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## What transition for cities?

Scientific debate, research, approaches and good practices

This Special Issue intended to wonder about the possible transformations for cities towards the sustainability transition. Hence, contributions coming from scholars as well as from technicians have been collected around three main topics: methodologies for prefiguring possible sustainable transitions; urban policies and drivers of the transition; possible projects and applications for sustainable transition. Reflections and suggestions elaborated underline the awareness that the transition process, above all, needs cooperation among decisions, information sharing, and social behaviour changes.

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## Transform *Active* Cities facing the ecological transition

Cha(lle)nges, Strategies and Practices in the EU Panorama

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### Abstract

Climate change is the ultimate threat multiplier, since it worsens most of humanity's most pressing environmental, societal, and economic challenges. Anyway, growing urbanisation brings both opportunities and challenges related to the ongoing transition process, since cities are at the forefront of changes and challenges. Regeneration of urban areas is a significant priority, which needs to take into account environmental quality, social justice and sustainable development. Transforming cities and regions into vibrant, sustainable, and resilient living places has become a key global priority. In the light of the above, the article – in the context of ongoing research activities – focuses on the ecological transition in the EU panorama, highlighting the active and decisive role of cities, with reference to some significant case studies in the implementation of Green and Nature-based Solutions (NBS) through an integrated, forward-looking, and broad-based planning approach. It is structured in three main parts. The first part frames the topic in the international scientific context. The second one, in the EU panorama, highlights the fundamental role of NBS with reference to the methodological approach, and the latest and most innovative ongoing policies, strategies, and practices. The third and final part develops the discussion and the consequent conclusive remarks with possible future research directions.

### Keywords

Climate Change; Ecological Transition; Nature-Based Solutions.

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## 1. Climate Change as a Threat Multiplier within the Global Dynamic Framework

As stated by the Acting Executive Secretary United Nations Framework Convention on Climate Change, Mr. Ibrahim Thiaw, at the Third Global Conference on Strengthening Synergies Between the Paris Agreement and the 2030 Agenda for Sustainable Development<sup>1</sup> (Tokyo, 20-21 July 2022), climate change is the ultimate threat multiplier, since it negatively impacts all UN Agenda 2030 Sustainable Development Goals (hereafter referred as SDGs) and worsens most of humanity's most pressing challenges such as poverty, hunger, drought, desertification, access to clean air, water energy (United Nations, 2022a).

According to the Intergovernmental Panel on Climate Change (IPCC, 2022), human influence has unequivocally warmed the atmosphere, ocean, and land, resulting in widespread and rapid changes in the atmosphere, oceans and biosphere. The scale of recent changes in the climate system as a whole and the current state of many aspects of the climate system are unprecedented for many centuries to many thousands of years (Antwi-Agyei, et al., 2017). Furthermore, the climate system is now in a situation where atmospheric concentrations of CO<sub>2</sub> are higher than ever in at least 2 million years and concentrations of CH<sub>4</sub> (methane) and N<sub>2</sub>O (nitrous oxide) are higher than ever in at least 800,000 years. We are facing a global challenge precisely because it is human influence on the climate system<sup>2</sup>. Also, according to the critical framework outlined by the World Economic Forum, the continued degradation of nature will add to stress on local residents, public health, businesses and ultimately the stability of society, while regional population growth will further impact the use of land and resources such as water and food. Beyond the sheer scale, complexity and interdependency of the needed changes, the climate transition will be disorderly because decades of inaction and hesitant implementation of transition measures on local and global levels have steered the planet onto a path that will be difficult to change (World Economic Forum, 2022 and 2023). Definitely, humanity's environmental challenges have grown in number and severity ever since the Stockholm Conference in 1972 and now represent a planetary emergency (UNEP, 2021). One of the main objectives of the transition is to seek to answer the question of how we can better understand the processes of structural social change to help achieve a sustainable future (Loorbach, 2009 and 2014). Because of this, the implementation both of the SDGs and of the Paris Agreement is an imperative and essential challenge for the benefit of all mankind (United Nations, 2022a)<sup>3</sup>. As a matter of fact, climate change and sustainable development pose significant intertwined challenges, and the adoption of the UN Framework Convention on Climate Change (UNFCCC), Paris Agreement and the 2030 Agenda and its 17 Sustainable Development Goals (SDGs) in 2015 represented major progress for multilateral efforts to address the world's most pressing problems (United Nations, 2022b).

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<sup>1</sup> The United Nations' 2030 Agenda for Sustainable Development, adopted in September 2015, is underpinned by 17 Sustainable Development Goals (SDGs) and 169 targets. National policymakers are facing the challenge of implementing this indivisible agenda and achieving progress across the economic, social and environmental dimensions of sustainable development worldwide. As the process moves towards implementation, there is a need to address the scope and systemic nature of the 2030 Agenda and the urgency of the challenges through a wide range of tools and science-based analysis to navigate that complexity and to realise the global shared ambition.

<sup>2</sup> Notably, each of the past four decades has been successively warmer than any decade preceding it since 1850, when global surface temperatures were 1.09°C higher in 2011-2020 than in 1850-1900, with increases greater on land than in the ocean. Temperatures have risen faster since 1970 than in any other 50-year period in at least the last 2,000 years. Furthermore, global average rainfall over land has likely increased since 1950, with the fastest rate of increase since the 1980s. The frequency and intensity of heavy precipitation events have increased since the 1950s over most land areas for which observational data is sufficient for trend analysis. Human influence is likely to have contributed to the pattern of observed precipitation changes since the mid-20th century. For more information, see <https://www.ipcc.ch/report/ar6/wg3/>. The IPCC Working Group III report provides, in fact, an updated global assessment of climate change mitigation progress and pledges and examines the sources of global emissions. It explains developments in emission reduction and mitigation efforts, assessing the impact of national climate pledges in relation to long-term emissions goals.

<sup>3</sup> The complete documentation of the Conference can be accessed via the dedicated Conference Website: <https://www.un.org/en/climate-sdgs-conference-2022>. The Third Global Conference on Strengthening Synergies between the Paris Agreement and the 2030 Agenda for Sustainable Development was held in Tokyo, Japan, 20-21 July 2022. It was co-convened by the UN Department of Economic and Social Affairs (UN DESA) and the Secretariat of the UN Framework Convention on Climate Change (UNFCCC).

The single biggest challenge to achieving sustainable development remains taking urgent action to combat climate change and its impacts (Fig. 1).



**Fig. 1. The SDGs Cake, in addition to the reports concerning the global challenges and objectives, highlights the basic, priority and essential role of the planet with its resources and of nature with respect to other economic and social aspects**

In this regard, a growing body of evidence demonstrates that climate action necessitates a multiple transition that addresses all dimensions of sustainability, including both social, economic, and environmental aspects. Furthermore, the territorialization of the SDGs while accelerating progress towards a climate resilient, net-zero future requires the active and collaborative engagement at national level, of line ministries as well as sub-national and local authorities in integrated planning and implementation (Cavalli & Pultrone, 2020; Dzebo, & Shawoo, 2023; Fuso Nerini et al., 2019). Meaningful engagement of youth, civil society, academia, the private sector, and local communities is also vital.

In essence, enhancing capabilities of various stakeholders to pursue synergistic implementation of climate and SDGs agendas is crucial. This includes enhancing capacities to identify synergistic opportunities and to overcoming technical, financial, planning, organizational, and behavioral barriers.

Another aspect of utmost importance to consider –to be placed at the center of the planning and implementation of integrated policies and programmes –is to achieve the *Just Transition*<sup>4</sup> without leaving no one behind. Indeed, climate action should prioritize the needs of marginalized, poor, and vulnerable communities, as well as those who will be most affected by transformational pathways (Galgóczy, 2022; Papa Francesco, 2015).

<sup>4</sup> The foundations on which the *just transition* is developed are to move towards a zero-emission economy in a fair and inclusive way, guiding the process according to specific parameters that avoid the risk of creating new inequalities. As part of the European Green Deal, the environmental plan to achieve climate neutrality, the European Union has implemented a program specifically dedicated to just transition. In fact, a fund of 150 billion euros has been set up to be used by 2027 precisely to organize the energy transition in a balanced way. It is a new financial instrument sanctioned in the framework of the cohesion policy which aims to provide support to the territories facing severe socio-economic challenges arising from the transition to climate neutrality. For further information see: [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en).



At the same time, there is a need to strengthen national and local development and climate strategies, including NDCs<sup>5</sup>, building on existing integrated approaches, such as Circulating and Ecological Spheres and Decarbonization Leading Areas, aimed at advancing the SDGs and action for climate.

Indeed, the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change, referred to above, highlights, for the first time, the social and demand-side aspects of climate mitigation, draws attention to the deep links between climate mitigation and sustainable development, and to how climate action is intimately connected to facing the crisis of nature.

Not to be overlooked, the contributions of digital technology could contribute to efficiency improvements, cross-sectoral coordination, and decreasing resource use, implying several synergies with the SDGs, as well as trade-offs, for example, in relation to reduced employment, increasing energy demand and the increasing demand for services, possibly increasing GHG emissions (Büchle & Andrä, 2016; Ellen MacArthur Foundation, 2019; Ronchi, 2021; IPCC, 2022; Pultrone, 2023)<sup>6</sup>.

There are many strategies, actions, and pathways available for building sustainable cities, working “with” and not “against” nature, as highlighted by United Nations Environment Programme (2021).

Numerous approaches and technologies that address critical human needs while conserving and restoring nature and ecosystem services have been developed, framed in the perspective of ecological justice and in a transformative framework to be rethought, based on the fair distribution of environmental goods and evils, on socio-ecological interconnection, on the action and capabilities of nature, and on participation in decision-making processes (Pineda-Pinto et al., 2021). They include: engaging in sustainable urban planning; encouraging densification for compact communities, especially in sprawling cities; regional planning to mainstream biodiversity, nature and ecological restoration; promoting sustainable production and consumption; promoting Nature-Based Solutions (hereafter referred as NBS); promoting, developing, safeguarding or retrofitting with soft infrastructure for water management while improving hard infrastructure to address biodiversity outcomes; promoting ecosystem-based adaptation within communities; maintaining and designing for ecological connectivity within urban spaces; increasing urban green spaces and improving access to them; increasing access to urban services for low-income communities; and promoting urban agriculture to increase local food supply.

This study, as part of the author's ongoing research activities on these topics, is focused on the ecological transition in the EU panorama. It is structured in three main parts. The first part frames the topic in the international scientific framework. The second one, with reference to the EU panorama, highlights the fundamental role of NBS with reference to the methodological approach, and latest and most innovative ongoing policies, strategies, and practices, analyzing the paradigmatic case study of the *GreenQuays project* of the Municipality of Breda (in The Netherlands) under the EU Urban Innovative Actions initiative (hereafter referred as UIA). The third and final part develops the discussion and the consequent conclusive remarks, with possible future research directions. It aims, on the one hand, to highlight the active and decisive role of cities in the implementation of NBS, on the other, the need for these to become an integral part of urban planning

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<sup>5</sup> NDCs stands for Nationally Determined Contributions, at the heart of the Paris Agreement and the achievement of its long-term goals. They embody each country's efforts to reduce domestic emissions and adapt to the impacts of climate change.

<sup>6</sup> In particular, the study by Büchle and Andrä crosses the four levers of digital transformation with strategic sectors of the green economy and evaluates the influence they may have with reference to the German economy: the possibility of using a vast amount of sensors for green technologies and digital data; the development of automation applied to dynamic supply chains, created by connecting machines with communication and information systems; the development of digital interfaces between companies and their customers and/or users; the use of the digital network for the exchange of information. It therefore evaluates the possible impact of the greater activation of levers in some sectors of the green economy: for the production, accumulation and dispatching of renewable energy, in the promotion of more sustainable mobility, for the efficient use of materials and the circular economy, and in the management of water networks. The analysis shows that the development of digitization in these sectors of the green economy in Germany could make it possible to reduce greenhouse gas emissions by 200 million tons from 2016 to 2025 and to increase the added value in these same sectors, again by 2025 of 20 billion euros.

processes through an integrated, forward-looking and wide-ranging design approach. This approach is essential for the effective territorialization of the UN 2030 Agenda and for the implementation of the Green Deal at a local level, given the challenges arising from the ongoing ecological, digital and energy transitions.

## 2. Cities as Main Players of the Ecological Transition in the EU Policies

### 2.1 Urban Challenges and changes ongoing toward sustainability

Within the wide and complex global framework above outlined, cities account for 70% of global CO<sub>2</sub> emissions, and, in the face of the growing pace of urbanisation, face huge challenges related to sustainable waste management, mobility, climate adaptation and energy. Today, approximately 56% of the global population (about 4.4 billion people) live in cities. By 2050, it is estimated that nearly 7 out of 10 people will reside in urban areas (State of Green, 2023). Furthermore, lately (on 19 June 2023), the World Meteorological Organization together with the Copernicus climate change service released the latest “State of the Climate Report in Europe”, which paints a gloomy picture for our continent: first in warming, fastest in warming from the 1980s to today -it travels twice the global average-, in 2022 alone extreme climatic events have caused the premature death of over 16,000 people (99.6% due to heat waves)<sup>7</sup>. Anyway, in the face of a multifaceted global crisis, as their political, economic, and technological power grows, cities can seize the opportunity to be leaders in the green transition and drivers of the green economy, helping to achieve the United Nations SDGs. Through intelligent solutions they can ensure that sustainable economic activities, energy consumption and positive environmental impacts are optimized (Droege, 2008; State of Green, 2020). In a nutshell, urbanisation, with its related expansion and densification phenomena, brings both opportunities and challenges related to the ongoing transition process.

Regeneration of urban areas is a significant priority, which needs to take into account environmental quality, social justice and sustainable development (Bianconi et al., 2020; Filippucci, & Salvati, 2018; Pertoldi et al., 2022; Pultrone, 2019, 2020, 2021a, 2021b, 2022). Transforming cities and regions into vibrant, sustainable, and resilient living places has become a key global priority (Newman et al., 2017). This is reflected in numerous policy initiatives at local, regional and national scale, and internationally through the 17 UN SDGs (particularly SDG 11). Together these are part of a global call to rethink and redesign urban environments through innovative solutions that address multiple issues, considering that land degradation and transformation<sup>8</sup> have contributed to about a quarter of greenhouse gas emissions in the last decades and that –although the issue is recognized as a global concern– approaches to addressing it have often been inadequate and fragmented (Di Gregorio et al., 2017; Pileri, 2022; UNEP, 2021; Zucaro & Morosini, 2018).

For this reason, the role and responsibility of urban planning are even more important in guiding the just, green, and sustainable transition (Pultrone, 2022; RETICULA, 2021; State of Green, 2020, 2021 and 2023;

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<sup>7</sup> The 2022 edition of the World Meteorological Organization’s (WMO) State of the Climate in Europe report, produced jointly with the Copernicus Climate Change Service (C3S\*), paint a sombre picture for Europe last year. According to the findings, Europe is the fastest warming of all the WMO regions, warming twice as much as the global average since the 1980s. What’s more, high-impact weather and climate events in 2022 resulted in over 16,000 reported fatalities, of which 99.6% were attributed to heatwaves. For more information, see [https://climate.copernicus.eu/wmo-c3s-release-sombre-findings-joint-state-climate-europe-2022-report?utm\\_source=socialmedia&utm\\_medium=tw&utm\\_campaign=wmo-c3s\\_june23](https://climate.copernicus.eu/wmo-c3s-release-sombre-findings-joint-state-climate-europe-2022-report?utm_source=socialmedia&utm_medium=tw&utm_campaign=wmo-c3s_june23).

<sup>8</sup> It is considered appropriate here to return to the distinction between soil transformation and land degradation, as illustrated by UNEP, 2021, where it specifies that transformation can be legal or illegal but is usually intentional. Ecosystems are deliberately altered with the aim of increasing the delivery of a particular benefit, or set of benefits, to a group of people, often at the expense of other benefits and almost always with a loss of biodiversity. Degradation, on the other hand, is the loss of ecosystem function, in transformed or natural soils, as a result of human actions and is usually not intentional. Degradation, like transformation, is typically accompanied by biodiversity loss. Degradation is widespread and ongoing, even accelerating, across the planet in both the developed and developing world. Rehabilitation aims to reverse degradation, but not necessarily to reverse transformation. Restoration, which aims to return both function and biodiversity to some previous state before transformation occurred, is harder to achieve and takes much longer.

Tîrlă, Manea, et al., 2014). At EU level, the transition challenges have been taken through the goals of the policies aimed at supporting cities to design sustainability interventions that benefit all residents, ensuring accessibility and equitable enjoyment of environmental public goods in line with residents' right to place and to a clean and healthy environment (EEA, 2012), and *The Green Deal* project has emerged as a far-reaching change in an ecological direction with the "Next Generation EU" Recovery Fund (EC 2015, 2019a and 2019b). As a matter of fact, this essential issue is tackled at several policy levels, but cities appear the drivers of sustainable development in EU, since it places where all the global challenges are coming together and where new solutions can be tried and tested by requiring an integrated, place-based, and participatory approach (Ali, 2016; Beatley, 2012; Pultrone, 2019 e 2020).

Above all, the ecological transition must be considered together with the digital and energy transition as a single major challenge, i.e., an important and joint effort to tackle a problem with a high impact on society and the whole planet in an integrated way, in a renewed relationship with nature (Colding and al., 2020). Indeed, many cities are experimenting with best practices in the framework of the urban green transition, which offers multiple themes and declinations of implementation<sup>9</sup>. These aim to make cities greener, livable, and connected to cope with the consequences of population growth, urbanization, and climate change (Walker et al., 2004; Demuzere et al., 2014; Tulisi, 2017; Wildt et al., 2021; Winslow, 2021; Johnson et al., 2022). In this process, holistic and strategic urban planning, and development in the areas of mobility and infrastructure, climate adaptation, as well as environmentally friendly architecture and construction play a central and decisive role (Papa et al., 2015). This is why, as urban challenges align, it becomes crucial to identify and share inspiring and effective solutions to radically improve cities and, more generally, our common home (State of Green, 2023).

## 2.2 Green solutions as tools supporting the ecological transition paradigm

At the heart of the ecological transition paradigm are undoubtedly the NBS, which are internationally recognized as a key part of climate action and biodiversity and need to be more widely deployed, including through the supportive policy framework offered by the EU Green Deal and related initiatives.

Over the past 20 years, several concepts have emerged to address the general challenges of integrated planning for green spaces, including NBS and Green and Blue Infrastructure<sup>10</sup> (hereafter referred as GBI).

For instance, Green Infrastructure (GI) and its integration into spatial planning has emerged as one of the most appropriate and effective ways to improve microclimate and tackle the impacts of climate change, specifically the Urban Heat Island (UHI) effect (Isola et al., 2023; Salata and Yiannakou, 2016).

Urban greenspaces have also been studied as networks, by means of the creation of models capable of measuring the performance of the system in its entirety, posing the basis of a new multi-disciplinary research field called *green network* (Tulisi, 2017). Other research is focused on the relations between the definition and implementation of a green infrastructure (GI) and hydro-geological hazard (Lai et al., 2021).

NBS aim to promote natural processes of urban development to help overcome the challenges of renewable energy, food security, water resources and climate change (Kabisch et al., 2017).

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<sup>9</sup> Particularly significant in this direction is the experience of Danish cities, which have a long tradition of holistic planning, in which concern for the environment, people and businesses go hand in hand. For more information see <https://stateofgreen.com/en/>.

<sup>10</sup> In the EU Green Infrastructure Strategy (2013), *green infrastructure* is defined as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces and other physical features in terrestrial (including coastal) and marine areas, and on land, green infrastructure is present in urban and rural settings. Blue infrastructure is similar to the one of green infrastructure and covers natural and semi-natural areas including aquatic ecosystems, coastal and marine areas. Peri-urban areas are of high relevance for the development of green infrastructure, and the concept of such infrastructure can be enriched with Nature Based Solutions (NBS). <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52013DC0249>.

According to Korkou, Tarigan and Hanslinm (2023), while there is a growing literature on urban NBS, including GBI in cities, there is still a knowledge gap on how these climate mitigation actions can be integrated into planning and design urban landscape, as well as their mitigation potential.

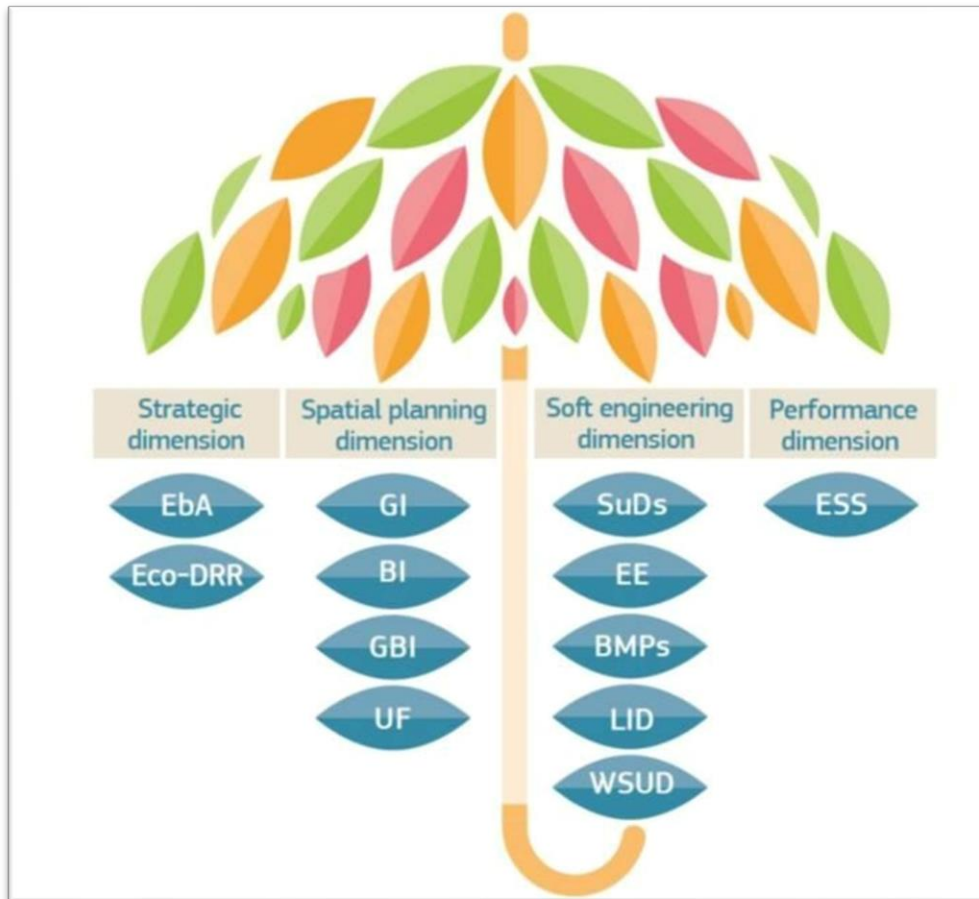
GI development should support natural processes to achieve broader sustainable impacts and benefits and is central to the adoption of NBS to contribute to crucial functions such as clean air and water, rainwater, biodiversity, and beautiful landscapes, thus providing multiple functions for ecosystem and biodiversity benefits. Considering the concept of multifunctionality in urban GI planning, five main related themes can be identified that should be incorporated into planning, both at the urban and territorial scale: 1) planning methods for urban GI, 2) evaluation approaches of urban GI, 3) ecosystem services and their benefits, 4) sustainability and climate adaptation, 5) urban agriculture. And, to guarantee multiple functions in urban infrastructures, the following are considered necessary: spatial distribution, optimal distance, integrated network, accessibility and public participation and engagement.

According to Winslow (2021), the characteristic of GI includes the following principles: 1) complete combinations between urban-rural areas and contexts; 2) integration with other urban infrastructures; 3) multifunctionality that provides for multiple services; 5) connectivity of form and function in the landscape; 6) multiscalar for natural and cultural processes and 7) transdisciplinary combining expertise from different disciplines. Within this context, NBS can therefore be considered an umbrella concept (fig. 2) that encompasses multiple dimensions (strategic, spatial planning, soft engineering and performance) and is based on a broad knowledge base of approaches including ecosystem services, ecosystem-based adaptation, ecosystem-based disaster risk reduction, ecological engineering, blue infrastructure, GI, blue-green infrastructure, urban forestry sustainable urban drainage systems, low impact design and other concepts (European Commission, 2013, 2019b, 2020, 2021 and 2022). According to the EU Research and Innovation policy agenda on Nature-based Solutions and Re-naturing Cities, NBS are solutions inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions (European Commission, 2015). NBS also contribute to the improvement of urban liveability<sup>11</sup>, in addition to the factors related to safety, health, economic and educational resources, infrastructure, culture and environment which influence the different classifications developed at national and international level, with more effective results, when possible, create synergies between them.

If appropriately designed, NBS can perform multiple functions beyond specific ones such as, for example, rainwater management or the reduction of heat islands, and therefore play a key role in creating the “livable city” (Alderton et al., 2019; Gough, 2015; Higgs et al., 2019; Young & Hermanson, 2013). To sum up, NBS are an essential tool for climate change adaptation and increasing urban biodiversity, supporting a triple bottom line of planet, profit and people, where the goal is to increase urban resilience.

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<sup>11</sup> The concept of livability – referring to concerns related to the long-term well-being of individuals and communities – includes factors such as neighborhood amenities, including parks, open spaces, walkways, neighborhood commerce, as well as environmental quality, safety and security. health, the availability and quality of public transport, educational institutions and healthcare facilities, the overall cultural and social atmosphere of a place, such as the presence of diverse recreational activities and opportunities for community involvement. The liveability of cities is assessed annually by the Economist Intelligence Unit (EIU) and monitored through its global liveability ranking. In 2023, Vienna in Austria ranked first for the second consecutive year as the most livable city (see: <https://www.eiu.com/n/campaigns/global-liveability-index-2023/>).



**Fig. 2. Conceptualization of NBS as an umbrella and their relation to key existing concepts: EbA (ecosystem based adaptation); Eco-DRR (ecosystem-based disaster risk reduction); GI (green infrastructure); BI (blue infrastructure); GBI (green-blue infrastructure); UF (urban forestry); SuDS (sustainable urban drainage systems); EE (ecological engineering); BMPs (best management practices); LID (low-impact design); WSUD (water-sensitive urban design); ESS (ecosystem services)**

### 2.3 From a “People-centric” to “Life-centric”<sup>12</sup> transition: strategies and practices

Jointly addressing the challenges of biodiversity, pollution, resources and climate provides the starting point for how *green cities* support ecosystems and build resilience. In this context, the increased focus on solutions in the GBI sector offers an effective and efficient approach to address these challenges in cities. While GI is important, it alone is not enough to achieve a green and healthy urban environment. Therefore, its integration in other sectors, beyond the protection of biodiversity and addressing the climate challenge, is of great relevance, so developing links with other policy areas such as zero pollution of air, water and soil, sustainable mobility, building renovation, energy, water resources management, circular economy and public health.

In this context, *Greening Cities*<sup>13</sup> is one of the topics of the second EUI-Innovative Actions (EUI-IA) Call for proposals opened in May 2023 dedicated to topics aligned with the New Leipzig Charter (2020) and the European Union’s priorities, such as the green and digital transitions, as well as the Urban Agenda for the EU.

<sup>12</sup> The two words refer to the *White Paper for A Green Transition-Urban green transition-transforming our cities for a new reality* (2023), showing how Danish urban planning is witnessing a shift from a “people-centric” to “life-centric” approach, recognising planetary boundaries and life in all its diversity, rather than simply human wellbeing.

<sup>13</sup> The topic *Greening Cities* contributes to and has interconnections with a number of EU policies and initiatives such as EU Green Deal, EU Biodiversity Strategy, EU Forest Strategy, EU Soil Strategy and Nature Restoration Law proposal, EU Strategy on Adaptation to Climate Change, EU Green Infrastructure Strategy, EU Zero Pollution Action Plan, New European Bauhaus Initiative, EU Renovation Wave Strategy, Affordable Housing Initiative, New European Mobility Framework, EU Missions on Climate-Neutral and Smart Cities and Adaptation to Climate Change, European Partnership Driving Urban Transitions of Horizon Europe, Covenant of Mayors for Climate and Energy, Green City Accord, European Green Capital and Leaf Awards, and Intelligent Cities Challenge and Urban Agenda for the EU. See also: <https://www.urban-initiative.eu/innovative-actions-greening-cities>.

Furthermore, it is also consistent with the *Green City* theme of the New Leipzig Charter, which puts forward a vision for the sustainable urban future in Europe, with the emphasis on the social and economic aspects expressed by the concepts of *Just City* and *Productive City*.

More specifically, urban authorities are called upon to answer to the following prompts:

- *Developing and enhancing urban green spaces* by focusing on projects that contribute to halting biodiversity loss, to verifiably and significantly reducing air pollution and to combatting heat waves, and at the same time, to achieving climate objectives and improving health and well-being of citizens.
- *Constructing green mobility corridors* with the help of GI within urban areas and between urban centres and peri-urban areas, that contribute to reducing air and soil pollution and noise, using artificial intelligence for traffic management systems, promoting sustainable multimodal urban mobility including active mobility modes such as cycling, and at the same time, to achieving climate objectives and improving health and well-being of citizens.
- *Preventing droughts and flooding* via projects focused on sustainable water management, including rainwater, in urban areas, with the help of green infrastructure that contribute to preventing droughts and flooding as well as to improving water quality, and at the same time, to reducing disaster risks and land take.
- *Designing and renovating buildings and their surrounding areas*, particularly in socially deprived quarters with NBS by integrating GI and NBS in the design and/or renovation of buildings and in their surrounding areas, including efficient resource management, also by using recycled construction material.

Hence, urban authorities are at the forefront and well-positioned to experiment with innovative solutions to bring forward the multiple benefits of GI through NBS. In a sustainable transition process, the support of capable institutions and governance is indispensable to coordinate actions across agencies and stakeholder coalitions. Alongside it, governance arrangements are often required to formulate and implement the multisectoral policies that stimulate the adoption and scaling up of innovative solutions to climate change and other sustainable development challenges (IPCC, 2018 and 2022). Concerning the main key actions to be undertaken to jointly address the Earth's environmental emergencies and human well-being, and with reference to the item Cities and Settlements, UNEP (2021) identifies the actors involved in the process and the different scalar and/or complementary levels of possible interventions, as outlined in table 1, where the recurring presence of keywords such as *NBS*, *sustainable Urban Planning*, *urban services*, *GBI* and *spaces* is noticed. The same subjects are the main actors also according to The Global Assessment Report on Biodiversity and Ecosystem Services (IPBES, 2019)<sup>14</sup>. In a broader sense, the increasing awareness of public bodies, managers and planners on the importance of NBS, the active participation or collaboration of all interested parties in urban green plans and projects is considered fundamental, also in order to prevent any conflicts between the different interests involved (Kivimaa, et al., 2019; Ferreira et al., 2020).

#### *The GreenQuays Project as an Emblematic Case Study for a Sustainable Transition*

It has been reiterated several times that cities are particularly vulnerable to the impacts of climate change and at the same time driving factors of the climate emergency, key players in achieving a carbon neutral society that guarantees *Just Transitions*. They operate as a venue for innovation, co-creation and citizen-led participatory actions, using technology, and have the potential to implement radical local experiments that can be scaled up and scaled across Europe.

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<sup>14</sup> IPBES is an independent intergovernmental body comprising over 130 member Governments. Established by Governments in 2012, IPBES provides policymakers with objective scientific assessments about the state of knowledge regarding the planet's biodiversity, ecosystems, and the contributions they make to people, as well as options and actions to protect and sustainably use these vital natural assets.

Indeed, some projects under the former EU initiative UIA can inspire and promote locally based green transitions in other EU cities, each called to tackle global challenges locally and concretely, as well as territorialize the 2030 Agenda SDGs.

Developed over the period 2020-2022<sup>15</sup>, it aims to develop and test green technology, specifically designed to support the development of a vertical ecosystem and to create conditions for the growth of herbaceous plants, ferns, and mosses. Various techniques are used to achieve this, such as tree sections in the quay walls, material choices and drainage system, and the combination of these different techniques applied in an inner-city context makes this project unique.

Anyway, beyond the specific project and its technical aspects, it is important to underline here, for the purposes of this study, that it involves a nature-inclusive development of the quays and surrounding (green) public space, by improving the quality of GBI and, at the same time, the quality of life of the inhabitants, also with a view to social cohesion and inclusion. In the coming years, Breda is committed to sustainability in the broadest sense of the word.

<b>Actors of ecological transition</b>	<b>Examples of key actions to be taken to address Earth's environmental emergencies and human well-being together with reference to Cities and Settlements</b>
Governments - legislature, judicial and executive branches at national, subnational and local level	Design and develop socially and environmentally sustainable cities and settlements by embracing NBS, promoting enhanced access to services such as clean water and energy and public transport, and making infrastructure and buildings sustainable.
Intergovernmental organizations	Promote sustainable urban planning, NBS for climate and biodiversity in urban areas, retrofitting of GBI, and access to urban services including clean energy and water.
Financial organizations	Develop and promote innovative financing for sustainable infrastructure. Support sustainable urban planning and investments in low-carbon infrastructure, including mass transportation, congestion charges, NBS and green and blue spaces.
Private sector	Engage with and support government in sustainable urban planning, public transport, energy-efficient buildings and partnerships to enhance access to urban services.
Non-governmental organizations	Campaign for and support sustainable urban planning and improved access to urban services and community initiatives, especially for the urban poor.
Individuals, households, civil society and youth groups, and indigenous peoples and local communities	Engage in participatory processes to advance sustainable urban planning and initiatives to increase access to urban services and promote NBS and GBI.
Scientific and educational organizations	Support sustainable urban planning and development, including the use of NBS. Promote education, information and awareness on sustainable cities and settlements and their importance for human health.
Media and social networks	Document the impact on people and nature of unsustainable systems in urban areas and support campaigns for transformations in how cities and settlements are planned and designed, including the supply of essential services.

**Tab. 1 Actors and actions to better transform humankind's relationship with nature, elaboration of the author from UNEP (2021:37-45)**

<sup>15</sup> These are the main Milestones: Small scale is built in the Nieuwe Mark (April 2020); launch event (May 2020); Start building real life pilot (April 2021); Detailed holistic design of the network of green infrastructure in the pilot site (December 2020); Real-life pilot is realized (August 2022); Municipal Guide on Renaturing the New Mark (August 2022).

*GreenQuays* project matches perfectly with its public trustees' ambition to be the first European city in a green park by 2030, since the ongoing *TransformA(c)tion*<sup>16</sup> process of the green river *Nieuwe Mark* provides a vital space for rich flora and fauna, and an even more vital contribution to a livable city centre. The multiple challenge addressed, common to many other cities in Europe, arises from the unsustainable urbanization choices of the past, from the deterioration of urban ecosystems and from the lack of resilience to climate change. The drivers of urban decay vary across ecosystems and locations, but the main pressures include the expansion of grey infrastructure, soil pollution, hydrological changes to water bodies, and climate change in general. These affect the ability of ecosystems to function, provide ecosystem services and cope with other challenges, such as controlling flood damage and providing livable places and recreational opportunities.

Therefore, innovative solutions are required that can ensure that they can continue to live in a livable city in the future, as part of a broader vision because it is "life-centric" and not only "people-centric" (Figg. 3, 4).

The partnership is made up of the following actors, each with specific skills, roles and responsibilities, with a view to complementarity and above all synergy, which also includes the participatory approach and the involvement of the inhabitants in the implementation phase: Municipality of Breda; The Baronie Area Federation of Nature Associations; Stadshart-Valkenburg Residents' Association; Delft University of Technology; Wageningen University and Research; Waterboard Brabantse Delta - regional water authority; Van den Berk Nurseries-private company; RAVON-NGO.

As already mentioned, *GreenQuays* project's main objective is the realization of sustainable urban renaturation in Breda using climate-proof design and nature inclusive regenerative solutions - green quays linked to public green spaces - as part of a bigger scheme targeting the urban restoration of the river Mark.

The results of the project – as part of an integrated and far-sighted planning process in the city, whose effects can continue and intensify over time through an integrated planning and territorial governance approach – can be summarized as follows, considering the available documentation:

- new technical solutions<sup>17</sup> and approaches for implementation of regenerative urban renewal in the river Mark.
- A participatory planning process for inclusive co-creation of public space to adequately address the needs and desires of citizens, and to contribute to the strengthening of local communities.
- An optimal green environment for flourishing flora and fauna through renaturing the grey infrastructure currently surrounding the river based on technical solutions and participatory inputs.
- A network of green public areas alongside the river establishing a living cohabitation between nature and people.
- Optimization of said solutions 1) to be scaled-up throughout the New Mark urban renewal strategy adopted by Breda; and 2) to be replicated elsewhere in Europe.
- Showcase a sustainable urban river renaturation process in densely built urban areas aiming at the restoration of ecosystems, the greening of urban environment.

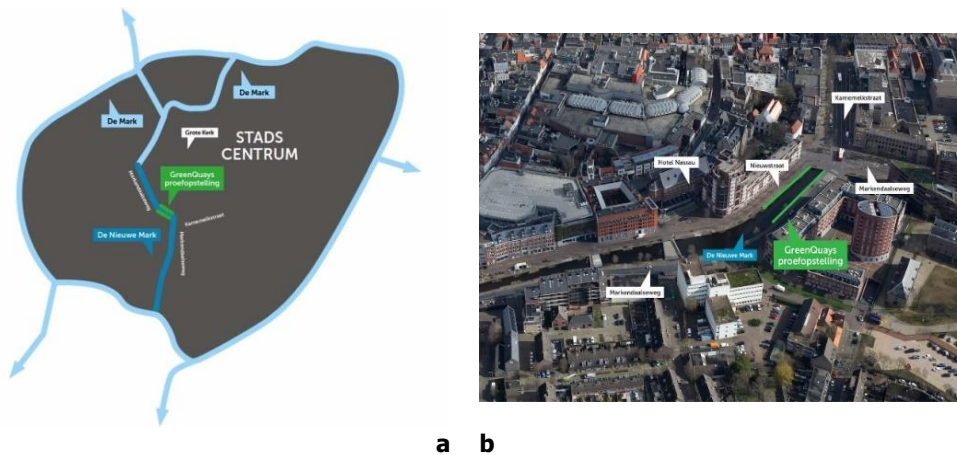
The necessary management, monitoring and assessment activities prove fundamental to bring out the lessons learned useful for the continuous improvement of the "landing" processes and implementation of the principles of the ecological transition, allowing their implementation in other different territorial contexts, with appropriate declinations and adaptations.

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<sup>16</sup> The use of the word *TransformA(c)tion* instead of transformation, and of the adjective *TransformActive* in the title of the article, as a pun, derives from the intention to underline the active role (action) of cities in the process of sustainable transformation required for the transitions in progress.

<sup>17</sup> Among the interesting innovative aspects, it should be noted that data for the wall plants are collected with an app (Vera-app) and find thus their way into the "Verspreidingsatlas", an Atlas of the Netherlands that documents the distribution of every wild plant.





a b

**Fig. 3. (a) Planimetric schematization and (b) bird's eye view of the area affected by the project with information concerning the main parts and elements**

### 3. Discussion and Conclusions

The article highlighted, at first, that the current expansive mode of development degrades and exceeds the Earth's finite capacity to sustain human well-being. As outlined so far, a growing number of reports and reviews describe the impact of and vulnerability to climate change of biodiversity and ecosystem services, both within and outside nature conservation areas. The impacts of climate change on biodiversity and ecosystem services are complex. Climate change, land-use change, land degradation, and air and water pollution act synergistically to cause pervasive, extensive, and systemic damage to biodiversity and ecosystem services on land and in the ocean. Globally, land-use change is the direct driver with the largest relative impact on terrestrial and freshwater ecosystems (IPBES, 2019), which calls into question the role and responsibility of Urban Planning, at the centre of the UN-Habitat "wheel of prosperity" (2013) together with Government Institutions and Laws. Above all climate change – accentuated and accelerated by anthropic action that disrespects the "common home" and the value of natural ecosystems for the life of the whole Planet Earth – is disrupting species interactions and ecological relationships (UNEP, 2021).



**Fig. 4 The GreenQuays project proposes the development of green and blue infrastructures as an opportunity for inclusion, too**

Indeed, the world is failing to meet most of its commitments to limit environmental damage and this increasingly threatens the achievement of the UN 17 SDGs. Many changes in the climate system become larger in direct relation to increasing global warming, including increases in the frequency and intensity of hot extremes, marine heatwaves, heavy precipitation, and, in some regions, agricultural and ecological droughts. Nature can be conserved, restored and used sustainably while simultaneously meeting other global societal goals through urgent and concerted efforts fostering transformative change.

The Sustainable Development Goals and the 2050 Vision for Biodiversity cannot be achieved without transformative change. The transformational changes in order to achieve a sustainable world require the responsible and undelayable commitment of different actors and presents options for action in the interconnected sectors of environment, economics, finance, energy, food, water, health and cities (EC, 2018 and 2021). Within this complex context, globally and locally, the conservation and sustainable use of biodiversity, GBI and ecosystem services have the potential to contribute significantly to mitigating climate change and to helping human societies adapt to its impacts. In addition, there are powerful economic and social arguments for taking action to protect biodiversity and ecosystem services.

This approach recognizes and values natural resources including land, soils, air, water and living resources, since nature can be conserved, restored and used sustainably while simultaneously meeting other global societal goals through urgent and concerted efforts, both forward-looking and far-reaching, fostering transformative change (IPBES, 2019). Therefore, innovative integrated, interdisciplinary and cross-sectoral approach is needed to strengthen collaboration across governance levels and advance urban support structures that:

- creates evidence for urban transitions, through inter- and transdisciplinary research and innovation, involving all stakeholder groups and considering technological, social, economic, cultural, planning and governance aspects;
- addresses urban dilemma interrelationships between various goals, strategies and interests as they define key policy areas critical for achieving SDGs and urban strategies;
- provides a favorable environment for urban experimentation, capitalizing knowledge and science-policy cooperation beyond joint calls to achieve city authorities' strategies and strengthen exploitation and scaling-up of research and innovation actors' results aligned towards urban transformations (Raworth, 2017) more effectively.

Greener, more sustainable, and more efficient urban development can be achieved by applying new technologies. Consequently, the global demand for smart city solutions is growing rapidly, primarily driven by the three global megatrends of urbanisation, green transition, and digitization (United Nations, 2022b).

Cities have a central and decisive dual role as a sphere of concentration and amplification of the crisis and, at the same time, as a privileged sphere of experimentation<sup>18</sup> (Sengers et al., 2019) acceleration of the multiple transition process underway, such as in ongoing UE policies, strategies, and projects (IPCC, 2022; McQuaid et al., 2021; Pultrone, 2018). Ongoing multiple transition involve multiple sectoral and cross-sectoral policies and the digital and ecological transitions must be seen as one major challenge. Ongoing policies, initiative, strategies, and projects –among which we also recommend the Driving Urban Transitions to a Sustainable Future (DUT), the new JPI Urban Europe program launched in 2022, which cannot be dealt with here but is worthy of further study and research<sup>19</sup> – provide innovative opportunities for integrated planning and synergistic implementation on climate action and the SDGs, since greater awareness of the benefits of nature-

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<sup>18</sup> Given the extensive and varied scientific literature on the concept of experimentation with reference to the sustainability transition, it is understood here as an inclusive, practice-based and challenge-led initiative, designed to promote system innovation through social learning under conditions of uncertainty and ambiguity (Sengers, Wiczorek & Raven, 2019: 153).

<sup>19</sup> The challenges are grouped into three themes called Transition Pathways: Positive Energy Districts (PED), the 15-Minute City (15mC) and Circular Urban Economies (CUE). For more information, see <https://jpi-urbaneurope.eu/driving-urban-transitions-to-a-sustainable-future-dut/>

based solutions can greatly help to advance the protection of biodiversity and promote the just transition and sustainable development models.

Transitioning to a circulating and ecological sphere (CES) can greatly advance protection of the environment, biodiversity, and climate (Dzebo and Shawoo, 2023). Given the interconnected nature of climate change, loss of biodiversity, land degradation, and air and water pollution, it is essential that these problems are tackled together, in an integrated way (UNEP, 2021).

The ecological transition is and must be the pillar of a resilient recovery, of a real *Green Deal*, in which greater attention and caution are paid to the relationship with nature, to the climate and ecological crisis. The mitigation and adaptation measures are not attributable only to energy policies, they affect other decisive sectors such as industry, agriculture, land use, construction and transport.

The protection of natural capital and the resilience of ecosystems are therefore essential conditions because they ensure the flows of ecosystem services without which there is no possibility of well-being and development. Just as it is necessary to go beyond the immediate responses to the multiple crisis underway with vision and plans for the future in which urban and territorial planning has a fundamental role (Ronchi, 2021). In this regard, over the last decade, the scientific and academic interest in developing concepts and theories that reflect a more holistic approach of socio-ecological systems to urban planning and design based on transdisciplinary integration has grown considerably, with reference to following themes: ecosystem services, socio-ecological systems, resilience, biodiversity, landscape, green infrastructure, as well as integrated and holistic approaches. This last approach includes the other six as a new potential paradigm of ecological urban planning and design capable of applying theoretical concepts related to sustainability (ecosystem services, socio-ecological systems and resilience, components of a sustainability flow) in a spatial context (biodiversity, landscape, green infrastructure: components of a spatial flow). This new paradigm, defined as “urban consonance” with reference to an interesting study by Heymans, Breadsell, Morrison, Byrne, & Eon (2019), reflects a harmony or agreement between nature and people and describes the harmony of evolution of key ecological urban planning and design through interdisciplinarity, where cities are considered as complex and dynamic socio-ecological system.

In this framework, NBS address social, economic, and environmental sustainability issues simultaneously, thereby presenting a multifunctional, solution-oriented approach to increasing urban sustainability, resilience, liveability (Dorst et al., 2019). Many European cities are actively playing their role as key agents of transformation, involved in numerous initiatives and networks that jointly shape policies with an urban dimension, as the case study of *GreenQuays Project* stands out.

The challenges of the ecological transition – which sees cities as a qualifying factor – are strongly connected to each other and above all sign of a profound historical change in society and the economy, a real change of civilization, to live better “according to” nature and not “against” nature. Indeed, in order to transform the challenges of the ecological transition into opportunities, there is a need for broad support which can be won by taking care, punctually and attentively, also of the social dimension. Therefore, future research should evaluate the contribution of participatory processes to the quality of decisions, building public trust in the decision-making process and to the success of implemented social learning strategies (Ferreira et al., 2020). Another interesting aspect worthy of further in-depth research and development is the mainstreaming of NBS, where planning tools and practices that support how urban NBS are implemented in a coherent and holistic way, are instrumental in pursuing sustainability transitions urban. This process of adoption and “becoming a norm” in policy and planning is commonly understood as mainstreaming. In order to be effectively implemented for cities, it cannot become just another slogan or buzzword for the aspiration of sustainability, but must be pursued, reformed and reformulated through urban planning and the implementation of multi-level governance to enable the overcoming unsustainable practices, assumptions, cultures and norms, which for too long have dominated the planning and development of cities.

In a nutshell, it then becomes essential to better focus attention on how and where the integration of NBS takes place in the transition process towards urban sustainability, how this can become an integral part of the definitive transformation of urban planning systems and practices to create sustainable, resilient, inclusive cities projects in line with Objective 11 of the 2030 Agenda (Adams et al. 2023). Anyway, the ecological transition for a circular society and economy in the use of resources and climate-neutral requires not only a great deal of scientific knowledge and a great deal of good and appropriate technology, but also needs to make use of the different cultural riches of peoples, the art, poetry, inner life and spirituality (Papa Francesco, 2015).

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## Image Sources

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Fig. 2: European Commission, Directorate, General for Research and Innovation 2021:19.

Fig. 3: <https://www.greenquays.nl/onderzoek>

Fig. 4: <https://www.greenquays.nl/project>

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