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Sustainable MED Cities

Integrated tools and methodologies for sustainable Mediterranean cities

Activity 4.1.1

Decision Making Methodology for Sustainable Cities

This project has received funding from the European Union's ENI CBC Med Programme under Grant Contract C_B.4.3_0063

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Executive Summary

This document describes a decision-making methodology to prepare the optimal retrofitting concept for a urban area and single buildings belonging to it.

The methodology is mainly addressed to municipalities with the intent to raise their capacity to deploy effective and high impact plans and programs to raise the sustainability of the bult environment.

The decision-making methodology is based on the use of the assessment tools SNTool, (urban scale) and SBTool (building scale).

The process adopts a participatory approach to maximise the involvement of stakeholders in the preparation of the retrofit concept. The participatory approach follows the PGS methodology (Participatory Guarantee System).

The decision-making methodology is articulated in a series of consecutive stapes that starting from a diagnosis of the current state of a urban area and buildings, will guide a Team in the preparation of the optimal retrofitting concept.

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ACRONYMS	
SBTool	Sustainable Building Tool
SNTool	Sustainable Neighbourhood Tool
MED	Mediterranean
DX.X.X	Deliverable X.X.X
SMC Team	Sustainable MED Cities team
LPC	Local Project Committee
S.MED.Cities	Sustainable MED Cities project
GF	Generic Framework

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Introduction

The sustainable retrofit of urban areas is a challenging task requiring careful planning and high level of engagement between all stakeholders throughout the different phases of the process to ensure that the expected targets are meet and that the project is financially, environmentally and socially successful.

At urban scale, the complexity of a retrofitting project is very challenging due to the high number of variables consider and the number of stakeholders involved. With an absence of clear and well-structured methodology guiding throughout this complex task, the chances of realizing an efficient urban scale retrofitting project decreases and only individual solution at the single building scale would be implemented.

In an urban scale project, the initial identification of the optimal retrofitting concept is critical because it will be the foundation of the full retrofitting process. Wrong assumptions in early stage of the planning process or would lead to a failure.

This document describes a decision-making methodology, based on the use of the Sustainable MED Cities assessment system (SBTool, SNTool – see D3.1.1), to guide in finding the most effective sustainable retrofitting concept in urban projects with regard to cost efficiency and the overall sustainability performance.

The decision-making methodology is intended to support the municipality from the early initiation of the project to the preparation of the **retrofitting concept that will identify the optimal package of interventions to improve the sustainability of an urban area.**

The proposed decision-making methodology foresees **the possibility to combine the study of a retrofitting for a urban area with the study of retrofitting concepts for single buildings** located in the same urban area. This multi-scale approach makes possible to take the surrounding urban area into consideration when engaging a building retrofitting project opening the doors for new cost effective and efficient retrofitting options, as at the urban level the synergies effect between the buildings can be exploited resulting into a win-win situation for the urban area as whole and for its single buildings.

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The decision-making methodology articulated in 7 phases, that are described in the following sections of the document:

1. Initiation
2. Preparation
3. Diagnosis
4. Strategic definition
5. Retrofit scenarios
6. Decision making
7. Retrofit concept

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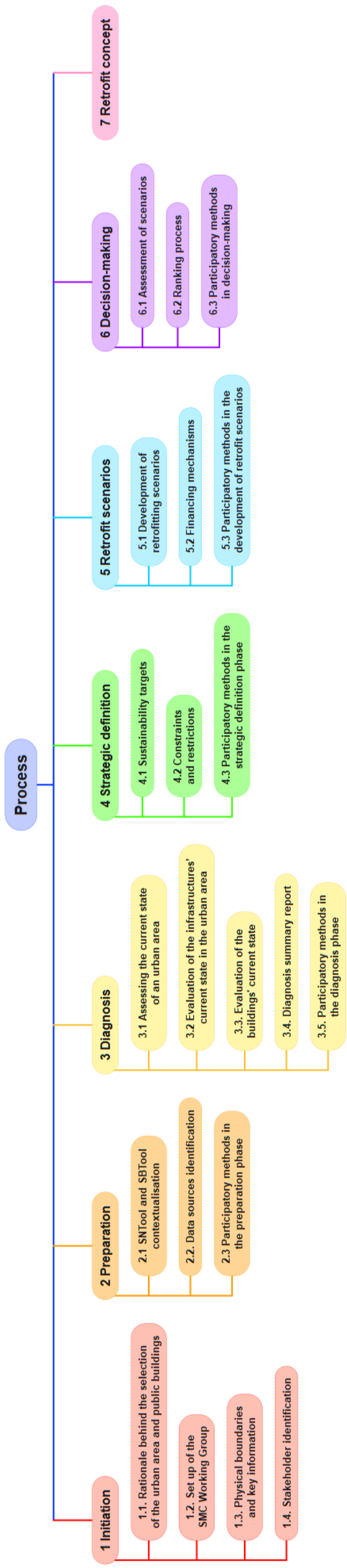

Fig. 1, Phases of the decision-making methodology

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1. Initiation

The initiation phase is the first step in the decision-making process to define the optimal retrofitting concept for urban and building scale projects. The objective is to select the urban area and the buildings for which the retrofitting concept will be defined, collect key information, identify the stakeholders to involve and set the working group (SMC WG) responsible for the decision-making process.

1.1. Selection of the urban area and the buildings

In this stage, the municipality must carry out the necessary steps to start the decision-making process. First, the municipality must select the urban area and the building(s) for which the retrofitting concept will be defined. The physical boundaries of the urban area must be clearly defined, using one or more of the following criteria:

- Geographical proximity
- Property ownership / occupier
- Social and Economic context
- Legal /administrative boundary lines
- Period of construction
- Energy supply infrastructure

The decision-making methodology is applicable to both small urban areas (Fig.2) and neighbourhoods (Fig. 3).

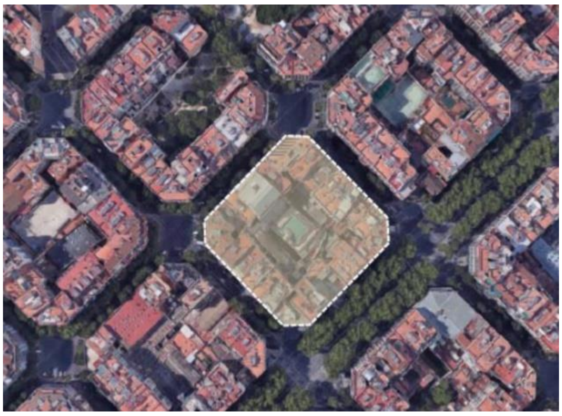

Fig. 2 – Physical boundaries of an urban area at small urban scale (Block in Barcelona, Spain)

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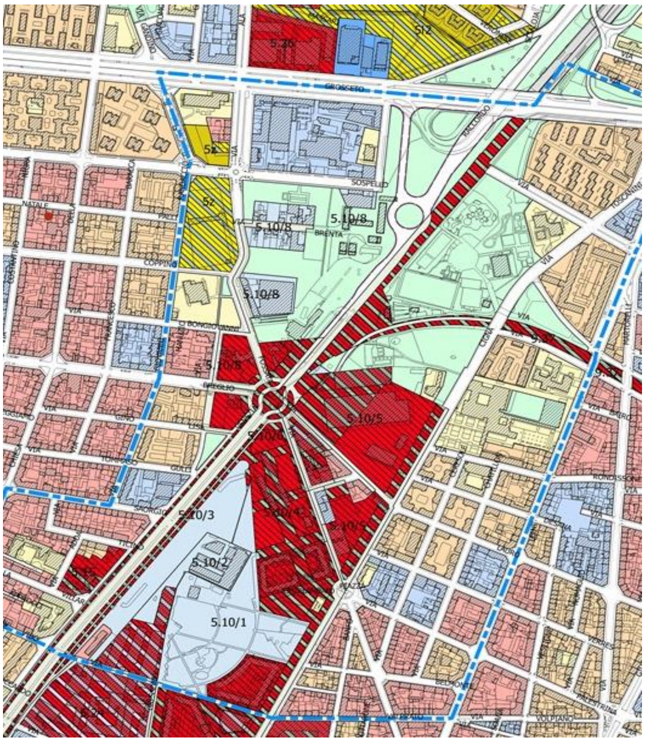

Fig. 3 – Physical boundaries of an urban area at neighbourhood scale (blue dotted line) (Spina 4, Torino, Italy)

After setting the physical boundaries of the urban area, the public buildings included in the retrofitting study shall be identified (Fig. 4).

Fig. 4 – Identification of the urban area (red line) and public buildings (in green) (AURORA Neighbourhood, Udine, Italy)

The municipaliti shall provide the rationale behind the selection of the urban area and buildings that will be the objects of the decision-making process.

1.2. SMC Team

The "SMC Team" is the group of experts appointed by the municipality that will manage the whole decision-making process. A coordinator of the WG shall be appointed. He/she will be the main responsible for the deployment of the activities and will act as interface with the municipality.

1.3. Collection of data

The SMC Team shall collect the necessary data to describe the urban area and the building(s), providing the necessary information to start the decision-making process. The climatic profile shall also be described in detaild.
Deliverable D5.2.1 Testing Protocol specifies the information to collect in the Initiation phase.

1.4. Stakeholders identification

After having set the physical boundaries of the urban area, the municipality shall identify the relevant stakeholders that can contribute to the study. The identification of the stakeholders can help to refine the sustainability goals and consider multiple approaches to reach them, as the municipality would be able to utilize the stakeholder's specialized knowledge during the study. Also, the early engagement of the stakeholders in the project would be helpful to reduce the risk of conflicts in the development of the retrofitting concept.

Typical stakeholders are:

- municipality's departments and other local authorities (e.g., Building Control, Health & Safety , Green Areas, Mobility Management, Urban Planning)
- Experts (e.g., urban planners, energy managers, landscape designers, etc.)

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- Utilities and service providers (e.g., energy, water, solid waste, etc.)
- Public Interest Groups (e.g., neighbours, residents' associations, business associations, sports and other local clubs and societies, neighbourhood watch, NGO's, politicians)
- External Parties (e.g., banks, funding agencies)

2. Preparation

The preparation phase is the beginning of the urban and building retrofitting concepts development. The preparation phase will provide the necessary information to create a sufficient working basis for the next phases.

2.1. SNTool and SBTool contextualization

The first step of the preparation phase consists in the contextualization of the SBTool and SNTool generic frameworks (transnational version) to the local conditions and priorities.

The contextualization process consists of (see D3.1.1):

- the selection of the assessment criteria
- the definition of the criteria's weights
- the definition of the benchmarks for each selected assessment criterion.

The selection of criteria determines the environmental, social and economic issues and subjects that will be taken into consideration during the retrofitting concept development. Each assessment criterion in SBTool and SNTool has a specific intent and addresses a specific sustainability subject. The exclusion of an assessment criterion in the local version of SBTool and SNTool means that it isn't considered relevant in relation to the local context and priorities.

At the same time, the value of the weights assigned to the selected criteria reflects the priorities of the municipality in the sustainable retrofitting of the urban area and public buildings.

It is recommended to carry out the selection of criteria and the weight assignment through a participatory approach, as foreseen by the PGS approach (see D4.2.1 Participatory Guarantee System), involving the stakeholders identified in section 1.2.

2.2. Data sources identification

The assessment method associated to each indicator in SNTool and SBTool requires specific information and data. It is necessary to identify, preliminary to the assessment activities, the sources of this information.

The identification of the sources of data can determine the exclusion of a criterion from the local versions of SBTool and SNTool. For instance, a criterion selected in the previous stage (3.1) could be later excluded because during the identification of the source of information it has been verified that the data aren't available or are of poor quality.

A valid retrofitting concept can only be defined if it is studied on solid data. Collecting the data together from several data providers is comparable with putting together a puzzle and needs a structured process to be followed. The SMC WG shall define all needed data at building and urban level for the assessment activities. Potential data providers, data sources and most promising strategies must be identified to gather all the needed data.

The use of software tools (GIS, energy simulation, cloud-based applications) may accelerate the collection and processing of the data collection process significantly.

For instance, data providers may be:

- municipal or regional departments (e.g., urban planning, energy, mobility, green areas, buildings, etc.)
- public agencies (e.g., energy agencies, social housing agencies
- statistical offices
- building owners / tenants
- certificates (e.g., energy performance, sustainability)
- utilities (e.g. local operators, energy utilities, water utilities)
- publicly accessible free source (e.g. Google Earth, Open Street Map)
- on-site inspection
- databases (e.g., from R&D projects)

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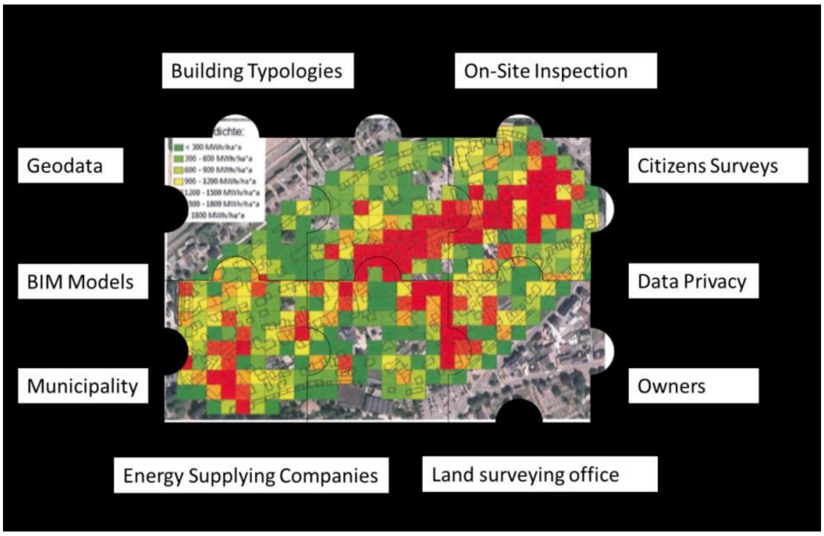

Fig. 5 – The puzzle of data collection for urban scale sustainability assessments

2.3. Participatory methods in the preparation phase

At the preparatory stage, stakeholders take centre-stage since it is here that the sustainability assessment tools (SNTool and SBTool) are contextualised. The selection of the assessment criteria is a very important step in the process because will determine which sustainability issues will be considered in the preparation of the retrofitting scenarios. More, the assignment of weights to criteria consists in a prioritization of the different sustainability subjects and should reflect the needs and expectations stakeholders. The contextualisation of SBTool and SNTool needs to be done in conjunction with stakeholders. A PGS workshop must be organised to validate the selection of the assessment criteria and the weighting process.

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3. Diagnosis

The diagnosis phase consists in the evaluation of the current condition and relative level of sustainability of the urban area and buildings using a contextualised versions of SNTool and SBTool.

Establishing an understanding of current conditions can serve several purposes for decision makers. Specifically, it can allow to:

- identify strengths and weaknesses as well as assets (such as hard infrastructure or intangible resources) that can be leveraged to support interventions
- identify interconnections, co-benefits, synergies, or trade-offs between city systems that can help guide efficient use of resources
- explore gaps in awareness and opportunities for action.

The objective of the diagnosis is:

- to set the basis for the definition of the performance targets for the retrofitting project of the urban area and public buildings (next phase)
- to identify the strengths and key weaknesses of the whole urban area and public buildings in terms of sustainability.

The aim of the diagnosis phase is to analyse the current state of the buildings and the urban area. The current state is to be analysed using SNTool and SBTool. The values of the indicators associated to the assessment criteria are compared against a benchmark (fixed in the Preparation phase) which allows evaluating the performance compared to an average value for the urban area or building type. Consequently, it is possible to identify the strengths and weaknesses of the urban area and buildings. A low indicator's value means that the results which the indicator addresses must be improved. By the end of the diagnosis, the current sustainability level of the urban area and buildings will be fully understood.

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3.1. Assessing the current state of the urban area

The key-weaknesses analysis is based on the SNTool assessment's results, possibly complemented with a soft analysis based on occupant surveys and workshops.

The performance scores evaluated using SNTool represent the average performance of the urban area in the various sustainability fields. Each criterion has been compared to the benchmark values (see section3.1) which allow the municipality in a quick an efficient way to check which urban indicators perform weak and which ones are performing well. If a criterion shows a result above a certain performance threshold defined by the municipality, the criterion is not relevant for the weaknesses analysis as it already performs well. Based on the first analysis on urban level, the SMC Team can rank the criteria according to their reached performance. Using the results of the benchmarking and ranking process a periodization of the different key-weak points of the urban area is possible.

For instance, the following table (Table 1) represents a simplified output (just few assessment criteria considered for an exemplification purpose) of an urban scale evaluation using SNTool:

Assessment criterion			Score
A2.1	Availability of green urban areas	Proportion of all vegetated areas within the neighbourhood boundaries in relation to the total area	-1
B2.1	Total final thermal energy consumption for building operations	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	0,5
C2.1	Total water consumption	Total amount of the neighbourhood's water consumption in litres per day divided by the total neighbourhood population	1,4
D2.2	Access to solid waste and recycling collection points	Percentage of inhabitants with access to solid waste and recycling collection points	0,4
E1.2	Particulate matter (PM_{10}) concentration	Number of days within a year that PM_{10} concentration exceeds the daily limit	-1
E2.1	Ambient daytime noise conditions	Percentage of building area over noise limit	1,2
F1.1	Performance of the public transport system	Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop	2,1

Table 1 – Output of a SNTool evaluation at urban scale

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The score associated to each criterion represent the actual level of performance of the urban area, using a scoring scale ranging from -1 (negative) up to +5 (excellent), where zero represent the minimum acceptable performance (see D3.1.1).

3.2. Identification of the weaknesses in the urban area

On the base of the performance scores, it is possible to rank the criteria and identify the critical issues:

Assessment criterion			Score
A2.2	Green areas in relation to the neighbourhood population	Total area of green in the neighbourhood divided by neighbourhood's total population	**-1**
E1.2	Particulate matter (PM_{10}) concentration	Number of days within a year that PM_{10} concentration exceeds the daily limit	**-1**
D2.2	Access to solid waste and recycling collection points	Percentage of inhabitants with access to solid waste and recycling collection points	**0,4**
B2.1	Total final thermal energy consumption for building operations	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	**0,5**
E2.1	Ambient daytime noise conditions	Percentage of building area over noise limit	**1,2**
C2.1	Total water consumption	Total amount of the neighbourhood's water consumption in litres per day divided by the total neighbourhood population	**1,4**
F1.1	Performance of the public transport system	Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop	**2,1**

Table 2 – Ranking of the SNTool scores to identify the most critical issues

Based on the results in Table 2, the main sustainability issues (score -1) results to be the availability of green areas (criterion A2.2) and the air pollution (criterion E1.2). The performance concerning the access to waste and recycling collection points (criterion D2.2), and the total final energy consumptions (criterion B2.1) is the minimum acceptable (scores 0,4 and 0,5). The best performance is reached by the public transport system (criterion F1.1).

To complement the SNTool evaluation, it is recommended to carry out a survey among the inhabitants of the urban area. The survey can be useful to identify the priorities of inhabitants and issues non quantifiable through the SNTool indicators. For instance, these can be occupant wishes concerning the design or amenities of the neighbourhood infrastructure (e.g. need for a new shopping opportunity or playground in the neighbourhood, need more parking space or brighter street lighting, etc.). To analyse the valuable feedback of the different occupants on these non-assessed key-weaknesses using SNTool, it is recommended to carry out a workshop by the municipality as part of the PGS approach (see D4.2.1 Participatory Guarantee Systems).

Based on the results of the two-part key weaknesses identification (SNTool + survey) a summary shall be created showing the SNTool assessment results and concurrently the identified non-simulated weaknesses by the municipality.

3.3. Evaluation of the infrastructures' current state in the urban area

The analysis of the current state of the energy and water infrastructures is useful to understand the key weakness and to collect useful information for the next phases of the decision-making process.

The evaluation of the current state of the water infrastructure shall include aspects as:

- sufficiency of the water provision in relation to the water demand
- drinking water quality
- availability and level of water treatment
- water losses due to deterioration of the water network.

In the following paragraph, it is detailed a proposed approach to assess the performance of the energy infrastructure.

3.3.1.Evaluation of the energy infrastructures

The SMC-WG shall evaluate the current energy infrastructure and renewable energy potential and identify the key weakness in the existing energy infrastructure and systems. Hence, these elements can be among others all components of heating/cooling networks like pipes, storage systems or heat suppliers. If in the urban area such components are available, it is necessary to of identify and rank the key weakness of these components regarding the energy and cost efficiency. This step can be skipped in case such systems are not available.

The performance of the energy infrastructure in the urban area is for instance not always correlating with the performance of single buildings connected to the heat network. The performances even may show contrary directions. If for example the energetic performance of the connected buildings is very high, the efficiency of the heat network can be lower due to an over dimensioning of pipes and shorter operation times. Moreover, it is also necessary to consider for existing heat networks the energy losses which may appear in operation from pipes and heat exchangers and evaluate them.

Furthermore, the evaluation of the current energy infrastructure and potential for inclusion of renewable energies, would help the SMC Team to have a better view on the current state of the urban area, thus they can later formulate more realistic and attainable targets for the retrofitting project. As for instance if in the current state analysis, the results of the solar energy potential show that there are very few suitable spaces for PV applications, then the SMC-WG in the “Retrofit Scenarios” phase might avoid developing senarios, in which the PV is used extensively and would rather consider the use of other renewable energy sources to meet its design targets.

Following is a brief description of possible methods that can be used to evaluate the current state of the energy infrastructure:

A. Heating and cooling networks

- Heat demand density map: the heat demand density map represents the overall heat demand distribution in the neighbourhood and indicates the regions with high heat demand.
- Connected heat density: the connected heat density is the quotient of the absolute heat demand of a dwelling in relation to the length of piping which is needed to connect the consumer to the heat supply system.

- Heat load profile: is the result of aggregating the load profiles of all the buildings which are located within the urban area. Furthermore, it shows the fluctuation of energy demand over time.
- (Heat) duration curve: the heat or load duration curve shows the number of hours on which a specific demand occurs. It is a sorted graph of the heat load profile and mainly supports the identification of the significant load capacities.
- Heat grid structure: the surface ratio and compactness ratio are used to assess the overall quality of the network.
- Auxiliary power: the auxiliary power demand shows the amount of required auxiliary power to supply the heating network. The required auxiliary power mainly consists of pump power demand. Only in the case of using electric heat pumps for heat supply the electric input power may also be rated as auxiliary power.
- Hours of operation: hours of operation are defined as the number of hours where a demand load occurs. In terms of heating loads the usually occur in seasonal periods (summer / winter). In commercial or industrial purposes the heat load usually constantly occurs through the year.
- Fraction of renewable energy in the heating system: the fraction of RES in a heating system describes the amount of energy which results from renewable energy sources, like solar thermal, geothermal or biomass energy.
- System efficiency: the system efficiency can be described as a quotient by setting the sum of efforts in relation to its output. Therefore, it is important to analyse efficiency rates of all integrated heat supply systems and to detect the sum of distribution heat losses.

B. Electrical demand

- District load profile: the district electrical load profile is the result of aggregating the load profile of all the buildings that are the urban area of investigation and it shows the variation of the power use over time.
- The district electricity balance line: the electrical energy balance line is the result of subtracting the produced energy from the consumed energy at every

simulation step for the simulation time. Positive values in the balance graph indicate that the on-site energy production exceeds the consumption and negative values show that the consumption is higher than production.

C. Inclusion of renewable energy potential

- Solar thermal: the solar thermal potential shall inform about the suitability on the installation of solar thermal application and the maximum on-site possible energy generation from solar thermal energy by summing up the possible production from all suitable areas.

Suitability Class for Solar Thermal Applications	Solar Radiation
Very high suitability	800 - >1000
appropriate	600 - 799
Limited suitability	400 – 599
Not suitable	< 399 (or area is below 5m²)

Table 3 – Suitability Class for Solar Thermal Applications

- PV potential: the PV potential shall inform about the suitability of the surface for PV application as well as the maximum on-site possible energy generation from PV by summing up the possible energy production from all suitable areas.

Suitability Class for Photovoltaic Systems	Solar Radiation (kWh/m²/year)
Very high suitability	> 1.080
appropriate	991-1080
Limited suitability	850-990
Not suitable	< 850 (or area is below 5m²)

Table 4 – Suitability Class for Photovoltaic Systems

- Wind potential: The key factor in the analyses of the wind power potential is the actual wind speed. Wind speed conditions depend on several site conditions. The utilization of wind energy is only possible if on the site a free space with an area greater that > 600 m² is available and the yearly average wind speed is >8 [m/s]. Wind speeds below 3.5 ms-1 and above 25 ms-1 are not usable.

- Shallow Geothermal: The geothermal potential mainly depends on the depth of drilling probes and geological conditions. Shallow geothermal installations refer to depths up to 400 m below the surface. Below depths of 15 – 20 m geothermal temperature is not affected by specific surface conditions anymore. The extractable energy potential of shallow geothermal probes varies between 20 W/m for ground collectors near surface and 50 W/m for drilling depths of 100 m.

After the current state evaluation, it is possible to start identifying the weak points of the energy infrastructure and systems in the urban area. Based on these results the municipality can consider and prioritize in the whole perspective the neighbourhood weak-point analysis also the energy infrastructure and systems.

3.4. Evaluation of the building's current state

Analogous to the process on urban level, the diagnosis phase on building level also contains a two-part key-weaknesses analysis based on SBTool as well as on occupant survey. Based on the performance of each SBTool's indicator against a benchmark, the key-weaknesses of the building can be identified and ranked according to the indicators' results. Hence, it is possible to prioritize different aspects in the building retrofitting which show the weakest performance based on the indicators. For example, if the indicator "Thermal Comfort" shows the weakest performance of all indicators, then there is a high need for improvements in this aspect.

There are on building level again several potential non-simulated weaknesses which cannot be measured or quantified by any indicator. These may for example be aspects like the wish of occupants for a different arrangement of the furniture or a more intuitive control of the sun protection in the building. Such aspects are not covered by SBTool and cannot be directly simulated but also need to be considered. The key-weaknesses for the non-simulated aspects can be analysed based on the collected feedback from occupant's surveys and physical workshops in the preparation phase.

3.5. Diagnosis summary report and SWAT analysis

At the end of the diagnosis phase, the SMC-WG develops a report that summarizes the main findings of the diagnosis phase. The report shall contain the following:

- main findings of the diagnosis, including weaknesses at urban and building scale
- recommendations on how to handle the weaknesses in the next phases of the decision-making process.

The report shall contain a SWOT analysis for the urban area, identifying the strengths, weaknesses, available opportunities, and possible threats. The SWOT analysis is based on a quadrant matrix, in which strengths and weaknesses (internal factors) are presented above the x-axis, and opportunities and threats (external factors) are presented below. Typically, strengths and opportunities (positive factors) are listed on the left of the y-axis, while weaknesses and threats (negative factors) are listed on the right *(see Figure 6)*.

Fig. 6 – SWOT analysis of an urban area

The SWOT analysis is a powerful tool for a fast and powerful initial diagnosis. Once the SWOT analysis in complete, the municipality can analyse the results and diagnose the implications.

3.6. Participatory methods in the diagnosis phase

From the perspective of occupant and user participation, the diagnosis phase involves little engagement. The SMC WG will analyse the current state of the buildings and urban area against the benchmarks set during the preparation phase, taking account of information previously gathered from occupants and users. The result is a summary of the weaknesses identified at building and neighbourhood level, from both a technical and quality of life perspective. The most important interaction with occupants and users in this phase will therefore involve communicating to them the results of the diagnosis.

This might usefully be done by a PGS workshop organised in person or using electronic means, offering an opportunity for people to provide feedback with comments, questions, criticisms or corrections.

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4. Strategic definition

The main goal of this phase is the definition of the main framework conditions for the later retrofitting design based on the results of the diagnosis phase. The strategic definition therefore serves as pointer for the later design phases by setting meaningful targets for the retrofitting project and by identifying the main constraints and restrictions which may limit the retrofitting design.

Specifically, this phase allows to.

- Build a shared vision to support decision making
- Drive improvement in performance by setting a baseline from which to assess change.

The strategic definition phase is articulated in two steps:

- setting sustainability targets
- setting constraints and restrictions.

In the first one, following the diagnosis' outcomes, the performance targets for the urban area and public buildings retrofitting projects are defined.

In the second one, the constraints that could limit the range of possible retrofit strategies are identified.

4.1 Sustainability targets

Before starting to create a sustainability retrofitting scenario for the urban area and the buildings, it is necessary to define clear and measurable targets that should be achieved by the retrofitting concept. Targets must address all fields of sustainability like environment, economy and social aspects.

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In general, targets need to be S.M.A.R.T. which means:

- Specific – target must be clearly defined
- Measurable – targets must be quantifiable
- Attainable – target must be realistic and achievable
- Relevant – are the targets relevant for sustainable urban districts and buildings
- Time-bound – specify when the result(s) can be achieved

To get a clear direction in which the sustainability retrofitting projects for the urban area and the buildings should be developed, targets must be measurable. In this step, **SBTool and SNTool are used to set measurable sustainability targets** at urban and building scale. In practice, for each assessment criteria it must be set a target score. Each target score will correspond to a target value of the indicator. For instance, regarding the diagnosis' outcomes described in Table 2, the SMC WG can set sustainability targets, in the form of a target score, for the low performing SNTool criteria (see Diagnosis phase):

Assessment criteria		Diagnosis score (See Table 2)	Target Score
A2.2	Green areas in relation to the neighbourhood population	**-1**	**1**
E1.2	Particulate matter (PM_{10}) concentration	**-1**	**1**
D2.2	Access to solid waste and recycling collection points	**0,4**	**1,5**
B2.1	Total final thermal energy consumption for building operations	**0,5**	**1,5**

Table 5 – Target setting for the urban area

As stated above, in SNTool, each target score corresponds to an indicator's value. For instance:

Assessment criterion		Indicator	Target Score	Target Value
A2.2	Green areas in relation to the neighbourhood population	Total area of green in the neighbourhood divided by neighbourhood's total population	1	15 m^2/inhabitant
E1.2	Particulate matter (PM_{10}) concentration	Number of days within a year that PM_{10} concentration exceeds the daily limit	1	30 days/year
D2.2	Access to solid waste and recycling collection points	Percentage of inhabitants with access to solid waste and recycling collection points	1,5	90 %
B2.1	Total final thermal energy consumption for building operations	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	1,5	90 kWh/m2

Table 6 – Target setting for the urban area

The outcome of this step will be a table (see Table 6) listing the sustainability targets in the form of target scores and target indicators' values in relation to the assessment criteria included in the contextualised versions of SBTool and SNTool.

4.2 Constraints and restrictions

Since each urban area and even each building in a district is an individual case, many potential retrofitting technologies cannot be implemented due to constraints and restrictions in different fields. The main constraints that occur in district and building sustainability retrofitting projects can be defined and structured into the following categories:

- Legal constraints (e.g. Building Codes, Cultural Heritage Protection)
- Technical constraints (e.g. Architecture, Systems)
- Financial constraints (e.g.Investment Cost, ROI)
- Environmental constraints (e.g. Climatic conditions, urban morphology)
- Stakeholder based restrictions

In this stage, the SMC WG must identify the existing constraints and their nature to proceed with the next steps in the decision-making process.

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Legal constraints are mainly caused by national laws, regulations and standards which settle the process of energy retrofitting of buildings and districts. Planners therefore have to consider the national energy saving ordinances in their projects. The planning concepts for energy retrofitting projects also are often affected by laws on cultural heritage protections or national and standards which give guidelines for the planners. Therefore, planners of district retrofitting concepts must be aware of all legal constraints in their countries before starting to plan the concept. Those legal constraints may give restrictions to many retrofitting technologies that are theoretically available on the market. For example, in some cases keeping the cultural value of the buildings and districts could be a restriction that will not allow the achievement of improvements to insulation of the building envelope or to installations of photovoltaics that in theory could be technically feasible. Also, certain thicknesses of insulation materials may be restricted as their insulation effectiveness (max. U-values) is too low according to the national energy saving ordinances

Technical constraints are setting the main restrictions for the use of technologies in building energy retrofitting projects. Each retrofitting technology needs special requirements for its implementation which may not always be given by each building or the district. For example, if the planners want to use a geothermal heat pump with ground collectors the property on which the building is located must have enough space for laying the ground collectors. According to the needed output of the heat pump the space may not be available in dense urban areas. Moreover, the use of renewable energy supply systems like biomass boilers needs enough space to store the biomass. The feasibility of solar energy systems on roofs and facades is also dependent on the solar radiation exposure of the area. For example, in a district some roof areas can be shaded by other buildings or trees and the sun exposure can be lower even if the global solar radiation is high. Furthermore, there are often many unforeseeable technical constraints in energy retrofitting projects like the load capacity of the building structure or structural damages.

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Financial constraints are often the largest obstacles in energy retrofitting projects on building and district level. Planners often have to consider the financial situation of the building owners as well as the tenants in order to avoid negative social impacts like gentrification. Depending on the type of the owners (private, public) also the economic efficiency of the retrofitting technologies is a big issue. Therefore, the financial constraints are setting main restrictions to the application of different retrofitting technologies. Compared to legal or technical constraints financial constraints cannot be generalized for different building types or a country. Instead, they are always depending on the financial situation and the individual willingness of building owners to invest in energy retrofitting measures.

Environmental constraints are often restricting the use of retrofitting technologies as they are depending on proper environmental conditions in the district. Most common are climatic conditions which are not suitable for the use of certain technologies like solar energy systems or wind power. The urban morphology or the condition of the ground also can set restrictions on the use of geothermal systems. The availability of biomass sources near the district can also be a limiting factor for the use of biomass boilers. The environmental conditions are mostly related to the whole district as they are not changing from building to building. Although in certain cases like solar energy potential they may be different for each single building.

4.3 Participatory methods in the strategic definition phase

At the strategic definition stage, stakeholders again take centre-stage since it is here that the framework conditions for the retrofit design and plans are defined based on the results of the diagnosis phase. A series of S.M.A.R.T. targets are set, and constraints and restrictions on the project identified. This needs to be done in conjunction with stakeholders. A PGS workshop must be organised to validate the sustainability targets for the urban area and for the public buildings.

5. Retrofitting scenarios

Once it has been established a vision for the future of the urban area and identified the sustainability targets that will drive efforts to achieve this vision, it can begin the development of a plan to make this vision a reality.

In this phase, the SMC WG develops alternative possible **retrofitting scenarios** for the urban area and the buildings that fulfil the defined sustainability targets in the Strategic Definition phase. As it's often the case, the team might come up with number of different scenarios, all of which fulfil the sustainability targets. Therefore, all valid scenarios would then be assessed in the next phase to choose the optimal one.

5.1. Development of retrofitting scenarios

A scenario can be defined as a package of retrofitting interventions.

Interventions may comprise changes to a physical (or hard) asset, such as a new development, technological solution, or other built structure. They can also comprise a soft intervention, such as a process or policy that builds knowledge or empowers skills and leadership (e.g., training, capacity building, behaviour change, improved coordination between departments).

Interventions should promote a holistic, interconnected approach to urban functions and consider the urban area as a system, and they should aim to bridge silos through an inclusive process that acknowledges co-dependencies and interdependencies. This integrated approach can help new ideas emerge and bring together new opportunities for cross-sectoral innovation. It can maximize synergies, foster efficient use of resources, and build longevity by ensuring that stakeholders and co-owners are engaged and invested in the successful implementation of the effort.

To achieve the sustainability performance targets (see 4.1), it is possible to develop alternative scenarios.

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In this phase the SMC Working Group will develop alternative retrofitting scenarios for both the urban area and the buildings. It is important that the scenarios differentiate significantly among each other. Otherwise, it would not make sense to compare them in the decision-making phase (next phase) by a value assessment. However, the final decision about the number and content of scenarios that are created and used is always carried by the SMC TEAM in cooperation with stakeholders. Each scenario is a package of different solutions to improve the sustainability of the urban area as a whole, considering all buildings as connected global system.

A retrofitting scenario is composed of a variety of single interventions in different thematic fields. The main fields among others are energy, water, use of land, resources consumption, climate mitigation and adaptation, mobility, health, socio-cultural conditions.

The approach proposed by this methodology is to consider the energy as the priority filed. Urban regeneration interventions in the field of energy retrofitting are influencing the other thematic urban regeneration fields. The energy interventions are the starting point in the preparation of a scenario. All non-energetic interventions will be then added and integrated in a unique vision.

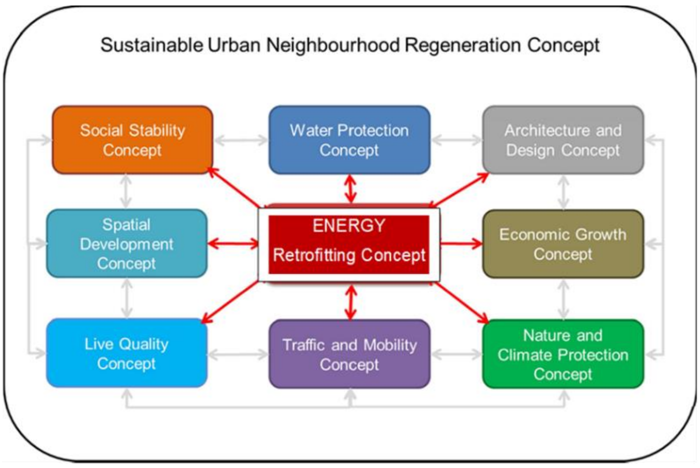

Fig. 7 – The energy field as the central one in preparing a scenario

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To create a retrofitting scenario, the SMC TEAM shall proceed according to the following steps:

A. Selection and optimization of energy interventions at urban level
B. Selection and optimization of energy interventions at building level
C. Selection of non-energy related interventions (water, mobility, use of land, services, etc.)
D. Identification of business models and financing schemes
E. Validation of the scenario

5.1.1. How to prepare a retrofitting scenario: selection of interventions

Compiling a package of interventions (scenario) is a major challenge. For example, while creating a scenario, the SMC Team must consider several aspects like the determined sustainability targets, constraints, and restrictions as well as different interactions between the applied interventions and the buildings in the urban area or its energy infrastructure.

The starting point in creating a scenario are the weakness identified in the Diagnosis Phase. **The interventions are studied by the SMC Team to improve the sustainability of the urban area and buildings with the objective to achieve the sustainability performance targets established in the Strategic Definition phase.**

The process is based on an iterative approach which allows to repeat the evaluation and re-select the package of measures as long as the SMC Team is satisfied with the achieved improvement results. Each iteration step will provide intermediate results by performing calculations and assessments using SBTool and SNTool. **The multi-scale approach allows to verify the impact of the urban scale interventions on the buildings and vice-versa**. To evaluate the effectiveness of a scenario, the SMC Team takes advantage of the results of the diagnosis phase concerning the current state assessment. Hence, it is possible to compare the current state results of the buildings and urban area with the intermediate results after applying the package of retrofitting interventions. Each iteration step therefore has the purpose to optimise the scenario. An automatic optimisation method cannot be used as the existing solutions available, like genetic optimisation algorithms, only allow the optimisation of a limited number of solutions and cannot take fully in account their impact at urban level and in relation to the local context. Hence, it is not useful to apply these methods as they may misdirect the SMC TEAM from finding an optimum scenario for the whole urban area.

As the identification of a package of interventions of a is a complex task, the SMC Team can follow a structured sequential approach based on three different mechanisms:

- Interventions filtering based on set constraints and restrictions
- Interventions compilation based on diagnosis results
- Interventions sequence logic of application

After the preparation of a scenario by the SMC Team, the results achieved finally need to be compared with the targets set in the Strategic Definition. Only if all targets have been reached, then the study about the financing of the scenario can start (see 5.1.1.1). If the targets have not been reached the scenario needs to be refined again by further iteration steps as long as needed till all targets have been reached. For valid scenarios, which have reached all targets the financing must be determined by considering appropriate business models and financing schemes. This step is needed in order to ensure the financing of the scenario as well as to identify all available useful financing instruments like grants, loans or contracting solutions (see 5.1.2).

5.1.1.1. Interventions filtering based on set constraints and restrictions

The first step in the optimisation of the intervention package to be conducted by the SMC Team is to ensure that all interventions which may not be suitable to be applied for the building or urban area are identified and excluded. Interventions cannot be suitable due to the defined constraints or restrictions for a concept which has been set for buildings and the urban area. For example, if cultural heritage protection laws restrict the installation of solar panels on roofs, the SMC Team needs to filter out all interventions which cannot be applied. To do this at the beginning is important, since the number of possible interventions can be limited to only practicable ones that really can be implemented.

5.1.1.2. Interventions compilation based on diagnosis results

The second process to be conducted by the SMC Team in the intervention package optimisation is to capitalize the results the diagnosis phase. The diagnosis phase provides a result summary in form of a comprehensive list of identified weak points. Based on the identified weak points, the SMC Team can assess the potential for improvements and therefore select most useful retrofitting interventions. Therefore, the diagnosis' results guide the SMC Team in the selection of the most effective retrofitting solutions.

5.1.1.3. Interventions sequence logic of application

After the identification of a useful set of interventions it is important to know in which chronological sequence the interventions should be applied. The goal of this optimisation step is to achieve the most efficient retrofitting design. As described above, the three optimisation steps of a retrofitting package of interventions are based on several iterations in which the different useful interventions are applied and the impacts are assessed by the SMC Team. Hence, the SMC Team needs to define for each iteration which interventions will be applied in which iteration step. Therefore, the methodology needs to pretend a chronological sequence how planners must apply the different selected retrofitting interventions to create most effective retrofitting scenarios. Moreover, in each iteration some interventions may be replaced by other ones which may be more effective if the SMC Team decides to do so. Nevertheless, the proposed sequence of applying the interventions during the iteration steps must be seen as a guideline that has to be revised by the SMC Team for each single variant.

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The following Figure 8 represents the sequence of applying retrofitting interventions in the iteration steps of process:

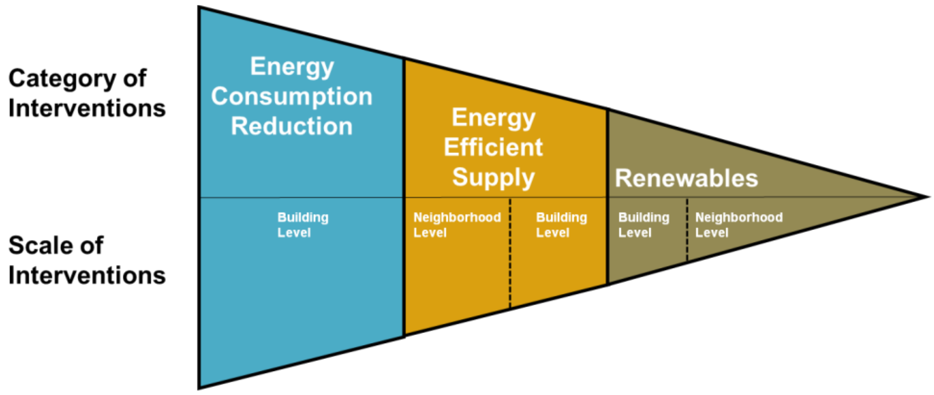

Fig. 8 – Sequence of applying retrofitting interventions in the iteration steps

To ensure the right chronological sequence to create a complete energy retrofitting concept planners initially should apply interventions from categories in the following order:

- Energy consumption reduction
- Increasing the efficiency of the energy supply
- Inclusion of renewable energy production

Energy consumption reduction

The reduction of the energy consumption is the basis for the creation of sustainable energy concepts and to achieve the set sustainability goals. For that reason, the reduction of the energy consumption must be the priority for planners. Keeping the order is also important as potential newly-constructed heat networks should be operated efficient in the long-term. If the chronological order is changed installed heating systems may be dimensioned upon the current energy consumption of the buildings or the urban area. If the energy consumption later will be reduced by interventions in a later iteration step, the heating systems may get oversized, and the efficiency may be lower. Thus, it is necessary to use the heat demand that will take place after passive retrofitting measures to reduce the energy consumption (consumer-driven) have been applied. Otherwise, the estimations would be based on the heat demand of the current state and will not reflect the future heat demand which will be the relevant one. Besides, it is in general from an ecological point of view more useful to prioritise the reduction of energy consumption over installing more efficient energy supply systems. The best energy is the energy which is not consumed.

Increasing the efficiency of the energy supply

After applying energy consumption reduction measures the next step will be to increase the efficiency of the energy supply in the district. Then, according to the general efficiency increasing potential the urban scale solutions should be preferred over individual solutions. After applying energy consumption reduction interventions on building level, the next step will be to increase the efficiency of the energy supply on urban level. According to the general potential of energy efficient supply interventions the urban solutions should be prioritized over individual solutions on building level. The reason for this is, that neighbourhood interventions have a lot of advantages compared to individual solutions as they allow taking advantage of synergies and scaling effects. Following main advantages are identified compared to individual solutions.

- Higher share of renewable energy sources attainable by exploitation of synergies. Buildings in neighbourhoods often have limited possibilities to include renewable energies like solar energy, geothermal energy, wind energy or biofuels to supply their heat demand. Single buildings also often are subjected to technical, legal or environmental restrictions that exclude the use of renewables or the application of passive retrofitting measures. For example, buildings with cultural heritage protection have no possibility to reduce the heating demand by passive measures like external thermal envelop improvements. In many countries, it is also not allowed to install solar thermal systems, photovoltaic systems or wind turbines on the roof or the facades of cultural heritage protected buildings. If roof areas are partially or completely shaded by other buildings or trees the use of photovoltaic systems may also be impossible. The use of geothermal energy for geothermal heat pumps is also technically difficult in dense urban areas as there are minimum distances between drillings necessary. The use of ground collectors also is only possible for small buildings as the needed areas for the ground collectors are often not available. For the use of energy carriers based on biomass, like wood pellets or wood chips, huge storage space is necessary. In dense urban areas, many buildings do not have enough storage space in the boiler rooms or outside the buildings. The examples show that the use of renewables may often be restricted due to the existing constraints. Considering the neighbourhood as a global energy system by connecting buildings via energy networks the mentioned problems may often be reduced. By establishing a common energy supply system, buildings with restrictions can have access to renewables that are provided by other buildings that are not faced by any restrictions. Hence, the share of renewables can be dramatically increased and the CO_2 emissions significant reduced compared to individual solutions and the sustainability of the whole district can be further improved.

- Higher overall energy efficiency factors. Using larger energy systems in heat / cooling networks (e.g. one 400 kW facility instead of twenty 20 kW facilities) the overall efficiency often can be increased due to lower overall losses. The actual improvements in efficiency cannot be specified in general as they are depending on the individual conditions (grid losses, boilers efficiency, heat demand density) of the heat network and the individual heating systems.
- Exploitation of financial scaling effects. Heat networks are very likely to cause reduced investment and maintenance costs compared to individual solutions. The price of a heating system per kW output decreases with increasing output power significant. Also, the maintenance costs for a central heating system in a heat network are lower than for individual heating systems. Therefore, heating systems have in the most cases a higher economic efficiency and lower life cycle costs than individual heating systems in single buildings. For heat centrals, it is also easier to change the heating system for the heat network because replacement works are only necessary for one facility. Therefore, planners of design variants should try to implement heat networks whenever it is possible.

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Inclusion of renewable energy production

The efficiency of the energy supply can be further improved using climate neutral and renewable energy sources. By increasing the share of climate-neutral and renewable electricity in a building and in the urban area, the primary energy consumption can be reduced significantly. Energy efficient supply interventions should be applied before adding renewables to avoid a wrong dimensioning of the renewable energy systems. For example, if a new more efficient boiler or heat network is installed as an intervention it may affect the economic efficiency of a solar thermal system for domestic hot water, as the hot water creation already may be more efficient. Hence, the dimensioning of the solar thermal system needs to be matched with the hot water demand and the new heating and hot water generation system. Furthermore, the energy balance between energy production and energy consumption must be optimised to achieve the best results for a scenario.

5.2. Financing mechanisms

For each scenario, possible business models and financing mechanisms must be identified in order to evaluate which one could be the most suitable for a practical future implementation of the retrofitting interventions. The possible use of the following financing opportunities should be evaluated.

Grants

Grants may be available at all stages for feasibility studies, proposal development, capital investment and maintenance expenses. They offer a subsidy to the total costs but exist only because governments or other altruistic organizations wish to see particular innovations develop that would otherwise not be economically attractive. They will usually only cover part of the costs.

Loans

Loans imply debts that must ultimately be repaid, and on-going interest charges. Retail and commercial banks will generally lend, but at a price that depends upon perceived risks. They will want to see a business model that shows adequate "debt coverage", i.e. a plan that shows how interest charges and debt repayment will be covered under normal and risky scenarios. Hence, lenders will often want to see co-funding by the owners and other stakeholders in the project. Furthermore, in order to borrow at a reasonable rate, the lender may require collateral security, i.e. financial recourse to stakeholder assets in the case of default. In contrast, pure project finance, without any recourse to the stakeholder assets, but secured only against the anticipated savings is sometime known as "non-recourse financing" and will be more expensive. Finally, for energy efficiency, preferential loans may be available at a lower cost. This is where governments or NGOs make funds available to retail and commercial banks under a scheme to incentivise particular initiatives.

Loan Guarantees

This is an ancillary financial product that can reduce the cost of debt finance. Essentially it involves another stakeholder to the project investment team, namely a loan guarantor. The loan guarantor is usually a public body created to lower the cost of energy efficiency loans, back acting as a final guarantee that defaults will be avoided.

Energy Performance Contracting

Energy Performance Contracting is usually undertaken by an ESCO, through a contractual obligation to implement the energy savings initiatives in return for a flow of payments from the building owner or end-user. To the extent that this flow of payments is less than the savings, it is attractive to the owner. Evidently the owner / end user is passing on some of the investment returns to the ESCO, but is avoiding the initial capital outlay. A variety of financial arrangements may be undertaken with the ESCO taking on some, none or all of the debt and collateral obligations, and performance risk may also be split in flexible ways.

Co-Investment

There are several initiatives around the world whereby municipalities or energy utilities assume the capital cost of retrofitting and place the charge on the property, to be

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recovered through the regular property tax-, or utility bill assessment and collection. Evidently, this is simply transferring the debt, but it may be an incentive for several reasons. Owners may not want, or be able, to accumulate more bank debt, or the bank terms may be unfavourable. For commercial owners, this is an easy way to transfer the cost to the tenants. Municipalities, furthermore, may have access to lower cost funds through bonds, specialist cleantech funds or related initiatives, and may be willing to spread the cost over a longer term.

Embedded revenue contributions

Many countries now encourage residential, commercial and industrial consumers to install solar, wind, biomass, micro-hydro and other renewable sources of electricity generation to reduce consumption of grid supplied energy and for sale back to the local distribution company, or, in the case of larger industrial units, to the wholesale market. These feed-in tariff (FiT) arrangements vary according to technologies, vintage, length of term and size of connection. District level solutions have a lot to offer here as there are economies of scale in the provision of generating facilities and transaction costs. “Smart” districts offer further revenue possibilities through the possibility of end-users of electricity “selling” demand reduction options to the distribution utilities.

In some countries, there are also “white certificate” trading schemes for energy efficiency which are intended to parallel what green certificates have achieved for renewable technologies. The idea is very similar, having a volume based target for energy savings, earning credits to the extent that they are achieved, and being able to trade credits so that those who are able to achieve it more efficiently do more and profit by selling to others who face higher marginal costs of energy saving. In Europe, Italy has been the only country to have some trading, although Belgium, France, Denmark, Poland and the UK have limited schemes.

Rental increases are sometimes anticipated following retrofitting and can be built into the financing model.

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Tax benefits

Fiscal measures are an important class of support and can relate to a reduced rate of tax for the owners, properties and / or contracting organisations, as well as specific tax and VAT benefits on the various cost or revenue elements. Evidently, they are idiosyncratic to individual EU member states, but are widely used as part of the business models.

5.3. Participatory methods in the preparation of retrofit scenarios

Inputs and suggestions from inhabitants, occupants and stakeholders are a valuable contribution in the development of retrofitting interventions. Stakeholders can provide feedback considering their targets and expectations on the prioritization of interventions. A PGS workshop shall be oranised to exchange on the possible retrofitting strategies and scenarios.

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6. Decision-making

The overall goal of this phase is to select the best scenario in terms of energy and cost efficiency as well as the overall sustainability among the ones created in the previous phase (5 Retrofit Scenarios). Only the scenarios which have reached the sustainability targets (4 Strategic Definition) can be compared in the decision-making phase. The selected best scenario will then developed in a retrofitting concept in the next phase (6 Retrofitting concept).

This phase is articulated in 2 steps:

- Assessment of scenarios
- Ranking of scenarios

6.1. Assessment of scenarios

Each scenario foresees a package of interventions to improve the sustainability of a urban area and one or more buildings belonging to it.

In this stage, the main goal is to identify the scenario, among the ones developed in phase 5, that allows the urban area and the buildings to reach the higher level of sustainability. To perform this task, it is possible to use SBTool and SNTool.

The following steps must be accomplished for each scenario:

- Urban area
    - identify the criteria in SNTool that are impacted by the retrofitting interventions
    - for those criteria, assuming the implementation of the interventions, the value of the indicators bas to be calculated and updated
    - the new SNTool overall score is updated.
- Building(s)
    - Identify the criteria in SBTool that are impacted by the retrofitting interventions
    - for those criteria, assuming the implementation of the interventions, the value of the indicators bas to be calculated and updated

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- the new SBTool overall score is updated.

The process described above allows to verify the potential level of sustainability reachable by the urban area and the buildings in relation to the interventions foreseen by each scenario.

For each scenario, the overall SNTool and SBTool scores take in account the sustainability priorities of the municipality and stakeholders. These ones have been "embedded" into the contextualised versions of SBTool and SNTool through the assignment of a weights to criteria, categories and issues.
At the end of the scenarios' assessment process, the final output are the SBTool and the SNTool scores associated to each of them. The table below provides an example concerning an urban area and two buildings:

Scenarios	Urban area SNTool score	Building A SBTool score	Building B SBTool score
Scenario 1	1,3	2,1	2,0
Scenario 2	1,5	1,7	1,5
Scenario 3	1,1	1,7	1,8

Table 7 – Results of the scenario's assessment

At this point, it is possible to proceed with their ranking.

6.2. Ranking process

On the base of the scenarios' assessment process (see 6.1), it is possible to proceed with their ranking to identify the optimal one. To rank a scenario, it is necessary to assign a sustainability global score aggregating the SBTool and SNTool scores trough a weighted sum.

The ranking process is articulated in 3 steps:

1. Assignment of a weight to determine the priority levels among the urban area and the buildings
2. Assignment of a global sustainability score to a scenario
3. Ranking of scenarios according to their global sustainability scores
4. Selection of the optimal scenario to be transformed in a retrofitting concept

Assignment of a weight to determine the priority levels among the urban area and the buildings

The first step is to assign a weight, expressed as a percentage, to the urban area and the buildings under evaluation. The weight reflects the relative importance among them. The table below provides an example concerning an urban area and two buildings:

Element	Weight
Urban area	90 %
Building A	7 %
Building B	3 %

Table 8 – Weight assigned to reflect the relative importance among the urban area and the buildings

In the example above, a strong priority has given to the urban area (investments, number of interventions, number of people affected, etc.) with regards to the 2 buildings. One of the 2 buildings (A) has a priority (historical building, more deteriorated, bigger, et.) towards the second one (B).

Assignment of a global sustainability score to each scenario

The overall score of each scenario is calculated as a weighted sum of the SNTool and SNTool scores. The weights are the ones set in the step above (Assignment of a weight to determine the priority levels among the urban area and the buildings).

This is example of the calculation of the global sustainability score for a scenario:

Assessment	Assessment's score (Z)	Weight (Priority level) (Y)	Weighted score (Z x Y)
SNTool - Urban area	1,3	0,9 (90%)	1,17
SBTool - Building A	2,1	0,07 (7%)	0,15
SBTool - Building B	2,0	0,03 (3%)	0,06
Scenario 1 score			**1,4**

Table 9 – Calculation of the global sustainability score for a scenarion

Ranking of scenarios according to their global sustainability scores

Once that a global sustainability score has been assigned to all the scenarios, it is possible to proceed with their ranking. The table below is an example of the rank of 3 scenarios:

Position in the ranking	Scenario	Overall score
#1	Scenario 2	2,0
#2	Scenario 1	1,4
#3	Scenario 3	0,8

Table 10 – Ranking of scenarios

6.3. Selection of the optimal scenario

According to the scenarios' ranking (see 6.2), Scenario 2 results to be potentially the one that allows to reach the higher level of sustainability.

However, to confirm the selection of Scenario 2 as the optimal one, it is necessary to consider other 2 aspects: the potential financial mechanism to implement the scenario and the non-simulated aspects.

Financial mechanisms

The final chose should combine the best scenario in terms of performance and financial sustainability. For example, if a scenario may not have reached the first rank but has many advantages in terms of financial mechanisms that are not reflected by the global sustainability score, decision-makers need to bear these aspects in mind

Non-simulated aspects

As the ranking result is based on a quantitative method also non-simulated aspects which cannot be described by the SBTool and SNTool scores need to be considered in the final decision-making. For example, if a scenario may not have reached the first rank but has many advantages in terms of qualitative improvements that are not reflected by the global sustainability score, decision-makers need to bear these aspects in mind. Hence, an expert judgement needs to be done to assess the final ranking of the variants beside the global sustainability score. The scenario which has finally been identified as the best ranked one (quantitative and qualitative aspects) is transformed in a retrofitting concept in the next stage.

6.4. Participatory methods in decision-making

Occupant and user participation becomes critical once more at the decision-making stage, where a selection is made from among the scenarios previously generated. In all cases, feedback from occupants and users should be invited at this point, before a final decision is made on the best scenario. A key question is the level of influence over this decision they are to be afforded vis-à-vis other stakeholders. The views of occupants and users should carry strong weight. After the SMC Team has ranked the variant design concepts, and assessed them for value, the results should be encapsulated in a summary report. This is then presented in a PGS meeting.

7. Retrofit concept

In this phase, the SMC Team is required to detail the best scenario in a retrofitting concept.

The retrofitting concept is a report containing the description of the interventions foreseen by the scenario. The interventions are illustrated for the urban area and the building(s) and organised following the issues of SBTool and SNTool.

For each intervention the information to provide is:

- Description
- Expected results
- Activities/works to implement the intervention
- Timescale
- Budget estimation
- Financial scheme
- Responsible for the implementation
- Partnerships
- Reference stakeholders
- Links with existing or future strategies, plans, programs

The retrofitting concept shall be considered as the first step or an integrated urban planning and design process. It provides a solid basis to build a valid retrofitting project in future.

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