facts

| Location       | Neighbourhood: Kiel-West  
|                | District: Kiel  
|                | City: Antwerp  
|                | Country: Belgium |
| Area           | Approximately 34 ha  
|                | 2,500 housing units:  
|                | • modernist high-rise social housing blocks  
|                | (about 84%)  
|                | • privately owned small-scale housing |
| Inhabitants    | 6,310 inhabitants; population density of 16,536 persons/km²; average age of 36.5 years; multicultural and low-income character |
| Functions      | Mainly residential |
| Local partners | • Environmental department City of Antwerp (EMA, Stadslab 2050)  
|                | • Urban quality team City of Antwerp  
|                | • Community workers  
|                | Samenlevingsopbouw, Opsinjoren, Woonkantoor  
|                | • Housing association Woonhaven  
|                | • Facility managers Infrax and Eandis  
|                | • Contractor Van Roey  
|                | • Developer Van Haerents  
|                | • Financial institute KBC  
|                | • Service provider Ecopower |
| Main issues    | • safety and inequality of residents (poverty)  
|                | • housing shortage for young families  
|                | • management and maintenance of public space, ownership  
|                | • rigidity of social housing  
|                | • lack of public services  
|                | • environmental issues, like air and noise pollution, flood prone area |
| Testing period | M30-34 (May 2016 – September 216) |
| Workshops      | 1. December 2013 – May 2014: interviews stakeholders and problem analyses  
|                | 2. 3-8th of November 2014: student workshop |
3. **10th of February 2015**: workshop with Woonhaven and the municipality of Antwerp
4. **23rd of June 2015**: Internal workshop OMGEVING and VITO

### 4.5.2 Case study process ([Month 30-34], using IDSS version 2.0)

At the moment the preparation of testing is going on. Several interviews were done with different stakeholders to understand the case study as much as possible. Previous deliverables contained the results such as the actor-institutional analyses. In 2014 especially some data collection, processing and the problem analyses was done. In 2015 more controlled workshops took place, such as the student workshop and internal workshop in order to open ideas and get feedback as much as possible, before the testing starts.
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Goal</th>
<th>Stakeholders</th>
<th>Outcomes/remarks</th>
<th>IDSS Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2013 -</td>
<td>Problem analysis, Analyse interests of stakeholders, Role of every</td>
<td>Ecopower, Woonhaven, Infrax, Eandis, social planning</td>
<td>• Face-to-face interviews with stakeholders Kiel and energy policies Flanders (Energent, energy cooperative) in order to collect necessary information (Table 15)</td>
<td>Problem analyse</td>
</tr>
<tr>
<td>May 2014</td>
<td>stakeholder</td>
<td>department, Samenlevingsopbouw, Woonkantoor en</td>
<td>• Guided site visits</td>
<td>IDSS used: N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Opsinjoren, Energent</td>
<td>• Problem analysis: main issues (actor – institutional analysis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Stakeholder analysis: essential data for the case study, the role of every stakeholder, the use of ECODISTR-ICT, potential partners, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Four dynamics for urban renewal in the case study: individual dwelling retrofit, public space and social infrastructure, building block renewal and infrastructure management and energy providers</td>
<td></td>
</tr>
<tr>
<td>September 2014 -</td>
<td>Data collection</td>
<td>Municipality of Antwerp, Woonhaven, Infrax</td>
<td>Division in data typology in order to link data types, indicators and fields of interest: 1. GEOMETRIC AND SEMANTIC MODELLING OF BUILDING (volume, area, orientation): received from the municipality of Antwerp</td>
<td>Collect data</td>
</tr>
<tr>
<td>January 2015</td>
<td></td>
<td></td>
<td>2. BUILDINGS QUANTITIES AND RELATED STATISTICS (type of housing, materials, U value, roof shape, PV system technology, window glazing): received from Woonhaven</td>
<td>IDSS used: N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 SOCIO-ECONOMIC DATA (age, income, unemployment, family type): received from the municipality of Antwerp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. BUILDINGS USAGES (heating system, number of rooms, cooling system, water heating, ventilation, energy demand, energy cost): received from Infrax (Table 16)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5. CLIMATIC DATA (humidity, air temperature, solar irradiance, rainfall, wind speed and direction): online data from KMI, geopunt, buurtmonitor, etc.</td>
<td></td>
</tr>
<tr>
<td>November 2014</td>
<td>Opportunities and threats of the dynamics for urban renewal</td>
<td>Students urban planning, LUCA school of arts</td>
<td>After an on-site visit and lecture about the case study, the students were divided in groups and had to create a movie about energy transition in Kiel on different levels of scale: street, district and city level. A link was needed between theory, analysis and spatial design. The students interviewed some local residents in order to develop different proposals. Some examples are smart meters, big-scale restorations, the district as an energy plant that consumes but also produces energy, raising the awareness of the people of the energy issues, creating an energy ring, etc. (Figure 22)</td>
<td>Problem analyse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IDSS used: N</td>
<td></td>
</tr>
<tr>
<td>February 2015</td>
<td>extra data collection, feedback on current state of IDSS, main issues</td>
<td>Woonhaven and the municipality of Antwerp</td>
<td>First the progress and different steps were explained. Two workshops were proposed: one for the problem analysis and one for the evaluation (as-is and to-be). This was demonstrated with data from the Rotterdam case. The different processes that were done in 2014 were explained, such as the actor-institutional analyses. Discussions took place about the KPIs and some additional data were asked to the stakeholders, such as geometric and semantic data.</td>
<td>Problem analyse and data collection</td>
</tr>
</tbody>
</table>
This session was organized to collect internal feedback from their colleagues with focus on practical use in the Antwerp case and exploitation potential for their office. VITO demonstrated the Dashboard, MCMSMV-module and CS-module. Different discussions took place, talking about most relevant data and/or modules, what are the most important stakeholders, what is the role of OMGEVING in the process and for which projects the IDSS could be used? Data on energy-efficiency and use were the most relevant, while the modules have to be able to connect to existing databases and others to show financial impact of measures. People with a specific interest or aim in the neighbourhood are the key stakeholders, such as inhabitants, local associations, but also social housing company or private developer that wants to renew the district. There are many projects that can use the software, but then some different functionalities will be needed. For example a wide range of complex projects, the multi-criteria analysis is the most important functionality, in order to keep up with the complexity. Other projects can be projects focussing on sustainable transformation and/or monitoring, a masterplan, a specific research question about energy, etc. The government is often the client. A flexible software is the most interesting to keep up with the different projects, as well as the possibility to connect to different databases, other measures, software, etc.

| June 2015 | OMGEVING, VITO | This session was organized to collect internal feedback from their colleagues with focus on practical use in the Antwerp case and exploitation potential for their office. VITO demonstrated the Dashboard, MCMSMV-module and CS-module. Different discussions took place, talking about most relevant data and/or modules, what are the most important stakeholders, what is the role of OMGEVING in the process and for which projects the IDSS could be used? Data on energy-efficiency and use were the most relevant, while the modules have to be able to connect to existing databases and others to show financial impact of measures. People with a specific interest or aim in the neighbourhood are the key stakeholders, such as inhabitants, local associations, but also social housing company or private developer that wants to renew the district. There are many projects that can use the software, but then some different functionalities will be needed. For example a wide range of complex projects, the multi-criteria analysis is the most important functionality, in order to keep up with the complexity. Other projects can be projects focussing on sustainable transformation and/or monitoring, a masterplan, a specific research question about energy, etc. The government is often the client. A flexible software is the most interesting to keep up with the different projects, as well as the possibility to connect to different databases, other measures, software, etc. |
| February 2015 - ongoing | Data processing | The received data is in process. A 3D model was processed, as well as different maps containing EPC values, heating, cooling, electrical consumption, etc. (appendix). Different modules were compared in order to understand which modules are necessary for the Antwerp case. *(Figure 23)* |

Table 14: Table about the case study process of the Antwerp case
4. BUILDINGS USAGES

<table>
<thead>
<tr>
<th>Data</th>
<th>Possible values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of elevators</td>
<td>Positive integer</td>
<td></td>
</tr>
<tr>
<td>Number of apartments</td>
<td>Positive integer</td>
<td></td>
</tr>
<tr>
<td>Number of rooms</td>
<td>Possibly splitted by appartements</td>
<td>Positive integer</td>
</tr>
<tr>
<td>Number of bathrooms</td>
<td>Possibly splitted by appartements</td>
<td>Positive integer</td>
</tr>
<tr>
<td>Heating system</td>
<td>Collective</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For a single building, several heating systems may exist</td>
<td></td>
</tr>
<tr>
<td>Heating system energy</td>
<td>Electric</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heat pump</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distinct heating network</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biomass</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Heating system type</td>
<td>Local heating / water based</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High temp / water based</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low temp (e.g. underfloor heating / Hot air heating)</td>
<td></td>
</tr>
<tr>
<td>Heating system efficiency</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Water heating system</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Water system efficiency</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Cooling system</td>
<td>Collective</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td></td>
</tr>
<tr>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Cooling system efficiency</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Table 15: Interviews taken with different stakeholders

Table 16: A part of the data collection, representing their possible values and units
Figure 22: student workshop resulting in different posters

Figure 23: Data processing based on geopunt (AGIV) and “buurtmonitor”
5 CONCLUSIONS

This chapter provides cross-case conclusions and recommendations regarding the further design of the IDSS. Since the software has only been fully tested in two of the five case studies, these conclusions are preliminary. Nevertheless, they already provide insight into the possible role of the software in decision making processes for urban district renewal and the interactions between software and users.

5.1 STAKEHOLDER REQUIREMENTS AND SOFTWARE RESPONSE TOWARDS A TRULY INTERACTIVE ECODISTR-ICT IDSS

During interactions between the different ECODISTR-ICT partners and in deliverable D1.2, a number of requirements for a truly interactive and integrated decision-support system were formulated. These include:

- the need to be able to go back and forth between calculated results and KPI input, enabling different rounds of KPI input and of software mobilisation and thus of a collective definition of the KPIs that matter
- the need for interactivity between different calculations, automatic calculation and visualisation of changes in different parameters following changes in other parameters, touch screen functionality showing different maps at the same time, etc.
- the need to include a broad range of KPIs, move (far) beyond energy related issues, and combine complex issues like energy poverty, mobility, green spaces, public spaces, home ownership, affordability, etc.
- the need to support the definition and the inclusion of KPIs, and to make explicit both quantitative and qualitative KPIs in the IDSS, even though there may not be an automated calculation module (yet)
- the challenge to identify, integrate and develop calculation models or qualitative assessment tools for all KPIs that are identified by stakeholders, implying a need of rather complete sets of KPIs and high demands towards software availability and complexity
- the challenge to be able to mobilize the IDSS in situations where power among stakeholders is rather equally distributed (very exceptional, e.g. when there is only one actor mobilizing the software) and situations where there are power differences
- in the case of a top-down one-actor situation, the need to have a user-friendly IDSS
- in the case of true collective decision-making, the need to ensure emancipatory conditions of mobilization of the software, e.g. transparency on how KPIs are selected and calculated, data are selected and imported, calculation modules mobilized etc.
- the need to integrate the stakeholder-analysis and their definition of KPIs into the IDSS-supported process.

As a result of these requirements, decisions were taken in the course of the development process that affected the structure and functionality of the ECODISTR-ICT IDSS. Examples of these consequences include:
- the organization of the ECODISTR-ICT dashboard along decision-making steps (analysis problem, as-is, ambition, to-be, assess alternatives, compare alternatives) that are rather seen as *tracks* instead of *steps* and can thus be operated rather independently
- the possibility to run the IDSS both as an open collective process and as a black-box-like sum of individual inputs
- the possibility to create both quantitative and qualitative KPIs
- the possibility to collectively define the meaning of KPI values
- the decision not to include pre-defined sets of binary KPIs.

This is the reason that the IDSS is a ‘support’ system which helps to assess alternatives, rather than select a best alternative.

The question remains whether these responses suffice to address the requirements of the stakeholders, and whether they hold out in real decision-making processes. This is where the testing of the IDSS in the case studies becomes important.

### 5.2 Testing the IDSS

The testing process of the ECODISTR-ICT IDSS is an intricate process, beyond theoretical testing or mere demonstrations for stakeholders. It involves:

- the assessment of stakeholders’ expectations regarding an integrated IDSS, using interviews and a survey, as reported in D1.1
- the making of a dashboard mock-up and the organization of several – oral and written - feedback sessions and responses with the ECODISTR-ICT WP5 partners, as well as with ECODISTR-ICT stakeholders
- the making of a demo version of the dashboard and the organization of several – oral and written - feedback sessions and responses with the ECODISTR-ICT WP5 partners and with ECODISTR-ICT stakeholders, e.g. in the Valencia Stakeholder Advisory Board meeting
- the making of a wish list of desired functionalities of the IDSS, both for the dashboard and for the connected modules
- the organization of feedback sessions within the ECODISTR-ICT consortium on this wish list
- the instigation of decision-making processes in the five ECODISTR-ICT case studies, as reported in D5.1, D1.2 and D5.2
- the partial use of elements of the different versions of the IDSS in different types of dry-runs, workshops and meetings
- the preparation of stakeholder workshops through collecting data, preparing calculation modules and designing alternatives
- the organization of full demonstration and feedback sessions with stakeholders
- the ultimate full testing of the IDSS in concluding workshops with stakeholders, mobilizing all functionalities.
The reports of the different cases studies in this deliverable D5.2 mainly concern the last stages of the testing of the IDSS. To draw full conclusions we must however look at the full spectrum of testing modes.

5.3 **Recommendations regarding development of the IDSS**

Conclusions in this section sum up priorities for the software developers of the IDSS. They should be read together with the wish list and priority list, as prepared during and processed after the ECODISTR-ICT meetings in Valencia (December 2014) and Stockholm (November 2015).

5.3.1 **Lessons for WP1: stakeholders and scenarios**

The main lessons for WP1 relate to the task of translating ambitions and priorities of stakeholders and the community into KPIs, alternatives and variants that can be inserted in the IDSS.

Defining KPIs and assigning priorities and ambitions to them, proved to be a complex task. Competent facilitators (both process-wise as technical-wise) are essential and a careful preparation is necessary. Points of attention include the following.

- The number of KPIs. The optimal number of KPIs is still open for debate. Stakeholders in the Valencia case pointed out that the number of KPIs used was too limited and important KPIs such as those related to socio-demographics and costs were missing. This contrasts with the case in Rotterdam, were a maximum of five KPIs per stakeholders was advised.
- Definition and nature of KPIs. A clear definition of KPIs is a prerequisite. Furthermore, the fact that new KPIs can be inserted in the IDSS was considered as very valuable, especially when qualitative KPIs are introduced next to quantitative KPIs. However, this could make the process more complex and time consuming. The following examples illustrate this:
  - qualitative KPIs: when introducing qualitative KPIs, an appropriate rating system has to be considered and agreed upon with the stakeholders as well
  - quantitative KPIs: using quantitative KPIs that are calculated externally or by expert judgment, limits the level of interaction of the IDSS (as each modification will need a manual recalculation)
- Weighting and ambition levels of KPIs. The fact that stakeholders are able to set their ambition and priority levels individually, improved their engagement and involvement in the process.

Regarding the ability to compose alternatives, stakeholders pointed out that the IDSS is very useful for this purpose, although a design module that makes it possible to edit or compose alternatives on their own is still lacking. The same can be said regarding composing and customizing variants: while the components for this feature are not fully developed yet, the current version of the IDSS already allows it to compose alternatives and variants - as illustrated in the Valencia case, where three alternatives were used: “conservative”, “standard” and “optimistic”.

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Integrated decision support tool for retrofit and renewal towards sustainable districts

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5.3.2 Lessons for WP2: data collection

The data collection process in Valencia clearly illustrated that this is a very intensive process. Improvements can be made regarding data validation, as the IDSS’s facilitators currently have limited capacities to verify the quality of uploaded data in modules.

Based on the experience of the data collection in Valencia, we recommend to develop templates (for each module or type of data) to facilitate the process of data collection and data validation. These templates could provide specific information on the kind of data that have to be collected as well as the data format.

5.3.3 Lessons for WP3: support modules

The need for a design module was already pointed out in previous sections. Main recommendations in this section relate to the connected calculation modules. Although only a limited number of calculation modules were connected to the IDSS in the case study of Rotterdam, this number increased in the case study of Valencia. It should however be pointed out that not all the modules are suited for the next cases (see overview in Table 17).

<table>
<thead>
<tr>
<th>Module</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIMOSIM</td>
<td>Integration to the IDSS’s framework has to be improved</td>
</tr>
<tr>
<td>SOCIAL SERVICES</td>
<td>Stand-alone module has to be developed further</td>
</tr>
<tr>
<td>VABI</td>
<td>Suited for Dutch context, adaptations might be necessary for other contexts</td>
</tr>
<tr>
<td>RAYMAN MODEL</td>
<td>Too complicated to couple to IDSS</td>
</tr>
</tbody>
</table>

Table 17: Recommendations for selected modules

The LCA, Green and the CS modules have proven to be useful for next cases but rely on the quality of collected data.

5.3.4 Lessons for WP4: integrated decision support tool

As already pointed out earlier, all features regarding the visualization of the as-is and to-be situations are highly appreciated by stakeholders. This relates both to map visualizations (using the Common Sense module) as intuitive graphs and figures in the dashboard and the MCMSMV module. Therefore, further improvements on these aspects are recommended.

The Rotterdam and Valencia case already provided useful feedback and improvements for the Dashboard. Further testing will likely lead to additional improvements related to visualizing KPI scores (e.g. scales, rating), entering KPI ambitions and weights.

However, it still proved to be difficult to interpret the MCMSMV module and to compare results. Optimal representations of the MCMSMV module remain to be tested in practice.
5.4 **RECOMMENDATIONS REGARDING THE USE OF THE IDSS**

Although preliminary, the testing of the ECODISTR-ICT IDSS enables reflections on the future use of the software.

### 5.4.1 Preparing the IDSS

The processes in Rotterdam and Valencia reveal that an **intensive preparation phase** is required prior to or in parallel with using the IDSS in practice. This is not only true for the planning and organisation of the workshops, but also for the necessary desk research, such as data collection (Valencia), preparing the process of defining and evaluating KPIs, generating alternatives, etc. Dedicated meetings with expert stakeholders are very valuable for this purpose, as already pointed out.

### 5.4.2 Involving different stakeholders

The ways of involving (or not involving) different stakeholders in the process has a large impact on the results of the workshops. In the case of Rotterdam and Valencia, the majority of participants in the sessions are policy makers, knowledge partners and civil society. What would be the effect if - for instance - industrial parties were better represented? In that respect, the case in Warsaw could lead to interesting insights.

When looking at the stakeholder groups in the sessions of Rotterdam and Valencia, we notice a general sense of consensus among the involved actors. This raises the question what the impact is on the process and the results in cases where ambitions and priorities of stakeholders collide with each other?

Also, the composition of the stakeholder group is likely to be subject to change. Especially for new participants, intermediate introduction sessions might be necessary in order to engage them efficiently in the process.

### 5.4.3 Defining roles

One of the main tasks of the process facilitator, is to ensure that stakeholders stay motivated during the process by careful planning of efficient and dedicated workshops. Therefore, it is recommended to organize the workshops within a fixed timeframe. Nevertheless, the composition of the stakeholder group is likely to be subjected to change. Especially for new participants, introduction sessions might be necessary in order to engage them efficiently in the process. Furthermore, it should be taken into account that stakeholders have different levels of expertise or engagement that might have an effect on the optimal number of workshops or required effort from the stakeholders.

The technical facilitator provides the required input (i.e. upload of collected data) and configures the IDSS (i.e. definition of KPIs, configuration of modules, generating alternatives and variants). This includes the validation of the results in cooperation with the process facilitator and to verify the
data, modules, KPIs, etc. if necessary. In other words, the testing shows that the technical facilitator should employ an iterative approach. Furthermore, specific technical knowledge regarding the IDSS (and its components) is recommended, in order to quickly identify issues and to steer the development process if needed. For instance, in the Rotterdam case where an early version of the IDSS was used, the problem-solving capacities of the technical facilitator played an important role during the test sessions.

Together, the technical and process facilitators translate the wishes and needs of the stakeholders into the IDSS, which supports the stakeholders in interpreting the final results. This not only requires thorough knowledge of the district and the IDSS by the process and technical facilitator, but also a good communication between the two. Direct contact is essential and is recommended. This is clearly illustrated in the cases of Rotterdam and Valencia.

Finally, it remains to be seen in the next test cases, whether the complexity of the process and/or the software allows that these two profiles can be combined into one (i.e. one person that could both steer the process with the stakeholders and handle the IDSS).

5.4.4 Enabling stakeholder interaction

So far, the IDSS has been used as a discussion support tool instead of a decision support tool. This was illustrated both in the case study of Rotterdam and in the case study of Valencia. An important achievement of the IDSS is the fact that it facilitates communication between the stakeholders and stimulates debate. Stakeholders get insight in the ambitions and priorities of other stakeholders, beyond their own field of expertise. The results of the IDSS are important triggers for group discussions. The importance of the results itself, are less emphasized by the stakeholders, while the fact that both quantitative as qualitative KPIs can be integrated in the IDSS was highly valued.

That the IDSS proved useful in supporting stakeholder interaction, is nicely illustrated in the fact that in Rotterdam as well as in Valencia, stakeholders were looking to continue the cooperation, even after the last test-sessions. Moreover, they were interested to see the results of the other cases (for instance, the stakeholders in Rotterdam are curious about the experiences of the stakeholders in Antwerp).

As such, the test sessions illustrate that the IDSS has its value as a support tool in interdisciplinary district renewal and that there is a clear interest among involved stakeholders in the tool. The question remains whether the next cases can mobilise its full capacity to support decision-making.

5.4.5 Varied use of the IDSS during the decision-making process

In the use of the IDSS, different types of sessions are necessary, in which the IDSS can be mobilized to different extents. This fact was also pointed out by the facilitators in the Rotterdam case, who noted that at least one session without the IDSS is needed prior to the final test session. But in reality, one preparatory session does not seem sufficient. In Rotterdam for instance, multiple workshops have taken place in a period of 12 months prior to the final test session. In the case of
Valencia, even more sessions were needed and in total nine sessions (without the IDSS) preceded the final test session in a period of 22 months.

Moreover, the topics for each session are chosen deliberately and follow a step-by-step approach. Essentially, the structure of the decision-making process that is structured in the IDSS is followed.

Furthermore, a variety of formats for interaction are used.
- Workshops with a broad audience such as social actors or inhabitants. These workshops have an exploratory nature and the objective is to make an inventory of area characteristics ("getting-to-know-the-neighbourhood"), key actors, main issues, etc. Therefore, the use of the IDSS is not a prerequisite. Examples: workshop with inhabitants in Valencia or a student workshop in Antwerp.
- Focused (bilateral) meetings in a small group with experts. The purpose is to gather feedback and support on the definition of KPIs, alternatives, scenario building and data collection. Example: Meetings in Valencia with energy experts.
- Sessions with dedicated stakeholders. Interactive sessions where the results of the IDSS and the ambitions and priorities of stakeholders are discussed. Examples: closing sessions of Rotterdam and Valencia with IDSS.

However, to ensure that stakeholders remain motivated during the process, it is recommended to organize the workshops within a fixed timeframe.

5.4.6 Processing results

The IDSS is a decision support tool. As a consequence, the accuracy and reliability of the results are very important, as well as a good visualization functionality. The current versions of the IDSS can still be improved (in particular regarding the data collection process and module connections). In addition, interpreting the results of the IDSS still requires some expertise, as a reporting functionality is still under development and working with KPIs remains an abstract and therefore difficult exercise. An improved visualization can support a better understanding of the results and provide the necessary context for decision-makers in order to support the decision-making process.

Furthermore, it should be taken into account that stakeholders have different levels of expertise or engagement that might have an effect on the optimal number of workshops or required effort from the stakeholders.

5.5 The making of an instrument

In the making of the ECODISTR-ICT IDSS, partners of different backgrounds meet, including software developers, process facilitators, urban designers, engineers, natural scientists, social scientists, etc. This could enable a self-reflection on the interaction between case study partners and software partners, and the extent to which methodological holist and methodological individualist approaches are merged (or not) in a new framework. This could be further elaborated in the next deliverable.
REFERENCES


Arup (2014), *FP7 Ecodistrict, WP05 Traffic counts report, version 1.0*.


ANNEX A – USERS’ MANUAL

DETAILED PROCESS OF THE VALENCIA CASE

1. Case Study Area - Analyse Problem

The area of study covers a small part of the District of Campanar. The area of study covers a total area of **14 ha**. The study includes a total of **53 buildings**, which date from 1930 to 2004. The majority of these buildings (80%) are apartment blocks that were built during the **70s-80’s**. The rest of the buildings were built either before 1970 or later than 1990 and except for one commercial building, all of them are apartment blocks. There are a total of 1616 residential units of an average surface of 100sqm.

The firsts workshops held during the Case Study in Campanar had the objectives of knowing each other and setting up a work group (CSRG), as well as knowing in depth the problems of the study area. Presentations prepared for the workshops, outcomes, and minutes can be found in the share point:

(https://esites.vito.be/sites/ecodistrict/WP5casestudiesOMGEVING/WP5_case5_Vaencia/T5-1_case_studies_preparation/Workshops)
A summary of the problems and ambitions are summarized in this table:

<table>
<thead>
<tr>
<th>Problems</th>
<th>Ambitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GREEN AREAS. Disappearance of local agriculture. Lack of &quot;natural&quot;</td>
<td>1. TO INCREASE AND PROTECT GREEN AREAS. Empowerment of local agriculture.</td>
</tr>
<tr>
<td>spaces. Worsening air quality. Lack of soil permeability. Lack of</td>
<td>Promotion of local products. Connecting the city with the gardens.</td>
</tr>
<tr>
<td>hydration, even if there is lots of water available in the city due to</td>
<td>Promoting urban gardens. Maintenance. Large green spaces act as the lungs</td>
</tr>
<tr>
<td>old waterways that have been placed underground. Heat stress in the</td>
<td>of the city. Natural greenery.</td>
</tr>
<tr>
<td>area due to lack of green area and shadows.</td>
<td></td>
</tr>
<tr>
<td>2. DEGRADATION OF HISTORICAL HERITAGE. Heritage disappearance. Lack of</td>
<td>2. SOCIAL INTERACTION AND USE OF COMMONAL AREAS. Young population mixed</td>
</tr>
<tr>
<td>Aids. Memory Loss of the neighbourhood facts.</td>
<td>with the old population. No more ghetto within the neighbourhood.</td>
</tr>
<tr>
<td>3. PUBLIC SPACE. Lack of maintenance and care. Lack of individual</td>
<td>3. PROXIMITY TO PUBLIC FACILITIES AND PUBLIC SERVICES. Civic Centre.</td>
</tr>
<tr>
<td>private financing. Public space dominated by parked cars and streets</td>
<td></td>
</tr>
<tr>
<td>for cars. Lack of pedestrian streets and quality open areas.</td>
<td></td>
</tr>
<tr>
<td>4. MOBILITY. Priority to traffic. Highway checkerboard that divides the</td>
<td>4. SOCIAL AND ECONOMIC BOOST. Promoting local commerce. Recover</td>
</tr>
<tr>
<td>district. Increased noise pollution. Architectural barriers. Accidents</td>
<td>commercial activity on the streets. Public-private financing well</td>
</tr>
<tr>
<td>No link with the rest of the city.</td>
<td>understood. Diversification of urban space.</td>
</tr>
<tr>
<td>5. HOUSING. Little care and maintenance of housing (individual and</td>
<td>5. HERITAGE PROTECTION. Other uses for local heritage buildings.</td>
</tr>
<tr>
<td>Housing Associations. Energy poverty. Lack of interest in energy</td>
<td></td>
</tr>
<tr>
<td>retrofitting by the neighbours. Buildings in need of retrofitting in</td>
<td></td>
</tr>
<tr>
<td>the following years.</td>
<td></td>
</tr>
<tr>
<td>6. PUBLIC SERVICES AND PUBLIC FACILITIES. Lack or absence. Large &quot;</td>
<td>6. ENHANCE MOBILITY AND CONNECTION. Leverage proximity and links with</td>
</tr>
<tr>
<td>urban equipment&quot; bringing problems: new stadium. The unused former</td>
<td>the city centre. Increased pedestrian zones and bike lanes. Improving</td>
</tr>
<tr>
<td>Civic Centre. Lack of places to meet.</td>
<td>Removal of architectural barriers. The neighbourhood well connected</td>
</tr>
<tr>
<td>7. LOSS OF SMALL BUSINESSES. Saturation of large shopping centres.</td>
<td>to the city. Traffic reduction.</td>
</tr>
<tr>
<td>Disappearance of the small commercial activity on the street.</td>
<td></td>
</tr>
</tbody>
</table>

2. Definition of KPIs and KPIs used in the Case Study

After long lists of indicators elaborated together with the stakeholders (https://esites.vito.be/sites/ecodistrict/WP5casestudiesOMGEVING/WP5_case5_Valencia), a selection of a small number of KPIs to be tested in the case study was done. The following table shows the KPI tested, the calculation module used (in brackets) and their definition:
<table>
<thead>
<tr>
<th>MODULE</th>
<th>KPI</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY (Dimosim)</td>
<td>Total Energy Consumption (kWh/m2) (District and Building Level)</td>
<td>Objective: Evaluate improvements in terms of climate impact of a renovation scenario and enable comparison to other renovation options. Description: The indicator refers to change in global warming potential in tonnes of CO2 per m² of heated area. It includes a lifecycle perspective, taking into account materials for renovation, changes in yearly energy consumption, changes in how heating is produced and finally the end of life treatment of the material. The indicator represents a change in global warming potential caused by a renovation scenario compared to a reference case where no renovation is made. A decrease in global warming potential is represented by a negative value of the change. (Calculations are made in the Renobuild tool, which is based on selection of predefined renovation measures and includes environmental data on various materials used in renovation and on energy production. The data on material mainly represent a European context and the energy data includes selections of country specific electricity mixes and selections for other heating energy.)</td>
</tr>
<tr>
<td>ENERGY (Dimosim)</td>
<td>Total Energy Consumption for heating (kWh/m2) (District and Building Level)</td>
<td></td>
</tr>
<tr>
<td>ENERGY (Dimosim)</td>
<td>Percentage of Renewable Energy (%)</td>
<td></td>
</tr>
<tr>
<td>LCA (Renobuild)</td>
<td>Change of Global Warming Potential per heated area (tonnes of CO2 emissions)</td>
<td>Objective: Evaluate improvements in terms of climate impact of a renovation scenario and enable comparison to other renovation options. Description: The indicator refers to change in global warming potential in tonnes of CO2 per m² of heated area. It includes a lifecycle perspective, taking into account materials for renovation, changes in yearly energy consumption, changes in how heating is produced and finally the end of life treatment of the material. The indicator represents a change in global warming potential caused by a renovation scenario compared to a reference case where no renovation is made. A decrease in global warming potential is represented by a negative value of the change. (Calculations are made in the Renobuild tool, which is based on selection of predefined renovation measures and includes environmental data on various materials used in renovation and on energy production. The data on material mainly represent a European context and the energy data includes selections of country specific electricity mixes and selections for other heating energy.)</td>
</tr>
</tbody>
</table>
| THERMAL STRESS (Rayman Model) | Heat Stress in Summer (PET Index, ºC)                               | Objective: Identify potential thermal comfort for a pedestrian in the public space, in terms of useful hours throughout the day. Description: The indicator refers to the percentage of hours between 8hrs and 22hrs where a street provides adequate thermal comfort conditions for a person to walk. Thermal comfort considers: he weather, the morphology of the streets, pavements and facade materials, the presence of vegetation and metabolic functioning. The indicator is expressed as a percentage of hours of comfort for 15 useful hours a day. From the climatic characteristics of the place, the potential for summer comfort for each type of section is calculated through a simulation heat transfer program by finite elements. For each city will have to determine the most critical season (winter or summer). The thermal comfort analysis classifies sections in the following categories:  
  • Potential excellent comfort (> 80% => 12 hours a day)  
  • Potential for good comfort (66% to 80% = 9-12 hours a day)  
  • Potential enough comfort (50% to 66% = 7.5 to 9 hours per day)  
  • Insufficient comfort potential (35% to 50% = 5-7.5 hour)  
  • Potential for summer comfort very poor (<35% = <5 hours a day).  

Thermal comfort (%) in summer = public surface with a comfort potential of more than 50% in summer (over 7.5 hour) / total public surface. *Comfort is calculated following the PET Index (Physiological Equivalent temperature in degrees Celsius), which is the thermal perception of the person. |
| Green (Berlin Version) | Biotope Area Factor (BAF) | Objective: Sealing and waterproofing (impervious soil) massively slows down the possibility of plant life and of emergence of multitude of dependent organisms. On the other hand, it involves changes in the hydrological cycle, in urban microclimate and in air pollution.  
Description: Biotope Area Factor indicates the relationship between the areas significant for the natural cycle of the soil and the total area of the study. A factor is assigned to each piece of land according to the degree of naturalness and permeability:  
- Soils with permeable surfaces. They are found in their natural state, without compacting. They keep all their natural functions. They have vegetation or offer conditions so that it can be developed. Commonly found in parks, gardens, flowerbeds, farmland, forests, etc. Lakes and rivers are considered permeable.  
- Soils with semipermeable surfaces. Soils, which without being in their natural state partially, maintain their functions. These are generally pavement or surfaces that allow the passage of air and water. They have lost all or part of the biological function. For example, land plots and vacant lots.  
- Green roofs. Vegetal substrates incorporated into the roofs of buildings. Extensive or intensive type.  
- Sealed surfaces. It can be built or not. Without structure and associated natural functions.  
BAF Index = \[ \sum (\text{factor of soil permeability} \times \text{area}) / \text{total area} \] |
| GREEN | Green Spaces per capita \((\text{m}^2 \text{ of green space/person})\) | Green surface \((\text{m}^2)\)/number of inhabitants |
| SOCIAL SERVICES | Proximity of the population to basic services \( (\% \text{ population covered}) \) | Objective: To have basic urban services such as public facilities, public transport networks, business proximity and green spaces, less than 10 minutes' walk (600m).  
Description: The degree of accessibility is evaluated based on four types of basic services considered.  
Basic Public Facilities (<600m): Educational, cultural, sport, health and social wellbeing. (5 services)  
Proximity commercial activities (<300m): bakery, meat products, fruit-vegetables, fish, supermarket, pharmacy, press, and other small commerce products. (8 services)  
Mobility networks (<300m): bus stops, bicycle network, and pedestrian network. (3 services)  
Green Spaces (<200m): Stay green spaces > 1ha (1 service).  
Proximity to services \( (\%) \) = \((\text{population with simultaneous coverage to 4 of the 5 basic public facilities, 6 of the 8 nearby commercial services, 2 of the 3 mobility services, and the service of green space / total population})\) |
3. **Data Collection**

In order to assess the As Is situation as well as the proposed alternatives, specific data was needed to do the calculations. First it was evaluated the data needed, the format and the level of detail and after this the local team has gathered the data in different ways. In the case of Campanar, data can be classified in two groups as it is summarized in the table below:

<table>
<thead>
<tr>
<th>Already existing data (City Data)</th>
<th>Data collected on the field or estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>- Year of construction</td>
</tr>
<tr>
<td></td>
<td>- Total area</td>
</tr>
<tr>
<td></td>
<td>- Building height</td>
</tr>
<tr>
<td></td>
<td>- Climate data</td>
</tr>
<tr>
<td></td>
<td>- Building shape (Cad file)</td>
</tr>
<tr>
<td></td>
<td>- Window ratio (%)</td>
</tr>
<tr>
<td></td>
<td>- Building properties: U values, energy systems, etc. (estimated by the year of construction)</td>
</tr>
<tr>
<td><strong>LCA</strong></td>
<td>- Energy mix</td>
</tr>
<tr>
<td></td>
<td>- Heating source before renovation</td>
</tr>
<tr>
<td></td>
<td>- Heating source after renovation</td>
</tr>
<tr>
<td></td>
<td>- Type of insulation for renovation</td>
</tr>
<tr>
<td></td>
<td>- Type of façade system for renovation (etc.)</td>
</tr>
<tr>
<td><strong>Green</strong></td>
<td>- Surface areas (m²): provided in the format of CAD files.</td>
</tr>
<tr>
<td></td>
<td>- Type of surface area (permeable, semi-permeable, sealed, etc.)</td>
</tr>
<tr>
<td><strong>Heat Stress</strong></td>
<td>- Position of trees (coordinates): public city data</td>
</tr>
<tr>
<td></td>
<td>- Species of trees (specie): public city data</td>
</tr>
<tr>
<td></td>
<td>- Geometry of tree (diameter of trunk, diameter of crown, height of trunk, height of tree)</td>
</tr>
<tr>
<td></td>
<td>- Fisheye images (.png)</td>
</tr>
<tr>
<td><strong>Social Services</strong></td>
<td>- Existing Public Facilities (coordinates) and type (health, education, wellbeing, social, etc.)</td>
</tr>
<tr>
<td></td>
<td>- Bicycle network</td>
</tr>
<tr>
<td></td>
<td>- Pedestrian paths</td>
</tr>
<tr>
<td></td>
<td>- Mobility (bus stops)</td>
</tr>
<tr>
<td></td>
<td>- Type of commercial activity (bakery, meat, fruit &amp; vegetables, pharmacy, etc.).</td>
</tr>
<tr>
<td></td>
<td>- Coordinates of commercial activity</td>
</tr>
</tbody>
</table>
Example of database of building properties for the energy module.

Example of façade image collection for estimating window ratio.
4. **As Is Situation**

In order to assess the as-is situation calculations have been made for each KPI. In the following image we can see the results of each KPI for the current situation of the area of study:

**Energy**: The different colours for the Energy KPI are related to their building age. Buildings in blue were built after 1981 with the building code NBE-79, and buildings coloured in pink were built before that year. The overall result is a total energy consumption per m$^2$ of 113,7kWh/m$^2$.

**Change of Global Warming Potential**: The current situation is the comparison scenario, so it is set to 0.

**Biotope Area Factor**: The as-is situation has 17.089 m$^2$ of permeable green surface and 118.960m$^2$ of sealed surface. As a result the current situation has a BAF of 0,12.

**Green space/capita**: 4,1 m$^2$

**Heat Stress in summer (PET °C)**: The maximum simulated PET temperature is 47°C in the main square of the study area.

**Cold Stress in winter (PET °C)**: The minimum simulated PET temperature is 9°C in the main square of the study area.

**Proximity to social services (%)**: Based on visualization and influence radius of each service, it has been estimated that 80% of the population is covered by basic services.
5. **To Be**

Stakeholders were grouped in four main teams in order to assign weights and to set ambitions. This task was performed in specific meetings and put in common in the final demonstration session held in October. Each group was limited to select only five KPIs in order to keep the process simple, to draw conclusions. The results are summarized in the following table:

<table>
<thead>
<tr>
<th>KPI</th>
<th>Stakeholder Group</th>
<th>Weight</th>
<th>Ambition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Renewable Energy (%)</td>
<td>IVACE Energy Agency</td>
<td>5</td>
<td>25%</td>
</tr>
<tr>
<td>Final Energy Consumption for Heating (kWh/m²)</td>
<td>IVACE Energy Agency</td>
<td>3</td>
<td>40kWh/m²</td>
</tr>
<tr>
<td>Total Final Energy Consumption (kWh/m²)</td>
<td>IVACE Energy Agency</td>
<td>5</td>
<td>70kWh/m²</td>
</tr>
<tr>
<td>Change of Global Warming Potential per heated area (CO₂eq/m²)</td>
<td>IVACE Energy Agency</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Proximity of the population to basic services</td>
<td>IVACE Energy Agency</td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td>Thermal Stress Summer</td>
<td>Municipality. Department of Parks and Gardens</td>
<td>5</td>
<td>13 °C PET</td>
</tr>
<tr>
<td>Thermal Stress Winter</td>
<td>Municipality. Department of Parks and Gardens</td>
<td>1</td>
<td>32 °C PET</td>
</tr>
<tr>
<td>Green Area per capita</td>
<td>Municipality. Department of Parks and Gardens</td>
<td>2</td>
<td>24m²/person</td>
</tr>
<tr>
<td>Biotope Area Factor</td>
<td>Municipality. Department of Parks and Gardens</td>
<td>5</td>
<td>0,5</td>
</tr>
<tr>
<td>Proximity of the population to basic services</td>
<td>Municipality. Department of Parks and Gardens</td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>Percentage of Renewable Energy (%)</td>
<td>Municipality. Department of Urbanism</td>
<td>3</td>
<td>25%</td>
</tr>
<tr>
<td>Thermal Stress Summer</td>
<td>Municipality. Department of Urbanism</td>
<td>4</td>
<td>34 °C PET</td>
</tr>
<tr>
<td>Change of Global Warming Potential per heated area (CO₂eq/m²)</td>
<td>Municipality. Department of Urbanism</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Green Area per capita</td>
<td>Municipality. Department of Urbanism</td>
<td>2</td>
<td>24 m²/person</td>
</tr>
<tr>
<td>Proximity of the population to basic services</td>
<td>Municipality. Department of Urbanism</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>Percentage of Renewable Energy (%)</td>
<td>Architects, Engineers and Neighbours</td>
<td>4</td>
<td>25%</td>
</tr>
<tr>
<td>Total Final Energy Consumption (kWh/m²)</td>
<td>Architects, Engineers and Neighbours</td>
<td>3</td>
<td>70kWh/m²</td>
</tr>
<tr>
<td>Green Area per capita</td>
<td>Architects, Engineers and Neighbours</td>
<td>5</td>
<td>7m²/capita</td>
</tr>
</tbody>
</table>
6. Assessment of Alternatives

Different proposals were made during the workshops and meetings to improve the as-is situation and to meet the ambitions set. Those alternatives were grouped individually for each KPI in three future scenarios: a conservative scenario, a standard scenario and an optimistic scenario.

a. Conservative Scenario:

**Energy**: Buildings, which are around 50 years old will be retrofitted. The will replace their envelop (façade and roofs) for better energy performance façade and roof systems. Besides, 20% of the windows are changed randomly for better performing ones, as well as 20% of the boilers are replaced for high efficient boilers.

**Change of Global Warming Potential**: In order to reduce the global warming potential, the renovation of these facades will take into account the carbon footprint and the life cycle of the materials used.

**Biotope Area Factor**: The area of permeable surface has been increased, obtaining an improved BAF of 0,12.

**Thermal Stress**: No measures are taken to improve urban microclimate.

**Proximity to basic services**: No measures are taken to improve the coverage of basic services.
b. Standard Scenario:
**Energy:** Buildings coloured in the image below replace their envelop (walls and roof) for better energy performance façade and roof systems. The buildings in blue not only replace their envelop but also install solar thermal collectors for DHW. Besides this, 30% of the windows are changed randomly for better performing ones, as well as 30% of the boilers are replaced for high efficient boilers.

**Change of Global Warming Potential:** In order to reduce the global warming potential, the renovation of these facades will take into account the carbon footprint and the life cycle of the materials used.

**Biotope Area Factor:** The area of permeable surface has been increased, as well as the parking spaces have replaced their surface for semi-open surface. Some green roofs are implemented.

**Thermal Stress:** No measures are taken to improve urban microclimate.

**Proximity to basic services:** No measures are taken to improve the coverage of basic services.

c. Optimistic Scenario:
**Energy:** Buildings coloured in the image below replace their envelop (walls and roof) for better energy performance façade and roof systems. The buildings in blue not only replace their envelope but also install solar thermal collectors for DHW. Buildings in green colour not only replace their envelopes, but also install common heat pumps and cooling machines. The
Besides this, 30% of the windows are changed randomly for better performing ones, as well as 30% of the boilers are replaced for high efficient boilers. The group of orange buildings install a common heating system based on a common biomass boiler besides replacing their building envelops.

**Change of Global Warming Potential:** In order to reduce the global warming potential, the renovation of these facades will take into account the carbon footprint and the life cycle of the materials used.

**Biotope Area Factor:** The area of permeable surface has been increased, as well as the parking spaces have replaced their surface for semi-open surface. Some streets replace their concrete sealed surface for porous concrete. Green roofs are implemented as much as possible.

**Thermal Stress:** measures to reduce heat stress are taken in the triangular square. 100 trees are planted of native species with properties of refreshing the air due to their evapotranspiration characteristics. Besides, green pavement surface is implemented as much as possible. Green facades are also included, as well as shading structures. Water features are also implemented.

**Proximity to basic services:** No specific measures are proposed, but it is intended that the necessary measures will be taken in order to cover 100% of the population with the basic public services.

7. **Comparison of Alternatives**

The final step in the ECODISTR-ICT tool is the comparison of scores among alternatives and among stakeholders. It is a useful feature in order to know what group of alternatives achieves a better final score. The MCMSMV tool was useful to show the different scores for each stakeholder and for each alternative. The selection of KPI’s was a limited quantity (only five KPIs could be selected by
stakeholder). The stakeholders selected different KPIs, but it was difficult to make overall comparisons and have a clear view on the results. Nevertheless, the tool is useful to see these differences and to generate debate in order to reach a consensus on the decisions to make.