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Decision making in urban development: The application of a hybrid evaluation method for a critical area in the city of Turin (Italy)

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3

#### 4 Abstract

Smart cities and sustainable neighbourhoods are increasingly gaining more attention within policy 5 decisions on urban transformations. In this context, Decision-Makers (DMs) need evaluation 6 methodologies able to support the definition of policies and actions for the future of cities, that focus 7 8 on a higher degree of life quality and new needs. In this paper, an integrated framework is proposed which combines the Stakeholder Analysis, the STEEP and SWOT analyses (STEEP+SWOT), the 9 Scenario Building and the Multicriteria Decision analysis approach (MCDA) which can be used to 10 envision sustainable future scenarios for an underdeveloped area in Northern Italy. The adoption of 11 integrated methodologies facilitates the analysis of each phase of the decision problem, from its early 12 13 stage to the selection of the most suitable scenario according to the context and the stakeholders engaged. With this perspective, the present research is a guiding tool for DMs for the design of 14 transformation/regeneration scenarios with a long-term perspective of sustainable cities and 15 16 neighbourhoods. From the results obtained, it is possible to build new and unexpected scenarios by combining the main opportunities and strengths of most suitable alternatives. 17

18

#### 19 Keywords

- 20 Mixed-methods, urban design, MAVT, Scenario planning, urban regeneration, smart cities,
  21 sustainable neighbourhoods.
- 22

#### 23 1 Introduction

The rapid urbanization and the increasing number of people living in urban contexts are negatively
affecting cities and the life quality of their citizens (Al-Azzam & Alazzam, 2019; Kumar, Singh,
Gupta, & Madaan, 2020). In 2010, 50% of the world population lived in urban areas and this figure

27 is forecast to rise to 68% by 2050 (United Nations, 2019). Due to the high density of people, capitals 28 and job opportunities, cities become particularly attractive and are required to respond in a resilient 29 and sustainable way to meet the new demands generated, but at the same time major environmental, 30 social and economic challenges have arisen. Sustainable Development Goals (SDGs) adopted by all United Nations Member States recognised this urgency by delivering the 11<sup>th</sup> SDG which enhances 31 inclusive and sustainable urbanization and promotes the participation in human settlement planning 32 and management (United Nations, 2015). Given these premises, smart cities and sustainable 33 neighbourhoods could be possible solutions for the common purpose of improving living standards 34 of urban communities considering major environmental, social and economic benefits (Silva, Khan, 35 & Han, 2018). Even if the concept of smart cities and sustainable neighbourhoods has quite a fuzzy 36 nature, it generally suggests the proposal of clever solutions aimed at boosting productivity both 37 qualitatively and quantitatively (Caragliu, del Bo, & Nijkamp, 2011). In order words, they are meant 38 39 as a complex composition of multiple attributes (Silva et al., 2018) linked to the concept of sustainable 40 regeneration (Bottero, Caprioli, Cotella, & Santangelo, 2019).

Sustainable regeneration, beyond the triple-bottom-line approach (Sala, Ciuffo, & Nijkamp, 2015), 41 requires the consideration of the land take and the reuse of abandoned sites to preserve the scarce 42 land resource and to reduce criticalities generated by the urbanization (Sdino, Rosasco, & Dell'Ovo, 43 2021). A crucial issue is represented by the presence of abandoned industrial sites, located in 44 peripheral and not attractive locations (Dell'Ovo, Bassani, Stefanina, & Oppio, 2020). Their reuse 45 implies remediation costs but their neglect may entail an ecosystem degradation and thus a loss of 46 ecosystem services (Assumma et al. 2021; Caprioli et al. 2021). Here, positive and negative 47 48 externalities have to be managed, as well as a trade-off among the multiple dimensions involved for 49 selecting the most sustainable alternative of regualification.

50 In this context, the adoption of integrated methodologies is strategic for analysing each phase of the 51 decision problem from its early stage to the selection of the most suitable scenario according to the 52 context and the stakeholders engaged. The development of a multi-methodological framework allows 53 Decision-Makers (DMs) to guide the regeneration by considering different perspectives and 54 satisfying the demands of society and the city (Shen, Peng, Zhang, & Wu, 2012). The identification 55 of priority actions and transformational changes require a complete and structured understanding of 56 the overall urban system and its subsystems (Webb et al., 2018).

The purpose of this contribution is to present a multi-level methodology where the regeneration of an abandoned and polluted site is carried out through analytical phases. The case study selected concerns the requalification of the area called Basse di Stura, a former industrial area located in the city of Turin (Italy). As in most regeneration processes, DMs are mainly the Public Administration, policy makers and public bodies, which work for city transformation with a comprehensive sustainable view, spanning environmental protection, social cooperation, technological advancement and cultural preservation.

Although the individual frameworks and methodologies adopted in this research are not new, their 64 65 combination through a multi-level, multi-scalar and multi-stakeholders approach is novel. This combination of frameworks and methodologies makes possible to support integrated and informed 66 decisions and explore strategic urban issues. Their implications can be explored using a rich 67 knowledge framework developed from the analysis of the social, infrastructural and environmental 68 layout of the case study (Webb et al., 2018). This integrated method can be used as a systematic 69 scheme for supporting research and practice in scenario analysis to cope with the intrinsic complexity 70 71 and uncertainty of urban strategy building (von Wirth et al., 2014a). Moreover, the method can ensure that knowledge development will be salient, credible, evident and legitimate (Cash et al., 2003). 72

73 2 A Multi-level methodology

Several evaluation models are available for supporting the assessment of policies, plans and projects in the context of urban transformations. Three main families of methods can be identified (Mondini, 2016). A first family records the economic analysis methods such as Cost-Benefit Analysis (CBA). These methods are based on the identification of the full range of costs and benefits generated by the projects and they provide synthetic performance indicators that allow to assess a preliminary

79 feasibility of the operations (Sartori et al., 2014). The limits of these methods have been highlighted 80 by many authors considering that a reductionistic approach does not consider the overall complexity 81 of the system and the participation of the different stakeholders (Munda, 2005). In the light of these 82 limits, a second family of methods can be recalled, which refers to Multicriteria Analysis. These 83 methods allow several criteria, both economic and extra-economic, to be taken into account and they are based on a strong interaction between DMs and stakeholders. A third category of methods can be 84 lastly mentioned, related to Environmental Impact Assessment (EIA) and Strategic Environmental 85 Assessment (SEA) which focus on the evaluation of impacts on the environmental systems. Each one 86 of the three aforementioned families has positive aspects but also intrinsic limits, thus moving partial 87 assessments; in this sense, for a more holistic vision, the paradigm of the integrated assessment has 88 been proposed which combines different approaches. In facts, (von Wirth et al., 2014b)(Ighravwe, 89 Babatunde, Denwigwe, & Aikhuele, 2020)(Ariza-Álvarez, Soria-Lara, Arce-Ruiz, López-Lambas, & 90 91 Jimenez-Espada, 2021a)(Alessandra Oppio & Dell'Ovo, 2020) as it is well known, urban design is a process characterized by the presence of multiple actors and stakeholders, many conflicting values 92 and perspectives which should be taken into account simultaneously, such as socio-economic, 93 94 technical, political and environmental aspects. In that context, the adoption of only qualitative or quantitative approaches seems to give a partial view of the problem under analysis. For that reason, 95 the interest in mixing methods has strongly increased to create purposeful knowledge and support 96 97 DMs in urban contexts addressing future urban development policies (Colorni and Tsoukiàs 2013). Different ways of designing and combining methods are feasible. The multi-phase approach has been 98 chosen in the present work (Meissner, Creswell, Klassen, Plano, & Smith, 2011), due to the 99 100 characteristics of the case study, where the urban design is crucial. The multi-phase approach supports 101 the development of a step-by-step process (Figure 1): firstly, qualitative analyses highlight the goal, 102 objectives and values of the decision problem; then, quantitative analyses help to validate and evaluate the final project solutions (Berta, Bottero, & Ferretti, 2018). In particular, the proposed 103 104 methodology combines three main working phases: the problem framing, the scenario building and

the problem-solving.

106 The first phase starts from a broad analysis of the case study to highlight the main elements, which characterize the decision problem. In parallel, a Stakeholder Analysis has been conducted, to 107 understand the actors involved in the process and predict their potential support or rejection of a 108 strategy. The second phase concerns the scenario building. Grounding on the results of Phase 1, this 109 phase is related to the design of possible alternatives taking into consideration the role and 110 111 expectations of stakeholders in the wider context of transformation of the area. To support the scenarios formation, the STEEP Analysis is combined with SWOT Analysis (STEEP+SWOT). Their 112 combination helps both the definition of strategies for the design of alternatives, and the identification 113 114 of a preliminary set of indicators. An additional tool, the Wilson Matrix, has been used during the scenario building to define plausible strategies for the regeneration (Amer, Daim, & Jetter, 2013). 115 The third phase involves the evaluation of the alternatives through a Multicriteria Decision Analysis 116 (MCDA) technique, in order to identify the best sustainable solution for the regeneration of the site. 117 The final result of this process is a set of ranked alternatives where the winning scenario represents 118 119 the most suitable alternative according to stakeholders' expectations.



121

#### 122 2.1 Stakeholders Analysis

In the multi-level methodology proposed, the Stakeholder Analysis is the first method applied to 123 124 support the decision-making process. Its role in urban transformation and planning is particularly useful to identify all the actors involved and interested in the process under analysis and, 125 consequently, to highlight their capacity to affect the diffusion or inhibition of strategies (Dente, 126 127 2014; Yang, 2014). A single or a group of actors can strongly influence the decisional outcomes, both for satisfying individual interests and objectives based on their values and preferences, and after their 128 relations with other stakeholders (Dente, 2014). As far as the decision-making process is concerned 129 in strategic planning and sustainability assessment procedures, the identification and classification of 130 the stakeholders are fundamental to highlight the conflicting interests among them at an early stage 131 of the process and to avoid negative effects in the next ones (Gill, Lange, Morgan, & Romano, 2013). 132 From a practical point of view, the first step in the development of a Stakeholders' Analysis is related 133 to the identification of some characteristics of each actor: their level of intervention (national, 134 regional, local), the category of actors they belong (political, bureaucratic, special interest, general 135 interest, experts) and the resources which they carry out (political, economic, legal, cognitive), as 136 well as their roles and expectations (Dente, 2014). 137

138 Among the different approaches to develop a Stakeholder Analysis, the present research combines two different methodologies: the Power Interest Matrix (Johnson, Scholes, & Whittington, 2007; A. 139 L. Mendelow, 1981) and the Social Network Analysis (Marin, B., Mayntz, 1994; Rhodes, 1997). 140 Their combination comes from the need of integrating the potentialities of these two approaches: 141 142 from one side, the Power Interest Matrix clearly shows the power and interest of each stakeholder in 143 the specific decision-making process (A. Mendelow, 1991), on the other side, the Social Network 144 Analysis (SNA) identifies the relationships among stakeholders. According to this approach, it is possible to visually understand the size and the form of the network, as well as the coalitions and key 145 146 actors in the decision context. This information is particularly useful because the connections and relations among stakeholders can affect the overall performance of the decision-making process(Bottero, Caprioli, & Berta, 2020).

#### 149 2.2 STEEP+SWOT Analysis

150 The SWOT Analysis is a well-known technique developed during the 60's (Humphrey, 2005) with the aim at analysing the strengths (S), the weaknesses (W), the opportunities (O) and the threats (T) 151 of a complex problem. The SWOT Analysis is a 4 quadrants matrix, that allows DMs to divide a 152 given problem according to existing endogenous factors (i.e. strengths and weaknesses) and possible 153 exogenous factors that could occur in the future (i.e. opportunities and threats). The SWOT analysis 154 supports the interpretation of the state of the art and the identification of the drivers able to empower 155 strengths and opportunities, and to minimize weaknesses and threats. It can be used as a tool to 156 validate and ensure the efficacy of the selected strategies. The SWOT Analysis was used in the fields 157 of marketing and economy, and, since the 80's, it was employed in the public sector for evaluating 158 alternative scenarios and public policies. Today, the SWOT Analysis is applied to both public and 159 private sectors, such as in the evaluation of plans, programs and projects, or territorial analysis for 160 161 the localisation of new interventions.

Despite the general validity of the SWOT analysis, this tool has been recently combined with 162 complementary ones to provide better and more organized results. The STEEP analysis is often 163 integrated with the SWOT analysis (STEEP+SWOT), a more recent tool that is generally employed 164 in the decision-making process to better visualize the driven factors of possible objectives and actions 165 of transformation scenarios (Armstrong, 2014; Cadrien, Messaadia, Majumdar, & Eynard, 2011; 166 Ighravwe et al., 2020). The STEEP Analysis considers the 5 following components: 1) the Society 167 (S) considers the features related to the citizens that live in the context under investigation, such as 168 the people age, non-employment rate, people migration, or social capital, among others; 2) 169 170 Technology (T) refers to the presence or the lack of devices, infrastructures that contribute to the economy of the context under investigation in terms of cooperation and/or competitiveness in the 171 market, or even in terms of security, e.g. presence of security devices, renewable energy or 172

accessibility to services; 3) the environmental component (E) provides an analysis of the
environmental characteristics with the aim to monitor the health status of the context under
investigation, e.g. CO2 emissions, air pollutants, water quality, or production of biological energy;
4) the economic component (E) refers to the state of the art of the sectors that contribute to the Gross
Domestic Product (GDP) and thus to the attractiveness of a given territory; 5) Policy (P) refers to the
presence or the lack of plans and programs, funds or projects that could contribute to the improvement
of the life quality in the context under investigation.

180 In this study, the STEEP Analysis components are combined with the 4 SWOT quadrants to analyze

181 the complex dynamics of a critical area.

#### 182 **2.3** Scenario building

Scenario is intended as "a set of hypothetical events set in the future constructed to clarify a possible chain of causal events as well as their decision points" (Kahn, 1989). Over the last decades, the traditional planning was not able anymore to satisfy the needs of contemporary cities and to plan efficacy long-term policies. Strategic planning has increased its role in planning processes thanks to the multidisciplinary approach, the long-term vision and a more place-based approach. Renovated thinking and practice through scenario building and planning are ever more required to govern the uncertainty (Chiffi & Chiodo, 2020).

190 The scenario building is a methodology that supports strategic planning (Albrechts, Healey, & 191 Kunzmann, 2003; Godet, 2000; Pillkahn, 2008; Stojanovic, Mitkovic, & Mitkovic, 2014) in the 192 design of possible city evolutions (Amer et al., 2013), taking into account the *desiderata* of actors 193 and stakeholders engaged, thus increasing policy consensus (van de Kerkhof, 2006).

Increasing emphasis is being placed on the use of scenario planning techniques which are able to consider uncertainty and complexity of decision problems and urban systems. Scenario planning stimulates a strategic thinking and helps to overcome thinking limitations through the envisioning of alternative futures and to support policy-making processes under uncertainty conditions. Scenarios are defined as possible, often hypothetical, sequences of events constructed in an internally consistent way considering casual processes and decision points. Scenario building is broad, diverse and comprises a wide range of approaches and techniques. The integrated use of scenario analysis in the context of urban planning and design leads to several benefits connected to the improvement of the decision-making process and identification of new issues and challenges which arise in the future, thus creating a learning process.

It is widely agreed in literature the consideration of a finite number of scenarios for future transformations. In many applications, the average number of scenarios range between 3 and 5 with a timeframe of development from the short to the medium-long term. Among the numerous tools available in scenario planning, Wilson matrix can be used to evaluate and prioritize the degree of influence/impact and uncertainty of each scenario driver, concept or factor on the future. It has been recommended that "high", "medium" and "low" categories are sufficient to rank the drivers within the matrix (Amer et al., 2013).

#### 211 2.4 Multicriteria Decision Analysis

The MCDA method has been selected to evaluate the alternatives generated by the scenario building approach previously detailed. In particular, MCDA is a specific field of Operational Research aimed at supporting decision processes (Brans & Gallo, 2007; Ormerod & Ulrich, 2013). In detail, MCDA techniques aid DMs in taking decisions among a set of alternatives by eliciting their preferences. It is defined both as an approach and a set of techniques able to provide an overall rank of alternatives (Dodgson, Spackman, Pearman, & Phillips, 2009) and to consider at the same time qualitative and quantitative data (Dodgson et al., 2009).

Among the different MCDA methods (for a complete survey it is possible to refer to Figueira et al., 2005), the Multiattribute Value Theory (MAVT) has been applied. MAVT supports DM in addressing problems that involve a finite and discrete set of alternatives that can be evaluated based on conflicting objectives (Keeney & Raiffa, 1976). It has to be noticed that, among the Multiattribute Decision-Making (MCDM) field of research, several methodologies have been developed to aid the DM in taking a consistent decision. The Multi-Attributive Border Approximation area Comparison

(MABAC) approach takes into consideration the conflicting attributes evaluating border 225 approximation area generated by the context and the DM (Pamučar & Ćirović, 2015; Zhang et al., 226 2020); the Multi Attributive Ideal Real Comparative Analysis (MAIRCA) method is based on the gap 227 between theoretical and real ratings within the alternatives evaluation (Gigović, Pamučar, Bajić, & 228 Milićević, 2016); the complex proportional assessment (COPRAS) method is structured to evaluate 229 the significance and utility degree of alternatives (Zavadskas et al., 1994). More generally, with 230 respect to other MCDA methods such as VIKOR, ELECTRE, TOPSIS, PROMETHEE, or GRA 231 approaches, MAVT has been selected because it has the strengths to orientate the discussion towards 232 the values of the performance of the alternatives, forcing the stakeholders to reason about projects 233 priorities and opening new perspectives for the discussion. For these reasons, MAVT has been applied 234 to many real world decisions also in the context of urban territorial transformations and in particular, 235 a compensatory method has been selected due to the different dimensions and values to be considered, 236 237 the necessity to find a trade-off among them. The aggregation function is the following:

239 
$$V(a) = \sum_{i=1}^{n} k_i v_i(x_i(a))$$

238

240 Where V(a) is the overall value function of alternative a;  $x_i(a)$  is the alternative as performance value for the attribute *i*, with i = 1, ..., m;  $v_i$  is the partial value reflecting the performance for attribute 241 242 *i*;  $k_i$  is the scaling factor for attribute *i* (Belton & Stewart, 2002) with specific reference to this parameter, different assessment methods are available in MAVT, such as SWING weights, rating, 243 pairwise comparison, trade off and qualitative translation. The aggregation rule presented within the 244 245 additive model selected (MAVT) supports the definition of a compromise between conflicting values which is of extreme importance in the field of urban development (A. Oppio, Bottero, & Arcidiacono, 246 247 2018).

[1]

#### 248 **3** Case study

249 The case study chosen for the experimentation of this innovative mixed-methods approach is a downgraded area called Basse di Stura, located in the Northern part of the city of Turin (Italy) (Figure 250 251 2). With its 150 hectares, it represents one of the wider free areas of the city, but, until now, underused due to the high level of contamination of the soil. In the last years, the Municipality of Turin has 252 expressed its interest for this area for the natural potentialities of this site and its strategical location. 253 The area is part of three relevant undergoing projects connected to the regeneration of blue-green 254 infrastructures in the city of Turin and the surrounding municipalities. The river Stura, the rural past 255 and the position at the edge of the city constitute fundamental elements in the definition of the natural 256 potential of the area. For that reason, the local administration established, for a long time now, to 257 transform the area in an urban and fluvial park. Until now, no operation has been started on the area 258 and its original conditions were strongly compromised in the last fifty years. The development of 259 260 industrial activities, around the 50s, but in particular after the 70s, has gradually led to a transition from a rural to an industrial vocation of the area. Even today, many factories and car dealerships 261 occupy the area, but, due to the crisis of the industrial sector that has taken place in Turin, a lot of 262 these activities are now closed. The main problem affecting the area is the worrying soil 263 contamination caused by the presence in the past of heavy factories and the illegal disposal of 264 industrial waste. For the transition to an urban and fluvial park, the Municipality of Turin has allowed 265 266 the landowners to build a small surface on the area or another site of the city in exchange for soil remediation. However, the high costs connected to the remediation have prevented the 267 transformation, which is not feasible for the small buildable surface expected (around 0.10 sqm/sqm). 268 269 Other aspects characterize the area of Basse di Stura and its surrounding: a set of farmhouses dating back to the 17<sup>th</sup> and 18<sup>th</sup> century, legal and illegal urban allotments located in the residual spaces 270 271 among infrastructures, the variety of flora and fauna along the river, two quarry lakes and the Roma camps. Figure 7 synthesizes the main characteristics which affect this site. 272





274

Figure 2. Localization and the main characteristics of Basse di Stura area.

The complex situation of the area, the variety of aspects to be considered and the multiple actors
involved in the process require the adoption of structured evaluation methods. For these reasons,
Basse di Stura area represents a useful example for testing such innovative mixed-methods approach.

### 278 4 Application

In this section, the methodological framework previously described has been applied to the Basse di
Stura area. It should be noticed that the results obtained by the individual tools and as product of their
integration are finalized to support the functioning of the methodological framework.

To proceed with the generation of the alternatives and their evaluation, a deep analysis of stakeholdersinvolved and the territorial context have been performed.

## 284 4.1 Results of the Stakeholder Analysis

Once listed the main stakeholders (see, Table A.1 in the Appendix), these single actors are divided based on their level of power and interest and analysed with respect to the interactions existing among them. This simultaneous analysis is possible thanks to the combination of the two Stakeholder analysis methods described in the methodological section, i.e. the Power Interest Matrix and the Social Network Analysis. Figure 3 shows the results of the Stakeholder analysis developed through this combination of methods. The analysis highlights the centrality of the Municipality of Turin which is the most central actor; other relevant stakeholders are the landowners of the area, the developers
and investors and their position in the bottom right part of the graph shows their relevant power and
interest.



294 295

296

Figure 3. The decision network combined with the power interest matrix for the problem under investigation

297 4.2 Result

## 2 Results of the STEEP+SWOT Analysis

The STEEP+SWOT Analysis portrayed the state of the art of Basse di Stura (Figure B.1), from which emerges a downgraded area with unexpressed potentialities to become in the future an attractive pole for the city. Soil contamination, air, and water pollutions caused health problems to Basse di Stura workers and to the residents who live nearby. The informal allotments caused social marginality and abandonment of vulnerable people. The non-intervention could trigger irreversible impacts in the 303 area. Its location benefits from strategic accessibility, such as with highway, airport, future metro 304 line, and technological opportunities (e.g. empowerment of intermodal transport, or energy production) can improve urban transportation. The vast green areas, the river Stura could connect this 305 306 area with the green and blue infrastructures of the Metropolitan City. Possible inclusion of the area within environmental projects could facilitate the restoration and enhancement of its habitats. 307 Education has the power of sensibilization and awareness of present and future generations about the 308 area (e.g. social justice, or waste recycling). The river flooding is a threat that could further damage 309 the area. The local economy is affected by a progressive abandonment of the farmhouses and 310 industries. Some opportunities could be the adaptive reuse of the industrial buildings for green energy 311 production (see EU project Together2020 of Turin), and for the creation of new job demand through 312 the design of co-working spaces. Taxes and subsidies for green technology may attract investors in 313 the area and facilitate the adoption of energy policies, even if the long-term transformations and the 314 315 huge amount of economic resources could threaten their interest. The ongoing revision of the Municipal Plan is thus an opportunity to regenerate Basse di Stura. 316

317 4.3 Results of the Scenario Building

318 The key elements emerged from the STEEP+SWOT Analysis have been integrated within the scenario tool, i.e. Wilson matrix, able to evaluate impact and uncertainty of the strategies proposed 319 for the regeneration of the Basse di Stura (see Figure 4). Those drivers evaluated in the Wilson matrix 320 with a high impact and low uncertainty have been selected for defining potential strategic scenarios 321 (Özkaynak, 2008). For example, the factors related to the remediation of the ground pollutants or the 322 accessibility to the site are crucial for the definition of the transformation projects, whereas the 323 324 elements related to the increase of the industrial activities or the valorization of cultural events can be devoted less attention as they are characterized by high uncertainty (industrial activities 325 326 development) or low impact (cultural events promotion).



327 328

Figure 4. Integration of the STEEP+SWOT key elements as drivers into the Wilson matrix.

329 Observing the results of the Wilson matrix, three different scenarios have been proposed (i.e. inertial,330 tendential, strategic). In detail:

- The inertial scenario is only based on maintenance of the state of the art of the Basse di Stura
  area, according to the normative and regulatory tools in force;
- The tendential scenario envisions the achievement of the Municipality aims, given the Basse
   di Stura area to citizens through the creation of an environmental-energy park. This proposal
   is based on the remediation of the green areas from metals pollutants with the subsequent
   creation of social aggregation spaces.

337 The strategic scenario is finalized to regenerate the Basse di Stura area into a positive environmental footprint area that is opened to the nearby areas. This scenario is enforced by 338 the adaptive reuse of the industrial heritage to create data centres and start-ups aimed at 339 340 triggering a clean and innovative business. The core building will be a research centre connected with other buildings opened to companies that could be interested in potential 341 synergies. More in details, a photovoltaic (PV) park will be designed to produce electric 342 energy, as well as an innovative system will be experimented to transform the energy 343 produced by servers in a profitable opportunity of the district to heat and cool the surrounding 344 areas. In this way, the Basse di Stura area will be transformed, in the short and medium-term, 345 into an innovative industrial district that will carry out highly specialized workplaces 346 347 according to a low-environmental-impact business.

Attention must be devoted to the presentation of the scenarios through storytelling, for facilitating actors and stakeholders in envisioning the potential transformations in the area (Figure 5). Storyline means a narrative which highlights the main features and the relationships between the scenarios driving forces. Finally, a set of objectives and strategies have been defined for each scenario and, then, organized into short, medium and long-term (see Figure B.2).



Looking for the bike sharing...







Maybe one day...

- Figure 5. Storytelling to support the scenario building (Elaboration from the contents of the XIV ASP Summer School students, 2018).
- 353 354
- 355

#### 356 4.4 Results of the MCDA evaluation

## 357 4.4.1 Ranking of alternative scenarios

358 Once having defined the scenarios, it is possible to evaluate them for obtaining the best sustainable

359 one by employing the system of performance indicators, according to the Multiattribute Value Theory

360 (MAVT).

In detail, starting from the study developed with the STEEP+SWOT Analysis, a consistent decision tree (Table 1) has been framed by taking into account main important characteristics of the area and needs of the stakeholders engaged in the decision problem. Table 1 shows the decision tree, reporting the objective of the evaluation, the criteria and sub-criteria considered. For each sub-criteria, the table describes the indicators selected to measure the performances of different alternatives, specified if qualitative or quantitative, the direction of preference, and the unit of measurement or the scale used.



Table 1. Decision tree

Objective	Criteria	Sub-Criteria	Indicators	Nature	C/B	Scale of measurement
	Chiefia	Employment	Estimation of the number	quantitative	B	n°
		Linpiojinem	of job places created	quantitative	2	
		Company image	Educative function and	qualitative	В	-: fair level of educational activities
			green-house emission	•		and greenhouse emissions reduction
	Society		reduction			0: good level of educational activities
						and greenhouse emissions reduction;
						+: Very good level of educational
						reduction
		R&D Activities	Papers and patents	qualitative	В	-: no change in the # of papers and
			increment for the company	1		patents published compared to
			/			previous year;
						0: slight increase in the # of papers
T						and patents published compared to
tura						previous year; $\pm$ : very significant increase in the #
li S	Technology					of papers and patents published
se c						compared to previous year
Bas		Acquired Know-	Probability of the	qualitative	В	-: fair probability of developing new
of		How	development of new			products;
ion			products			0: good probability of developing
erat						new products;
sence						developing new products
Re		Sinergy with pre-	Degree of interactions	qualitative	В	-: fair degree of interaction between
		existing technologies	between	•		new and old facilities;
×			new and old facilities			0: good degree of interaction
						between new and old facilities;
						+: very good degree of interaction
		Renewable energy	Estimation of the quote of	quantitative	В	%
-		technology	renewable energy	1	_	
			production			
		Air pollution	Estimation of NOx	quantitative	С	ton/y
		~ ~ ~ ~ ~	emission			
	Environment	Soil pollution	Reduction of heavy metals	qualitative	В	-: no reduction of pollutants in the
			contamination			0: slight reduction of pollutants in the
						soil:

					+: significant reduction of pollutants in the soil
	Natural landscape	Biodiversity (Red List Indicator)	qualitative	В	<ul> <li>No changes in the current biodiversity level;</li> <li>Increase in the number of different plant and animal species;</li> <li>High increase in the number of different plant and animal species</li> </ul>
	Attractiveness of further investment	Likelihood of further private investment in the area	qualitative	В	<ul> <li>: fair attractiveness for the future investments;</li> <li>0: good attractiveness for the future investments;</li> <li>+: High attractiveness for the future investments</li> </ul>
Economics	Convenience of the investment	ROI (profit [€] / Investment [€])	quantitative	В	%
	Payback time	Payback time (Investment [€] / Yearly cash flows [€/y])	quantitative	С	y y
	Public incentives (green certificate)	Revenues from green certificates (Saved CO2 [ton/y] * GC price [€/ton])	quantitative	В	M€/y

Once the decision tree has been framed, it is possible to measure the performances of the alternatives according to the indicators defined. Results are presented in Table C.1 in the Appendix. From the performance matrix, it is evident how the inertial scenario is not able to improve the overall quality of the area considering the set of criteria selected, but this scenario does not require costs, unlike the tendential and strategic scenarios. However, these two last scenarios, albeit in different ways, take into consideration the general objective of requalification with a particular focus on the natural environment.

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The MAVT analysis has been carried out with the support of the Definite Software (Janssen, Van Herwijnen, & Beinat, 2000) which makes possible to standardize the performances, weight the set of criteria, aggregate scores, visualize partial and final rankings and perform the sensitivity analysis. Concerning the standardization phase, the software makes all the scores homogeneous by the transformation into dimensionless values [0-1] through linear functions (Figure 6). These functions have been carefully discussed with the client, the experts and the stakeholders involved and decided by considering the nature of the set of criteria defined.



383

Once the performances have been standardized, it is possible to proceed with the aggregation 384 considering the formula [1] presented in section 2.4. As it has been already explained, a compensative 385 386 aggregation procedure has been selected, which means that a weak performance obtained in one 387 criterion can be compensated by a good one obtained in another criterion (Dodgson et al., 2009), with the final aim to provide an efficient solution which is a balance among the criteria defined. Given the 388 importance of all the four components in achieving the final objective and always in agreement with 389 the objectives elicited by the DM, it has been decided to visualize a neutral scenario where the same 390 influence has been assigned to the dimensions considered in the decision problem (i.e. 25% of 391 importance to the four considered criteria of Technology, Society, Environment and Economic). 392 From the calculations, the strategic scenario ranks at first place with an overall score of 0.80, followed 393 394 by the tendential scenario (0.53) and the inertial scenario (0.06).

## 395 4.4.2 Sensitivity analysis and final recommendations

Despite the global coherence of the obtained results, it is always necessary to perform a sensitivity analysis in order to test the internal robustness of the ranking and to validate the results. In particular, the sensitivity analysis was performed based on "what if" questions to see if the final answer is stable when the inputs were changed. Moreover, it is of special interest to see whether these changes modify the order of the alternatives. In the present paper, the stability of the results has been studied with reference to the variation of the weights of the criteria using the One-at-a-Time (OAT) approach. The 402 OAT approach assigns to one criterion at a time the highest weight (50%) and the others an equal
403 weight (16,7%) in order to observe the effects on the final results (Figure 7). As it is possible to see
404 in Figure 6, the result is constant and robust and the strategic scenario achieves always the first place,
405 also by changing the set of weights.



406

407

Figure 6. What if scenario.

The ranking visualized is not only important for the selection of the most suitable alternatives but 408 also to discard those not good enough. In this case, it is evident how the inertial one does not reach 409 the needs required for the requalification of the area, whereas both the strategic scenario and 410 411 tendential one present different positive features. For this reason, they have been thus envisioned according to meaningful values that are represented by the economic value, energy services, future 412 generations heritage and environmental protection. An effective way could be the generation of a new 413 414 hybrid scenario that comes from the combination of the tendential and strategic scenarios and 415 maximises the positive aspects of the two projects (Figure 8).

416



Figure 7. Spatial visualization of the winner scenario: the strategic scenario (Elaboration from the contents by the
 students of the XIV ASP Summer School).

## 420 5 Discussion and conclusions

417

This research presents a multi-level methodology for supporting the design and evaluation of 421 422 alternatives in the context of complex problems, applied to the case study of Basse di Stura area in Turin. The integration of different tools into an overall evaluation methodology makes it possible to 423 envision alternative transformations of the site. The combination of Stakeholder Analysis, 424 STEEP+SWOT Analysis, Wilson matrix and MAVT shows its potentiality in supporting the 425 definition of scenarios that take into account health and well-being aspects, socio-economic 426 427 development and environmental valorization. Furthermore, it provides a strong structure to the design 428 process. The adoption of scenario building is limited in practise, as emerged from the literature and as pointed by Ariza-Álvarez, Soria-Lara, Arce-Ruiz, López-Lambas, & Jimenez-Espada (2021). The 429 430 practical application of this research bridges the gap between theory and practice, is useful for highlighting scenario building potential. Moreover, the real-world case study application presented 431 432 in this paper shows how the mixed method approach is able to build and compare different alternative 433 scenarios related to a single action plan. More specifically, it can help to justify the decisions through

a clear, transparent and rational framework and supports DMs in establishing shared solutions and
intervention priorities. These last aspects are strongly relevant since scarce public resources and
consensus are the two main obstacles and constraints in urban project development.

437 The Stakeholder Analysis proved to be useful for understanding the multiple perspectives and views to be taken into account for effective regeneration of the area. Thanks to the combination of the 438 Power/Interest matrix and the Social Network Analysis it was possible to identify the key players that 439 triggered the transformation of Basse di Stura.STEEP+SWOT Analysis allowed DMs to analyse the 440 current state of the art. The matching of the STEEP and SWOT analyses improve the organization of 441 strengths, weaknesses, opportunities and threats according to the meaningful dimension of "different 442 environments that coexist in a city" (Camagni, Capello, & Nijkamp, 1998). This tool also supports 443 the identification of the main driving forces relevant to the scenarios generator and their transfer 444 (Schwab, Cerutti, & Hélène von Reibnitz, 2003). The Wilson matrix and the storytelling facilitated 445 446 the envisioning of the potential scenarios to be evaluated, leading the identification of the driving forces with the highest impact and low uncertainty, the definition of a set of performance criteria for 447 the evaluation and the construction of a protocol of objectives and strategies. The storytelling was a 448 suitable tool for describing the goal and the perspectives of each scenario, thus facilitating actors and 449 stakeholders in better understanding the defined objectives and strategies (Ariza-Álvarez et al., 450 2021b; Carbonell, Sánchez-Esguevillas, & Carro, 2017). The efficacy of scenario tools in building 451 452 alternative scenarios depends on a comprehensive knowledge on the values, pressures, opportunities and risks. If these are not properly detected by the evaluator, they could lead the key players to 453 prioritize certain issues rather others. MCDA was useful to compare different alternatives and select 454 455 the one able to find a balance among the dimensions considered. Moreover, given the level of detail 456 of the scenarios proposed, it allowed the analyst to use the different type of indicators and to select 457 those able to catch the peculiarity of each sub-criterion. The aggregation phase resulted in a final and partial ranking and the sensitivity analysis is useful to validate and justify the final choice to be taken 458 459 by the DM and to communicate the results transparently. The results obtained by performing the

MCDA should be read considering the aggregated score and also the partial scores, which can give 460 461 information about the main criticalities detected in each scenario. This consideration sheds light on the proactive role of the evaluation aimed at generating new and unexpected scenarios by combining 462 463 the strengths of the most suitable alternatives or by improving the main weaknesses resulted (Caprioli & Bottero, 2020; Dell'Ovo & Oppio, 2019). The DM, according to the final ranking, can generate a 464 new alternative aimed at maximizing the objectives considered as most important. MCDA provides 465 DMs with the suitable process to solve a complex problem, even if political decisions have the final 466 word on future transformations. 467

From this application, some future work can be outlined. Firstly, the proposed evaluation 468 methodology will be replicated in other critical areas, to increase its reliability. Secondly, the 469 STEEP+SWOT Analysis will be improved by integrating the dynamic SWOT Analysis (Carmelina 470 Bevilacqua, Anversa, Cantafio, & Pizzimenti, 2019; Bezzi, 2005) to explore the degree of dependence 471 472 between the driving forces, aiding the structuring of decision problem and more efficiently supporting strategic guidelines and recommendations. Thirdly, the main actors identified in the Stakeholder 473 Analysis could be further involved in the criteria weight elicitation phase also to visualise different 474 scenarios by performing a sensitivity analysis and test the internal robustness of the final rank. 475 Fourthly, concerning MCDA, other methods could be tested such as the Analytic Network Process 476 (ANP) to further explore the interdependency of the performance criteria deriving from the 477 478 interrelations of driving forces and thus evaluating a group of alternative scenarios defined through scenario tools. To this end, it is possible to conclude that the combination of the evaluation tools 479 seems to be very promising in the generation of useful framework able to support real strategic 480 481 assessment procedures and to aid the DMs to renovate the vision of urban plans, programs and projects. 482

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- 665

## Appendix A

## Table A.1. Survey of the relevant stakehodelrs for the Basse di Stura area

STAKEHOLDERS	LEVELS	RESOURCES	CATEGORIES	EXPECTATIONS
EU (European	international	economic	political,	supporting projects for solving
Union)			bureaucrats	environmental and social issues
Italian government	national	legal, political,	political,	supporting projects for solving
		economic	bureaucrats	environmental and social issues
Piedmont Region	regional	legal, political, economic	political, bureaucrats	<ul> <li>supporting projects for solving environmental and social issues;</li> <li>developing projects for the regeneration of blue-green infrastructures in the city of</li> </ul>
ARPA (environmental	regional	legal	bureaucrats, expert	- bringing the environment to a safe and clean condition;
Designers (architects,	national, regional,	cognitive	expert	developing effective projects;
planners)	local			
Big landlords (Poste, Italgas) -	national	legal, political, cognitive,	special interest	<ul> <li>creating value from land</li> <li>profiting from developing, building,</li> </ul>
Private land		economic		leasing or selling land of buildings
Investors	national, regional,	economic	special interest	profiting from developing, building, leasing or selling land of buildings
Metropolitan city	local	legal, cognitive,	political,	- developing projects with the municipality
of Turin		political, economic	bureaucrats	of Turin and the neighbourhoods
Municipality of	local	legal, cognitive,	political, bureaucrats	- developing the urban park
	R	economic		<ul> <li>quality services;</li> <li>efficient and organized public transports;</li> <li>involving local communities;</li> <li>supporting projects for solving environmental and social issues</li> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> </ul>
Neighbouring	local	legal, cognitive,	political,	- new services (e.g: bike sharing, green
municipanues		economic	bureaucrais	- developing projects with the municipality of Turin
AMIAT (Municipal waste management company)	local	cognitive	special interest	<ul><li>safety and security;</li><li>bringing the environment to a safe and clean condition</li></ul>
GTT (transport agency)	local	cognitive, political	special interest	<ul> <li>increasing the number of clients of their service;</li> <li>collaborating with public and private sector.</li> </ul>
Environmental associations	local	cognitive, political	general interest	<ul> <li>raising awareness about topics related to protection of environment, wildlife;</li> <li>supporting projects for solving environmental issues;</li> <li>preventing environmental degradation</li> </ul>

Small landlords	local	cognitive	special interest	- profiting from developing, building,
				leasing or selling lands
				- avoiding remediation
Local commercial	local	cognitive	special interest	- safety and security
activities				- increasing profit
				- new transport connections and better
				quality of the existing ones
				- supporting urban regeneration and social
				inclusion
Citizens	local	cognitive	general interest	- safety and security:
associations		0	6	- new and quality services:
				- efficient and organized public transports:
				- collaborating with public and private
				sector
Nomad community	local	cognitive	general interest	- avoiding relocation
Noniad community	local	cognitive	general interest	need for long term housing solution
				- need for long-term housing solution
				- access to education and employment
0	, ,		• • • •	- safety and security
Owners of	local	economic,	special interest	- avoiding relocation
industrial		cognitive		- profiting from developing, building,
activities				leasing or selling buildings
Cultural and	regional	legal, cognitive	bureaucrats, expert.	- raising awareness about topics related to
heritage	regional	iegui, eoginii e	general interest	protection of environment wildlife culture
associations			general interest	heritage sights endangered social groups
associations				ate :
				protocting historical sites (formhouses
T			Y	- protecting instorical sites (familiouses
Tourists	regional, local	economic,	general interest	- safety and security;
		cognitive		- quanty services;
				- efficient and organized public transports
Circoscrizione 4	local	legal cognitive	political	- safety and security.
Cheosenzione 4	local	legal, cogintive	burgenerate encoiel	- safety and security,
			Sureaucrais, special	- quality services;
			interest	- efficient and organized public transports;
				- involving local communities;
				- supporting projects for solving
				environmental and social issues
		<b>X</b>		- preventing environmental degradation;
		<i>Y</i>		<ul><li>preventing environmental degradation;</li><li>supporting urban regeneration and social</li></ul>
		Y		<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> </ul>
(		<i>y</i>		<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> </ul>
Construction	national,	cognitive	special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building,</li> </ul>
Construction Companies	national, regional, local	cognitive	special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> </ul>
Construction Companies Real estate	national, regional, local national,	cognitive economic,	special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building,</li> </ul>
Construction Companies Real estate developers	national, regional, local national, regional, local	cognitive economic, cognitive	special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> </ul>
Construction Companies Real estate developers	national, regional, local national, regional, local	cognitive economic, cognitive	special interest special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> </ul>
Construction Companies Real estate developers Local media	national, regional, local national, regional, local local	cognitive economic, cognitive cognitive	special interest special interest general interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the</li> </ul>
Construction Companies Real estate developers Local media	national, regional, local national, regional, local local	cognitive economic, cognitive cognitive	special interest special interest general interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> </ul>
Construction Companies Real estate developers Local media	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive	special interest special interest general interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the</li> </ul>
Construction Companies Real estate developers Local media Energy companies	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive economic	special interest special interest general interest special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> </ul>
Construction Companies Real estate developers Local media Energy companies	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive economic resources	special interest special interest general interest special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> </ul>
Construction Companies Real estate developers Local media Energy companies	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive economic resources	special interest special interest general interest special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> </ul>
Construction Companies Real estate developers Local media Energy companies	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive economic resources	special interest special interest general interest special interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> <li>energy hub centre</li> </ul>
Construction Companies Real estate developers Local media Energy companies Bike sharing	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive economic resources economic	special interest special interest general interest special interest general interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> <li>energy hub centre</li> <li>increasing the number of clients of their</li> </ul>
Construction Companies Real estate developers Local media Energy companies Bike sharing	national, regional, local national, regional, local local national	cognitive economic, cognitive cognitive economic resources economic	special interest special interest general interest special interest general interest	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> <li>energy hub centre</li> <li>increasing the number of clients of their service</li> </ul>
Construction Companies Real estate developers Local media Energy companies Bike sharing University	national, regional, local national, regional, local local national local regional	cognitive economic, cognitive cognitive economic resources economic cognitive	special interest special interest general interest special interest general interest expert	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> <li>energy hub centre</li> <li>increasing the number of clients of their service</li> <li>collaborating with public and private</li> </ul>
Construction Companies Real estate developers Local media Energy companies Bike sharing University	national, regional, local national, regional, local local national local regional	cognitive economic, cognitive cognitive economic resources economic cognitive	special interest special interest general interest special interest general interest expert	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> <li>energy hub centre</li> <li>increasing the number of clients of their service</li> <li>collaborating with public and private sector;</li> </ul>
Construction Companies Real estate developers Local media Energy companies Bike sharing University	national, regional, local national, regional, local local national local regional	cognitive economic, cognitive cognitive economic resources economic cognitive	special interest special interest general interest special interest general interest expert	<ul> <li>preventing environmental degradation;</li> <li>supporting urban regeneration and social inclusion;</li> <li>profiting from developing, building, leasing or selling</li> <li>profiting from developing, building, leasing or selling</li> <li>informing about the entire process of the project (ex-ante, in-itinere, ex-post)</li> <li>integration of energy facilities/grids in the area</li> <li>exploitation of local energy sources</li> <li>energy hub centre</li> <li>increasing the number of clients of their service</li> <li>collaborating with public and private sector;</li> <li>supporting projects for solving</li> </ul>

## Appendix B

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STEEP	Ĩ	Ř	Ť	R
components	STRENGHTS	WEAKNESSES	OPPORTUNITIES	THREATS
Society	Presence of historical rural heritage Proximity to high density residential areas	Health issues due in part to the site contamination Informal urban allotments (e.g. gipsy camps) Degradation of the architectures Neglected rural buildings (e.g. farm-houses)	Take advantage to historical and artistic assets. Open spaces can be used by different activities and education initiatives, in synergies with nearby places. Enhancing the landscape viewpoints	Obstruction of the landscape views Increase of social margination and marginality Abusive allotments in neighborhood Abandonment of the area
Tecnology	Waste of ex landfill is used to produce energy Area easily accessible from the highway Direct connection of the area with the airport Closeness to the metro line	Unused industrial structures Noise poliution from traffic Old industrial buildings Lack of bike sharing Lack of bike sharing Separation from nearby residential area Few public transports	Enhancement of the environmental management of the exi Andfill area Adaptive reuse of the industrial buildings Development of new technologies for energy monitoring Regenerate the sile for research R&D and renewable energy Connection of the area through cycle mobility to the city Improvement of public transport connection Enhancement of bike and electric car sharing points	Worse abandonement of the industrial buildings Increase of traffic and noise, air pollution High costs may limit the research of sustainable solutions. Creation of invasive structures and land take
Environment	Presence of extended green areas Presence of habitat and microhabitat annexed to the river Stura	High contamination by heavy metals and hydrocarbons, caused by the ex landfills Ecosystem degradation Industrial waste Air and water contamination Difficulty treatment of the groundwater flow	Inclusion of the area within a system of fluvial parks Increase of ecological quality Educational initiatives on waste recycling and reuse Potential use of the area to produce renewable energy. Inclusion into environmental projects, in network with other waterbodies that flow in the city.	Dry up of the river Stura and progressive groundvater pollution Occurrence of flooding events by river Stura Air contamination and pollution caused by abusive allotments Long time and huge funds to regenerate the area could limit the investors offers.
Economics	Rural and industrial vocation of the area Self-sufficiency of the farmhouses system (e.g. cultivation and cattle)	Lack of general services Progressive decommission of farmhouses Production of non-renewable energy by the industries Scarsity of funds for remediation of the area	Attraction of local activities thanks to the increase number of turists and citizens Refurbishment of dismissed industrial sites Reopening of indutries to increase the job demand in the area Producing renewable energy on site to reduce the high costs Promotion of tourism, workplaces, infrastructures initiatives in the area.	Private land owners that want to make profits No remediation funds Abadonment of the industries may decrease the job demand in the area Worsening situation in terms of quality of life in the area.
Policy	Strategic position in the city recognized by local policies Presence of regulations for protecting the existing cultural heritage Taxes and subsidies for green technology Periodic environmental monitoring of the area	Complexity of the bureaucratic problem Few flexibility of the current municipality plan of the city.	Take advantage to the strategic position can gain more important role inthe city. Subsidies and tax reduction guaranteed by the law can incentive to invest in the area. Participation of local community into a transparent negotiation process with the potential investors.	Potential adoption of too sectorial policies.

Figure B.1. STEEP+SWOT Analysis developed for investigating the Basse di Stura area

Scenarios	Objectives	Stratagies	Vision		
Scenarios	Objectives	Strategies	SHORT	MEDIUM	LONG
	i.1 Improve urban livability and attractiveness of the area	i.1.1 Creation of green areas by regenerating the area			-@
		i.1.2 Creation of pedestrian and cycle paths			
Inertial		i.1.3 Remediation of agriculture areas			
scenario		i.1.4. Improve nearby architectures and historic assets	- <u>(</u>		
	i 2 Encourage socio-economic	i.2.1 Obtaining energy from the ex-landfill remediation			-3
	development	i.2.2 Improving intermodal transport network			
		t.1.1 Remediation and decontamination of the area	-0		-
	t.1 Environmental regeneration	t.1.2 Creation of a green wetland			
		t.1.3 Implementation of renewable energy solutions			-
	t.2 Improve the life quality of citizens	t.2.1 Creation of open public spaces			-
Tendential		t.2.2 Sensibilization on environment and energy	_		
scenario		t.2.3 Educational initiatives on innovative solutions			
		t.2.4 Increase the economic attractiveness in the area			-0
	t.3 Energy innovation	t.3.1 Localization of an energy research center	-6		
		t.3.2 Active involvement of university and partners			
		t.3.3 Create a thematic park and energy-based	-		
	s.1 Promoting socio-economic	s.1.1 Adaptive reuse of the industrial buildings			
	development with regard to industries	s.1.2 Job opportunities in the new industries			
		s.1.3 Improve electrical transportation			(A)
	s.2 Minimizing the impacts on the environment	s.2.1 Produce energy through autonomous systems	-		
Strategic		s.2.2 Reduce pollution through sustainable solutions	-		
scenario		s.2.3 Remediation of the whole area			
		s.2.4 Waste management for energy production	- A		
		s.3.1 Renewable electric energy generators on site			
	s.3 Create new energy	s.3.2 Thermal energy generators on site			
	indipendence	s.3.3 Creation of a smart micro-grid		<u> </u>	

Figure B.2. Scenarios, objectives and strategies for the requalification of the Basse di Stura area

## Appendix C

Objective	Criteria	Sub-Criteria	U.M.	Inertial Scenario	Tendential Scenario	Strategic scenario
		Employment	n°	0	100	1200
	Society	Company image	-/+	-	+	0
	Technology	<b>R&amp;D</b> Activities	-/+	-	+	0
		Acquired Know-How	-/+	-	0	Υ Í
		Sinergy with pre-existing technologies	-/+	-	0	+
		Renewable energy technology	%	0	75	100
Regeneration of	Environment	Air pollution	ton/y	30600	30600	0
Basse di Stura		Soil pollution	-/+		.t	0
		Natural landscape	-/+	0	+	-
	Economics	Attractiveness of further investment	-/+		0	+
		Convenience of the investment	%	0	5	10
		Payback time	у	0	10	25
		Public incentives (green certificate)	M€/y	0 0		2
	S.P.					

## Table C.1. Performance matrix