

# NATURE-BASED AND INNOVATION-LED URBAN REGENERATION: A HYPOTHESIS OF GREEN DISTRICT FOR THE METROPOLITAN CITY OF REGGIO CALABRIA

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**Abstract:** The interest in nature-based solutions for urban regeneration increased rapidly during the last years. Urban areas are affected by the side effects of rapid urbanisation processes which need to be tackled quickly. The European Union placed the nature-based urban regeneration topic on the top of EU research areas' priorities in order to improve the well-being in urban areas, increase the sustainable use of energy and boost carbon sequestration. The aim of the paper is to understand how the introduction of nature-based solutions in innovation-led urban regeneration can contribute to the realisation of a green district in a central neighbourhood of the Metropolitan City of Reggio Calabria (IT). The proposal will be framed into an urban regeneration model in order to propose a replicable model to apply in other distressed urban areas impacting on the social, economic and environmental dimension. Findings, deriving from the MAPS-LED Project (CLUDs Lab) and Gevaul Lab research activities, will show the positive impacts of the proposed nature-based and innovation-led solution at urban district level in terms of carbon sequestration, energy and money savings, in consistence with the main aim of Europe 2020 strategy: reach a smart, inclusive and sustainable growth.

**Keywords:** sustainable urban development, urban regeneration, nature-based solutions, green district, MAPS-LED.

## 1. INTRODUCTION

The aim of the paper is to understand how the introduction of nature-based urban regeneration could contribute to the realisation of a green district in a central neighbourhood of the Metropolitan City of Reggio Calabria (IT). The need of converting a neighbourhood into a green district responds to the rapid change in the quality of the urban environment and, consequently, in the quality of life (Bai, 2012). Urban areas are currently affected by the side effects of rapid urbanisation processes. According with the UN estimations (2014), the 54 per cent of the global population live in urban areas with a potential increase to the 66 per cent in 2050. Europe reveals the most urbanised regions of the world, with a total of the 73 per cent of population living in urban areas (UN, 2014). The emerging demand of services, especially those related to ICT, Financial Market, Education (Hall, 2001), is the main push of the urbanization process in the global era. The role of the city as engine of economic growth becomes more and more relevant. The concerns about unemployment, social exclusion and environmental impacts are growing faster, as well. The environmental pressures raise up as one of the most important problem to tackle, especially due to the climate change effects. The introduction of sustainability principles, in order to balance competitiveness and economic growth, affected the planning system during last decades, emphasising the need to re-nature cities in the reaffirmation of ecological processes as a base for the future development. The awareness of establishing a new and balanced relationship between nature and human activities is no longer seen as just a constraint but as an opportunity for a sustainable and equitable growth. The European Union recognised the importance of re-naturing cities and

territories with the adoption of the Research and Innovation Policy Agenda for Nature-based solutions (EC, 2015). One of the research priorities focuses on nature based urban regeneration to enhance sustainable urbanisation. The development of proper and feasible solutions able to enhance sustainability through urban regeneration is a complex and dynamic process (Bevilacqua & Trillo, 2012). Urban regeneration is characterised by a “comprehensive integration of vision and action” (Zheng et al. 2014: 272) and is acquiring a powerful role in shaping the future of cities (Bevilacqua, 2012). In order to understand how nature based solutions can be integrated in suitable urban regeneration initiatives the paper is structured as follows. The first section briefly describes the relationship between nature and city from a planning perspective. It begins with the change imposed by sustainable development principles to the planning system and introduces the centrality of urban regeneration in reaching a sustainable urban development in the EU policy context. The second section introduces the concept of nature-based solutions reporting the available definitions, their main characteristics and information on the EU Research and Innovation Agenda on Nature Based Solutions (NBS). The third section describes the elements taken into account for the proposal of a green district starting from the application of nature based solutions for building energy retrofitting in a central neighbourhood of the City of Reggio Calabria (IT). Data deriving from the comparative scenario analysis applied to the small scale experimental activity will be estimated for the considered district. The results illustrate the benefits deriving from a possible application at larger scale (district) in terms of carbon sequestration, energy and money savings. These elements will be framed into an urban regeneration scheme coherent with objectives of the EU Cohesion Policy following the Smart Specialisation Strategies (S3) perspective. The results allow to propose a possible green district model based on the concept of nature based urban regeneration in order to enhance sustainable urbanisation processes.

## **2. TOWARDS THE SUSTAINABLE URBAN DEVELOPMENT**

### **2.1. The relationship between city and nature from a planning perspective**

Sustainable Urban Development is a central element in the urban planning debate since the 1990s (Hall, 2014). The positions on how to address it shifted from the conservationist approach (1970s) to more complex positions (1980s) that have introduced sustainable development principles for national and local policies (Healey and Shaw, 1993). These principles imposed a change in the planning processes characterised by the myth of continuous growth. The golden age of planning was ended (Hall, 2014), and planners had to deal with the revision of the traditional planning system, which was basically growth-oriented. Sustainability seemed to revitalise a new vision for planning through the “ecological modernisation”, according which sustainability can be achieved without impeding economic growth (Davoudi, 2000 in Hall, 2014: 463). After the initial difficulties for planners to translate into practice the sustainable development principles, spatial planning has been seen during the 1990s as crucial in tackling the environmental issue in a broad sense, including sustainable development as policy principle in national and local planning policy (Bulkeley, 2006). Sustainable development policy goals started to be translated into practice through the planning of future development of cities. Land-use planning is not only related with regulatory aspects but it contributes to the management of environmental change in localities (Healey and Shaw, 1993). Lennon & Scott (2016) described an evolutionary process of planning theory and practice related to the relationship between city and nature from a planning perspective. The need to put in relationship nature and city firstly came to the fore

with the rapid industrialisation processes which has brought influential thinkers and planners to redefine an urban development models. During the 20<sup>th</sup> Century the relationship between city and nature has been analysed through different theoretical approaches (Howard, LeCorbusier, Wright, McHarg, Mumford etc.). The introduction of sustainable development principles during the 1970s has contributed to the review of the traditional regional and urban planning assumptions. By the 1980s with the new-urbanism movement the attention shifted toward a more compact city in order to ensure a good quality of life. Green design principles started to be integrated in city planning, shifting to a new and holistic approach which “seeks to work with natural processes through promoting the sensitive use and enhancement of green infrastructure” (Lennon & Scott, 2016: 274). This new approach defined as “Socio-ecological systems” considers cities as “complex hybrid systems” functioning “at multiple interconnected spatial and temporal scales largely determined by natural processes, but frequently calibrated by society” (Lennon & Scott, 2016: 274). It shifted from a traditional position characterised for an excessive orientation to the environment protection and preservation to the ecosystem approach which also include “enhancing, restoring, creating and designing new ecological networks characterised by multi-functionality and connectivity” (Scott et al., 2016: 267). These elements remark the need to adapt urban policies, planning tools and practices -and research- for the implementation of suitable models aiming at a sustainable urban development.

## **2.2. The centrality of urban regeneration for the sustainable urban development**

The complexity of current urban problems highlighted the need of an integrated approach able to include the social, economic and environmental perspective in a sustainable urban development perspective. Urban regeneration emerged during the last decades as suitable model for an integrated sustainable urban development. Thanks to its capability to intervene on all these dimensions, it represents the opportunity for cities to reach a Sustainable Urban Development in ensuring a smart, sustainable and inclusive growth. Urban regeneration is a widely experienced phenomenon but it is little understood and it is difficult to identify a common practice to apply in every context (Roberts & Sikes, 2000). According with Couch et al (2003: 2) “Regeneration is concerned with the regrowth of economic activity where it has been lost; the restoration of social function where there has been dysfunction, or social inclusion where there has been exclusion; and the restoration of environmental quality or ecological balance where it has been lost”. The urban regeneration concept evolved during the last 50 years in parallel with urban policies. Its focus “varied, shifting between a focus on the built environment and environmental quality (1950s and 1960s), to a social emphasis in the late 1960s, an institutional emphasis in the mid-1970s, and an economic emphasis by the late 1970s” (Healey, 2006: 98). The economic downturn at the end of 2010s increased the pressure on weak urban areas, pushing for a concrete effort of public authorities in urban regeneration based policy settings and implementation. Within the European policy context, the interest in urban regeneration for an integrated sustainable urban development emerged during the last decades. EU placed urban regeneration as central element in reaching a sustainable urban development with the Toledo Declaration (2010) that recognised its strategic potential for a smart, sustainable and inclusive growth in Europe (EU, 2010). The Declaration represents the basis for a concrete effort by Member States in defining a renovated Urban Agenda for the new Programming Period 2014-2020 and strengthening the urban dimension of Cohesion Policy. The attention of EU on Sustainable Urban Development is confirmed by the use of European Structural Funds and particularly by the European Regional Development Fund (ERDF), which allocates financial resources on integrated actions for sustainable urban development in cities (EU, 2013b). Among the EU initiative

funded by the ERDF Urban Innovative Actions (UIA) play a crucial role in identifying and testing innovative solutions for sustainable urban development. One of the topic selected by UIA is about the sustainable use of land and and nature-based solutions. The UIA together with NBS research agenda could provide the opportunity to experiment in different European cities nature based urban regeneration models. This process should be supported by local authorities through the implementation of urban policies and drawing of urban planning tools able to provide a suitable framework in re-naturing cities through nature based solutions.

### **3. NATURE BASED SOLUTIONS FOR CITY RE-NATURING**

The interest in city re-naturing is recent and encompasses different policy areas, which focus on a conception of the city different from the “eco-city” (Lennon & Scott, 2016). This new concept is based on the adoption of nature-based solutions (NBS) finalised at the definition of a new relationship between city and nature. “Such nature-based solutions mediate the relationship between human activities and ecosystem processes in urban landscapes and, if developed appropriately, could mitigate human impact” (Haase, 2016: 279). Although the interest of academics on this topic increased recently, few definitions of nature based solutions are available and the concept has not been explored in depth (Nesshöver et al. 2017). The concept is mainly adopted by policy-makers (IUCN, 2016) with the implementation of sporadic nature based solutions at local level. The European Union has recently recognised the importance of re-naturing cities and territories with the adoption of the Research and Innovation Policy Agenda for Nature-based solutions (EC, 2015). The EU Agenda defines NBS as “actions inspired by, supported by or copied by from nature” aiming to “help societies address a variety of environmental, societal and economic challenges in sustainable ways” (EC, 2015: 24). This definition highlights the capability of nature based solutions in tackling the current challenges and trigger a more sustainable growth. Similar to the EU definition but more focused on the ecosystem approach, the International Union for Conservation of Nature and Natural Resources (IUCN) defines NBS as “actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (IUCN, 2016: 2). This definition focuses on a re-natured city concept more related to the ecosystem approach, which seeks to manage the natural environment in balancing benefits for nature and society (Nesshöver et al. 2017). Ecosystem-related approaches (ecosystem Approach, ecosystem-based Adaptation/Mitigation, Ecosystem Services Approach) mainly focus on the management of the natural environment and describe how society depends on nature. It remarks the “linkages between ecosystem structures and process functioning and consequent outcomes which lead directly or indirectly to valued human welfare benefits” (Turner and Daily, 2008: 27 in Nesshöver et al. 2017: 1218). Another definition of nature based solutions linked with the ecosystem services approach is provided by Maes and Jacobs (2015: 123): “any transition to a use of ecosystem services with decreased input of non-renewable natural capital and increased investment in renewable natural processes”. Despite the few definitions available of NBS, it is possible to identify three main typologies (IUCN (2016: 9): (i) solutions that involve making better use of existing natural or protected ecosystems; (ii) solutions based on developing sustainable management protocols and procedures for managed or restored ecosystems; (iii) solutions that involve creating new ecosystems (e.g. establishing green building)”. Eggermont et al. (2015: 245), in taking into consideration the example of greening roof and walls (3<sup>rd</sup> type) explain how these solutions alone “would hardly contribute to increase biodiversity and the delivery of other Ecosystem services” if they will be not integrated into an adequate urban

planning approach at city scale. Researches and experimentations related to building energy retrofitting exploiting natural resources demonstrated how new technologies could contribute to the mitigation of environmental pressures in the built environment. This aspect opens the debate on two important issues: the consideration of NBS in a holistic vision aiming at the valorisation of the local supply chain related to the natural element to exploit, following the ecosystems services approach; the inclusion of NBS for building energy retrofitting in a more comprehensive planning vision that should include also the social and economic aspects related to NBS. From a strictly environmental perspective it could allow the sustainable use of the natural ecosystems, their proper management and a good level of restoration of the natural capital exploited. The awareness of re-naturing cities together with the centrality of urban regeneration in reaching a smart sustainable and inclusive growth could lead toward a renovated urban development pattern characterised by nature-based urban regeneration.

### **3.1. The EU efforts for Nature-based solutions**

The EU recognised the efforts of national, regional and local policy-makers on conservation and sustainable use of the natural environment together with an increasing interest by local communities in bringing back nature into urban areas (EU, 2015). The recent EU attention on NBS as a useful element in reaching a smart, inclusive and sustainable growth, combines the need to boost economic growth and achieve sustainability (Maes & Jacobs, 2015). Particularly, the EU Horizon 2020 Research Programme “foresees large-scale pilots and demonstration projects of tangible nature-based solutions” (Maes & Jacobs, 2015: 123), which integrates the objectives and priorities of the EU Research Agenda (EC, 2015). The Agenda prepared by an expert group on “Nature-Based Solutions and Re-Naturing Cities” (EC, 2015) highlights seven research priorities and four Thematic Goals. Research Priorities are not strictly related to a specific Thematic Goal allowing the possibility of an integrated approach in defining the adoption of suitable models for re-naturing cities. This process requires particular efforts by local authorities which should consider such solutions in any urban project or strategy (EC, 2015). Urban Regeneration through nature-based solutions is one of the research priority in order to enhance sustainable urbanisation. According with the EU (2015) three are the main interconnected challenges and trends to face in providing strategic opportunities for nature based solutions for sustainable urbanisation. The first is related to economic development measures: improving sustainability in cities could bring to new business models that will empower economic growth and at the same time reduce nature resources exploitation. The second is related to sustainable urban planning with nature-based solutions in providing opportunities for the adaptation to climate change and increasing urban resilience. The third is related to the contribution of nature based solutions to the social dimension of sustainable urbanisation: the increasing of well-being conditions in the urban environment could improve the living conditions of people and reduce health risks for vulnerable groups of people. As remarked by the EU Agenda (2015), urban regeneration through nature-based solutions could help in stimulating re-naturing processes for cities due to its potential to “offers a context for innovative interventions for green growth” (EC, 2015: 16).

## **4. NATURE BASED URBAN REGENERATION PROPOSAL FOR THE CITY OF REGGIO CALABRIA: METHODOLOGY**

The EU has recognised the need of “a more comprehensive evidence base on the social, economic and environmental effectiveness of possible nature-based solutions, including a

comparison with more traditional solutions” (EU, 2015: 21). The paper methodological framework is centred on the application of nature based solution used for building energy retrofitting through green building techniques. A comparative scenarios analysis on a small scale (building) experiment has been conducted in a central urban area of the Metropolitan City of Reggio Calabria (IT). The idea derives from the research and experimental activities held by the Università Mediterranea of Reggio Calabria (IT) in the field of Smart Specialisation Strategies (MAPS-LED Project – Horizon 2020 – Cluds Lab) and on energy building retrofitting strategies (Gevaul Lab). The first step relates to the comparison of two scenarios for the building scale experimental activity: Business as Usual (BAU) and eco-sustainable (ECO). The first is based on the application of traditional solutions. The second is based on the application of nature based solution in greening construction technique finalised at the building energy retrofitting. The results deriving from the experimental activity at building level will be then scaled up and estimated for the entire district using 3D GIS mapping techniques. The last step is to frame a nature based urban regeneration scheme consistent with the Europe Cohesion Policy objectives and applicable through local urban planning tools.

#### 4.1. The experimental phase on building prototype

The Gevaul Lab focused on the natural properties of Cork for a possible use in green construction techniques for building ecological retrofitting. The experimental activity is based on the valorisation and use of local natural elements such as cork. Its application in greening construction techniques for walls and roofs insulation allow to consider it as nature based solution according with Eggermont et al (2015: 245). Cork is a natural element present in the regional natural landscape as well as in different areas of the Mediterranean basin. Despite it was exploited till the second half of the past century for local economic activities it has been for a long time underused. One of the most important characteristic of cork is its natural capacity to capture Carbon Dioxide. It can result crucial for the development of possible implementation in the urban environment, especially in nature-based urban regeneration interventions. The experimental phase has been conducted on a Public building within an urban block of a central neighbourhood of the City of Reggio Calabria (see Figure 1) located in the area of intervention for the proposed green district (see Figure 2a).



*Figure 1: Reggio Calabria. Urban Block interested by experimental activity in a three-dimension GIS urban environment: a prototypical yard of sustainability*

The building has a particular institutional relevance because it houses an important public authority: The Regional Administrative Court House (TAR). Ecological retrofitting transforms ordinary maintenance into an opportunity for building energy efficiency. Through the comparison of a Business as Usual (BAU) scenario characterized by the use of traditional materials and an Eco-Sustainable scenario (characterised by the use of cork panels for roof insulation and walls passivation) it has been possible to estimate the economic (initial

maintenance costs) and environmental (global energy performance index) benefits deriving from the application of this greening building technique (see Table 1). The "Eco-sustainable" scenario is characterized by the adoption of natural thermal insulating hydraulic lime plaster, natural cork fitted with a funnel that produces the dual function of both thermo-insulation and ventilation in order to eliminate thermal bridges and avoid over heating in summer, the air conditioning system with indoor units and the installation of condensing boiler. The application of these materials determines an effective dynamic thermo-hygrometric and, in particular, summer perspiration reducing the discomfort of humidity (moisture) which triggers the need for cooling in summer and the massive demand for air conditioning.

*Table 1: Reggio Calabria. Urban Block #128 Total costs for the two intervention scenarios Special work for the specific building (Regional Administrative Court House). Related Pay Back period*

	<b>BAU Scenario</b>	<b>Eco Sustainable Scenario</b>	<b>Q</b>	<b>Tot costs BAU</b>	<b>Tot costs ECO Sustainable</b>	<b>D</b>
<b>Interventions</b>	€/sqm	€/sqm	sqm	€	€	%
Plaster renovation	60	80	2.675	160.500	214.000	33%
Windows replacement	400	500	554	221.600	277.000	25%
Pitched roof renovation	130	180	505	65.650	90.900	38%
Flat roof renovation	105	140	500	52.500	70.000	33%
<b>Total amount</b>				500.250	651.900	30%

The initial cost for the "Eco-sustainable" scenario is higher (+30% see Table 2) than in the "business as usual" due to the use of bio-ecological materials with higher quality and durability, and the most efficient climate system. It follows lower costs of ordinary and extraordinary maintenance and a cut in energy management costs. Eco sustainable retrofitting to the urban scale must be driven not only by the initial costs, but also by the management and maintenance costs during building life cycle. In this perspective energy savings is taken into consideration as a parameter for the estimation of environmental and economic advantages. Global Energy Performance Index (EPGI) has been calculated to estimate energy savings on the examined building. Once obtained data on energy consumptions (heating and cooling), it was possible to estimate the management costs for the two alternative scenarios assuming the average cost of € 0,115/kWh (thermal) and € 0,195/kWh (cooling) (see Table 2).

*Table 2: Reggio Calabria. Urban Block #128 EPGI for the BAU scenario.*

	<b>EPGI</b>	<b>Net area</b>	<b>EPGI Tot</b>	<b>Energy cost</b>	<b>Management cost</b>
	kWh/sqm	sqm	kWh/year	€/kWh	€
<b>Heating</b>	142	1.300	184.600	0,115	21.229,00
<b>Cooling</b>	102	1.300	132.600	0,195	25.857,00
<b>Total</b>			<b>317.200</b>		<b>47.086,00</b>

The "Eco-sustainable" scenario achieves an energy annual savings of € 27.157,00 in terms of management costs in the life cycle. This differential of less 57 per cent compared to the annual theoretical management costs of the "business as usual" scenario, can be added as cost saving (see Table 3). Payback of additional costs for Building Sustainable Retrofitting (differentiated from Business As Usual Retrofitting) can be assessed (at 4% Hurdle Rate) in 6 years.

Table 3: Reggio Calabria. Urban Block #128 EPGL for the eco-sustainable scenario

	EPGI	Net area	EPGI Tot	Energy cost	Management cost
	kWh/sqm	sqm	kWh/year	€/kWh	€
<b>Heating</b>	57	1.300	74.100	0,115	8.521,00
<b>Cooling</b>	45	1.300	58.500	0,195	11.407,00
<b>Total</b>			<b>132.600</b>		<b>19.929,00</b>

An estimate of the overall cost provides in the medium-long term an obvious convenience of the "eco-sustainable" scenario not only in terms of maintenance interventions, energy consumption, pollution abatement, indoor quality and general environmental protection, but also a better financial result. In addition to significant energy savings it is also possible to get high health, lower environmental impact and reduction of CO2 emissions into the atmosphere. Knowing therefore also the energy dynamics of a building system allows to identify those choices aimed both at the improvement of the energy efficiency and to the reduction of environmental impacts. At this stage the application of GIS techniques allow to compare quickly the data for alternative scenarios.

#### 4.2. The scaling up phase at district level

At this point a generalization from the building to the district level has been performed for the case study area (Massimo, 2009; Massimo, 2015; Massimo et al. 2016). It is located in a central neighbourhood of the city of Reggio Calabria. The majority of the built environment was rebuilt at the beginning of 1900 as an interesting Liberty – Art Nouveau settlement (see Figure 2a). The eco-sustainable Scenario based on natural cork system is conservative and high energy efficient. Its design adopts, at building level, ecological techniques and materials to reduce heat dispersion toward the outdoor as well as to cut fossil fuels consumption for heating and conditioning and consequently to lower related CO2 emissions. The neighbourhood has been mapped into a 3D valuation GIS (see Figure 2b) giving the relevant extension of: 490.000 sq.m of district total area; 125 urban blocks; 840 buildings covering a built-up area of 208.000 sq.m with 2.500.000 cu.m of built volume; 800.000 sq.m of apartments; over 400.000 sq.m of fronts to be insulated; about 180.000 sq.m of roofs to be aerated-ventilated and insulated; a population of 6.400 residents, plus thousands of University Students living temporarily in the area as tenants.



Figure 2: Reggio Calabria. Case study area (a); Urban scale 3D case study area model (b)

BIO Urban Sustainability works have been designed and valued in their environmental and energy impacts. As the prototype experimentation on building has showed, natural insulation and ventilation reduce the needs and energy consumption for winter heating as well as for more demanding air conditioning during summer. Relevant is also the amount of avoided Kg

of CO<sub>2</sub>. Data on building typologies, size and architectural characteristics have been gathered and mapped through GIS technique in order to estimate the potential benefits in a scaling up phase at district level. The use of GIS tools makes possible automatic assessment for the entire case study area. The variables taken into account in comparing a BAU and ECO sustainable scenario are: total monetary initial (investment) cost of works; energy consumption, total annual running costs, CO<sub>2</sub> emission per year (see Table 4). The positive results achieved (see Table 4) give two empirical positive evidences: physical in terms of energy saving thanks to sustainable bio-ecological materials employed; economic with a short period of pay-back of the “initial cost monetary negative premium”.

*Table 4: Reggio Calabria. Scaling up phase (district) potential benefits through building energy retrofitting*

		<b>BAU</b>	<b>Sustainable</b>	<b>D</b>	<b>D</b>
		x 1000	x 1000	x 1000	%
Investment work cost	€	64.400	85.600	+21.200	+ 24
Energy needs per Year	kWh	83.000	50.000	- 33.000	- 40
Management costs per Year	€	12.450	7.500	- 4.950	- 40
CO <sub>2</sub> emission per Year	kg	16.000	9.500	- 6.500	- 40

Research, field work, on field observations, as well as specific experimentations performed on the sample prototypal buildings assuming an intervention of sustainable energy rehabilitation, have highlighted an average reduction of 40% of the theoretical amount of energy needed as well as a reduction of the 40% of management costs per year. The consequent monetary amount of year energy saving is of € 4.950.000,00. Considering a total saving of passivation equal to € 4.950.000 per year the correspondent payback at steady rate of 4% (Hurdle Rate) can be assessed in about **6** years. In a period of 8 years, adopting a medium-high discount rate of 4% the extra initial cost of “eco-sustainable” scenario (Nature-Based on Cork) is recovered. In a period of 20 years the 50 per cent of the total initial cost is recovered. An astonishing result if summed up with environmental and energy positive outcomes, not taking into consideration the relevant direct environmental benefits (40% of CO<sub>2</sub> emission reduction). These empirical evidences encourage to follow the path of Sustainable Urban Conservation at larger scale and to apply the methodology in other prototype buildings and in different climate zones.

### **4.3. Hypothesis of Nature based Urban Regeneration for the City of Reggio Calabria: integration between policy opportunity and local urban planning tools**

Although the EU interest in nature-based solutions is currently focused on research priorities, the Cohesion Policy for the programming period 2014 allow to explore interesting possibilities for the application of nature-based solutions in cities. First of all, the need to re-nature cities cannot disregard innovation. It is one of the of the EU Research Agenda about nature based solutions (EU, 2015). It is also a central element in EU Cohesion Policy thank to the adoption of Smart Specialisation Strategies (S3). The S3 approach focuses on specific innovation-intensive sectors aiming at transforming regional economies on new or existing knowledge-based domains (EC, 2013a). The S3 process, which need to be translated into Regional Plans (RIS3) can help in the identification of those local potentials that innovation can trigger in order to discover new market opportunities and domains. The Calabria Region RIS3 plan has selected the greening building areas as one of the strategic trajectories of the

regional innovation strategy (RIS3). The valorisation of natural resources in the building construction technique in order to boost sustainability, empower the local economy and enhance the wellbeing of people is one of the key points. The main issue is related on how integrate these ideas into the traditional local urban planning tools in accordance with the European, national and local (regional) policies in boosting a smart, inclusive and sustainable growth.

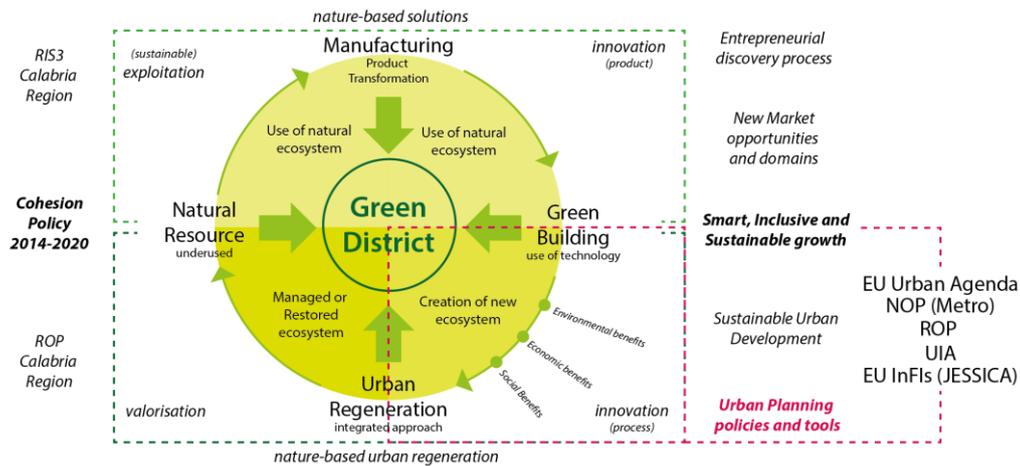


Figure 3: Green District through nature-based urban regeneration in the S3 perspective

At local level (city) the Italian planning system give relevance to the general comprehensive plan. It has both a land-use regulatory function and the capacity to select the general future development trajectories of the territory and development guidelines for each district. The general plan (city) functioning needs the implementation of executive urban plans for each specific district. It is here that urban renewal or redevelopment programs/plans have to be applied. We argued, as highlighted in figure 3, that from the integration between European, national and local policies with the local urban planning tools implementation it is possible to enhance sustainable urbanisation process through nature based urban regeneration. This process requires the proactive involvement of research institutions as well as public authorities, businesses and local communities. Land-use regulations and design guidelines need to be updated both in terms of integration of uses within the district and in terms of the possible use of nature based solutions. Another important aspect to take in consideration relates to how to fund these initiatives. Funds could derive from the integration of different sources: direct EU funds, National Operative Programs (PON Metro), Regional Operative Programs, EU financial instruments, national and local resources and the private sector. The experimentation at district level of a nature based urban regeneration scheme could allow the creation of an innovative urban ecosystem stimulating a sustainable and equitable growth. These processes will improve the urban quality of life, contribute to the reduction of Co2 emission allowing also money savings for owners and create jobs through the valorisation of the cork-related local supply chain.

## 5. CONCLUSION

The paper focused on the possibility to introduce nature-based solutions urban regeneration finalised at the realisation of a green district in a central neighbourhood of the Metropolitan City of Reggio Calabria (IT). We argued that urban regeneration can play a central role in tackling current urban problems for an integrated sustainable urban development. As highlighted by the literature, different theories about the relationship between city and nature

has been developed by influential thinkers and planners. The current interest in city-re-naturing pushed toward the introduction of nature based urban regeneration, with the aim to reduce the environmental pressures in the urban environment. For the EU, nature based urban regeneration is a key element in reaching sustainable urbanization processes, and building energy retrofitting through nature based solutions – i.e. greening walls and roofs – is considered as an element to increase sustainability in the urban environment. The “building scale” experimental activity conducted in a central neighbourhood of the city of Reggio Calabria, has shown the benefits deriving from the application of nature-based solutions in greening buildings energy retrofitting. The comparative analysis scenario conducted reveals how the application of the described techniques at district level will reduce CO2 emissions and generate economic savings for owners. The scaling up phase at district scale need to be framed within the existing economic development and urban planning tools through suitable nature based urban regeneration initiatives. “This integrated approach defines new ways of thinking in producing new responsive scenarios to the social, economic and territorial demand of transformation” (Bevilacqua & Pizzimenti, 2016: 918). In order to maximise positive impacts nature based urban regeneration needs to take into account innovation (production and use) as cross element for all the dimensions involved -social, economical and environmental- in order to create an innovative ecosystem. In this perspective, the S3 approach, deepened with the MAPS-LED project, allow to exploit the potential of local economic areas both at district and at the local supply chain level. Nature-based solutions in urban regeneration interventions can stimulate the application of innovative solutions finalised at the valorisation of local supply chains of natural resources locally available stimulating the Entrepreneurial Discovery Process and reinforcing local economy in creating new market opportunities. Furthermore, the possibility to use the Innovative Financial Instruments (InFIs) such as JESSICA, or to experiment EU Urban Innovative Actions – integrating local urban planning tools- can multiply the positive effects of investments and generate returns that can be used for the improvement of public services. The economic evaluation and the feasibility of the green district model presented will be investigated in further studies in order to propose it for a concrete implementation.

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