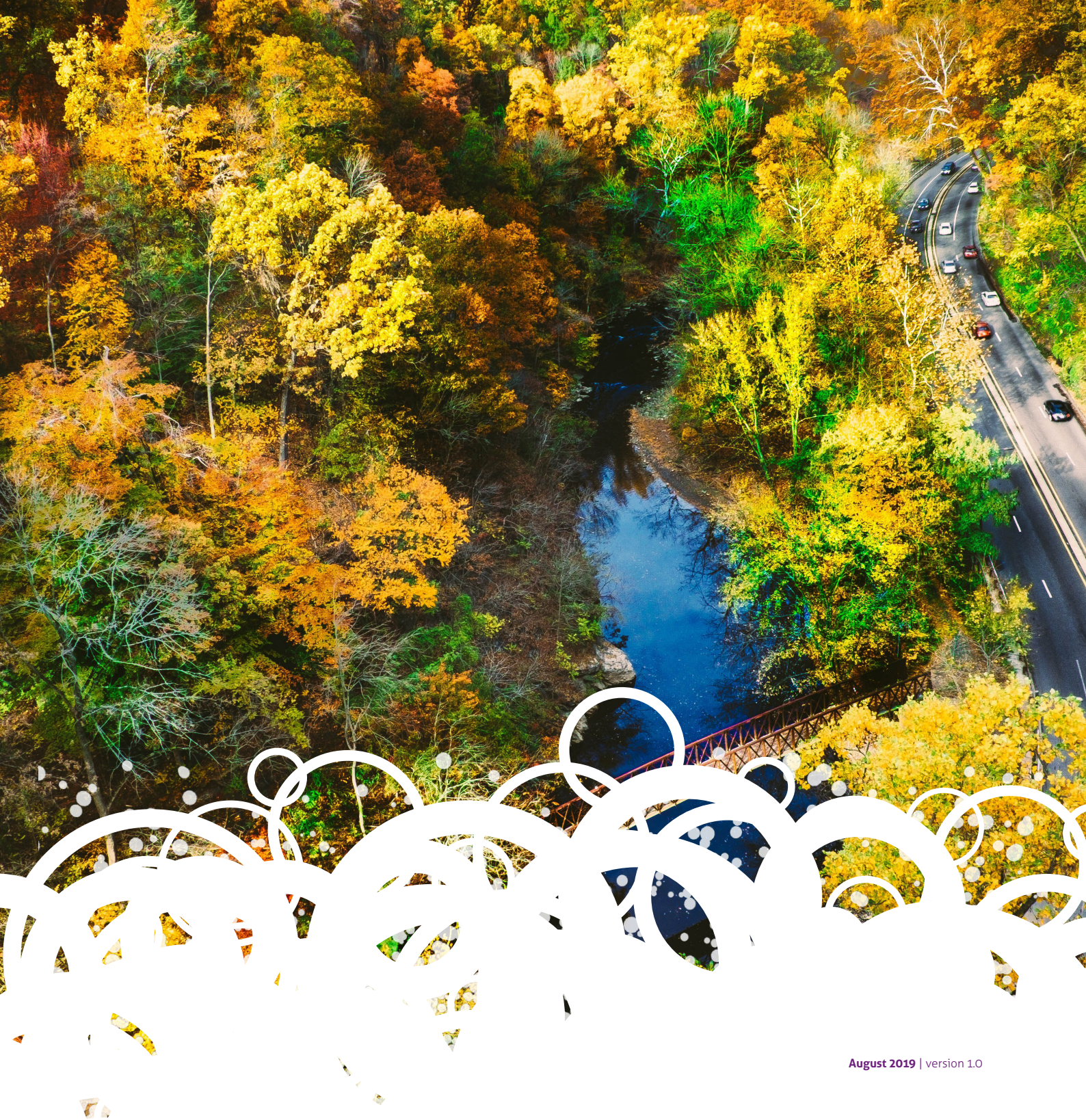


August 2019 | version 1.0

› ROADMAP FOR THE BGI MANUAL

Bridging the knowledge gap in the field of Blue Green Infrastructures

EXECUTIVE SUMMARY

EXCEPT INTEGRATED SUSTAINABILITY

IFLA EUROPE INTERNATIONAL FEDERATION OF LANDSCAPE ARCHITECTS

JNCC

biodiversa

Cyfoeth Naturiol Cymru Natural Resources Wales

CONTENTS

1. CONTEXT

Blue-Green Infrastructures (BGIs) are "strategically planned networks of natural and semi-natural areas[1]" with other environmental features. They are designed and managed to support a wide range of ecosystem services - e.g. biodiversity enhancement, water purification, air quality, space for recreation and climate mitigation and adaptation. They relate to and are a key component of Nature Based Solutions (NBSs).

BGIs are inspired and supported by nature, and are designed to provide more natural features and processes for urban and rural landscapes, as well as seascapes. This is to be achieved through "locally adapted, resource-efficient, and systemic interventions[2]". The stream of research produced on BGIs in the last decade has been plentiful and constant, and came as a consequence of the growing awareness on the multifunctional potentials of BGIs as expressions of sustainability-centred approaches to planning and living. BGIs strongly rely on natural systems - e.g. weather, precipitations, and soil.

PROBLEM DEFINITION - THE WHY

The multiple challenges BGIs address make the process of designing long-term solutions particularly complex, and organizations across Europe are investing in mainstreaming the practices of resilient design. While the topic currently populates the academic and policy debate on the European level, the process of translating key lessons and insights on BGIs from science to practice is far from straightforward. Despite the existence of a number of BGI-related databases and platforms, a comprehensive tool that integrates the knowledge needed by such a wide range of stakeholders would greatly assist the uptake of BGI in infrastructural projects at all scales. Such a tool is still missing.

PROPOSED SOLUTION - THE WHAT

To address this knowledge transfer deficit and the related issues, a practical guidance manual for BGIs is proposed as a solution.

The aim of the BGI Manual is to support a number of target groups in:

› Enhancing their understanding of BGI-related, state of the art scientific knowledge.
› Transferring BGI knowledge into practice.

THE PROJECT SETS OUT TO REACH:

- Policymakers and decision makers in regional and local area development.
- Project managers responsible for delivery of strategic infrastructure.
- Designers working on projects of all scales.
- Construction managers.
- Operatives, maintenance managers, and staff.

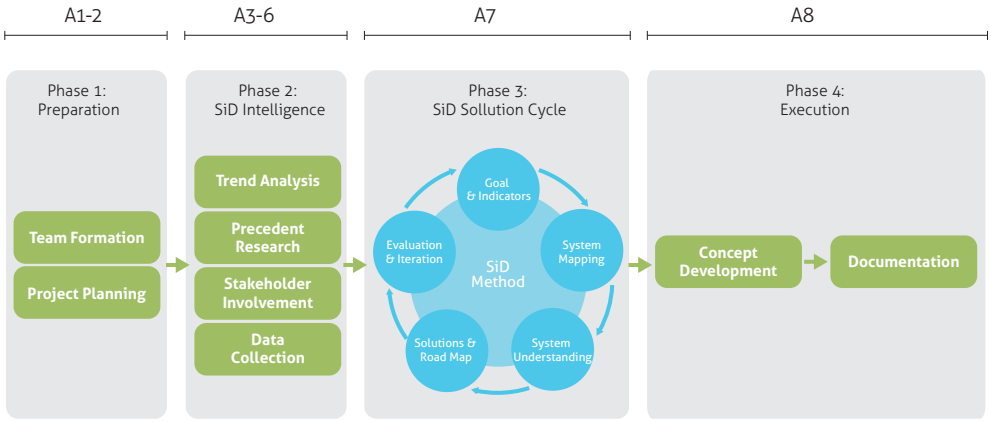
1. http://ec.europa.eu/environment/nature/ecosystems/benefits/index_en.htm
2. https://ec.europa.eu/research/environment/index.cfm?pg=nbs

PROJECT OUTLINE - THE HOW

Preliminary research is deemed the first key task to address in the roadmap. The final research report is the result of collaboration between a number of organizations, active on a range of topics spanning from integrated sustainability approaches to the built environment, to biodiversity conservation, and landscape architecture:

› **International Federation of Landscape Architects - European Region** (IFLA Europe), Belgium
› **Joint Nature Conservation Committee** (JNCC), United Kingdom
› **BiodivERsA** (BDA), France
› **Natural Resources Wales** (NRW)**,** Wales
› **Except Integrated Sustainability** (Except), The Netherlands

The approach followed is rooted in the Symbiosis in Development (SiD) framework for sustainable development, developed by Except. The SiD framework enables multi-faceted sustainability innovations using systems thinking and network theory. The SiD Process is pictured in the Figure 1 below:



› Figure 1 - Visualization of the Symbiosis in Development (SiD) process.

THE INTELLIGENCE PHASE

This step consists of four components, which answered the following research questions:

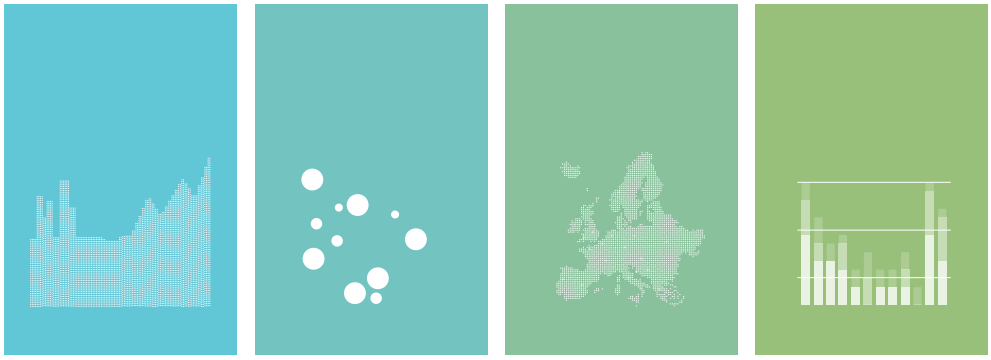
› **Trend Analysis:** What are the environmental, social, and economic trends that can influence BGI research and development, and the related knowledge transfer, now and in the future?

› **Stakeholder Analysis:** Who are the key stakeholders involved in developing BGI, and what barriers and opportunities for knowledge sharing do they perceive?

› **Precedent Research:** Which BGI experiences, solutions, and methods can be addressed to retrieve lessons and caveats for future implementation?

› **Data Assembly:** What data exists in the BGI field, and how can these be structured?

A3-6 SUBPHASES (INTELLIGENCE PHASE)

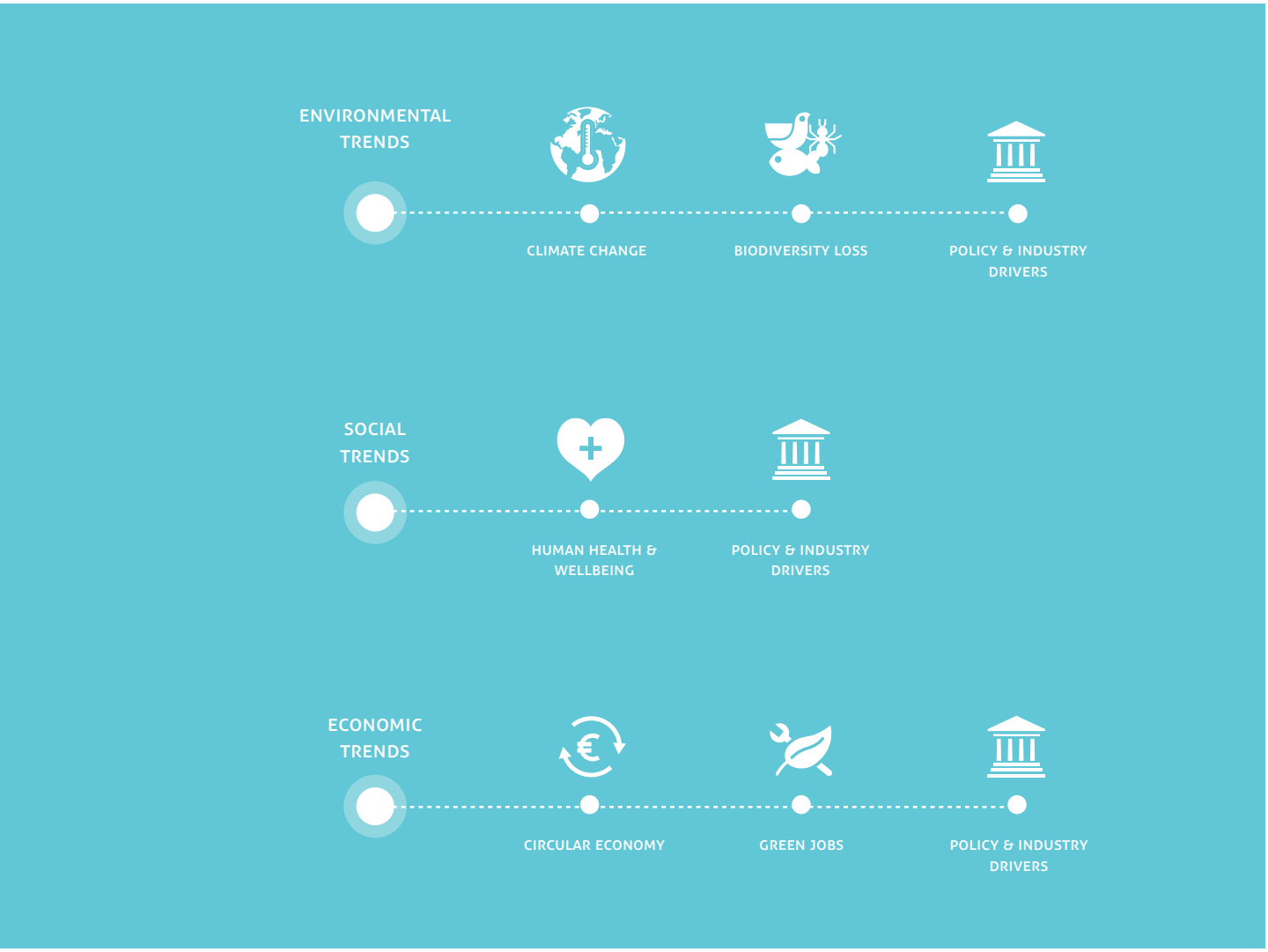


› Trend Analysis › Stakeholder Analysis › Precedent Research › Data Assembly

While it provides pointers and insight in the direction of a future BGI Manual, the core of this phase entails gathering the necessary information and key insights relating to the BGI field, in preparation for a co-creation session with participant organizations, structured along multiple SiD Solution Cycles (Phase 3 in Figure 1).

2. TREND ANALYSIS

BGI-related environmental, social and economic trends are analysed in order to identify short, medium, and long-term phenomena that are likely to influence the design and implementation of BGI, now and in the future. This trend analysis is a result of thorough desk-based research of the latest reports issued by a number of authoritative regional and global organizations and institutions and draws on the expertise and experience of the project partners.



› Figure 2 - Trends and sub-trends

ENVIRONMENTAL TRENDS

This group of trends covers the interrelated environmental phenomena of climate change and biodiversity loss. The effects of climate change manifest themselves in: extreme droughts or floods; the Urban Heat Island effect due to increasing temperatures and urban centres' materials and design; and forest fires caused by increasingly hot and arid summers. In turn climate change, as well as land use change and human activities, is creating habitat destruction and fragmentation, which is causing increasing rates of biodiversity loss worldwide. Globalisation is also increasing the spread of invasive which compete with local biodiversity for space and resources and alter local environments, as well as affecting the provision of ecosystem services.

BGIs represent a means to mitigate and adapt to climate change. BGI can reduce the heat load in an area, mitigate flood events, and be used to develop a holistic approach for the spatial planning of green spaces at different scales. BGI can be integrated into urban and rural developments to tackle water management issues e.g. rain gardens, permeable pavements, swales, retention ponds, wetlands. Finally, the potential for biodiversity enhancement increases where BGIs provide a network of multi-scale green spaces to increase functional and structural connectivity between areas and counteract habitat fragmentation.

SOCIAL TRENDS

Societal trends relate to issues such as population growth, urbanization, and social inequality with their consequent negative implications on humanity's health and wellbeing. Disappearance of nature from daily life, traffic congestion, air quality, noise, and loss of natural open spaces are just a few examples of these implications.

In recognition of this, features such as parks, gardens, green roofs and green walls are increasingly incorporated into urban planning and design. BGI can support ecosystem services that are directly linked to human health and wellbeing - i.e. air quality regulation, water quantity regulation, heat stress mitigation, noise reduction, promotion of physical activity, stress reduction, and social interaction.

ECONOMIC TRENDS

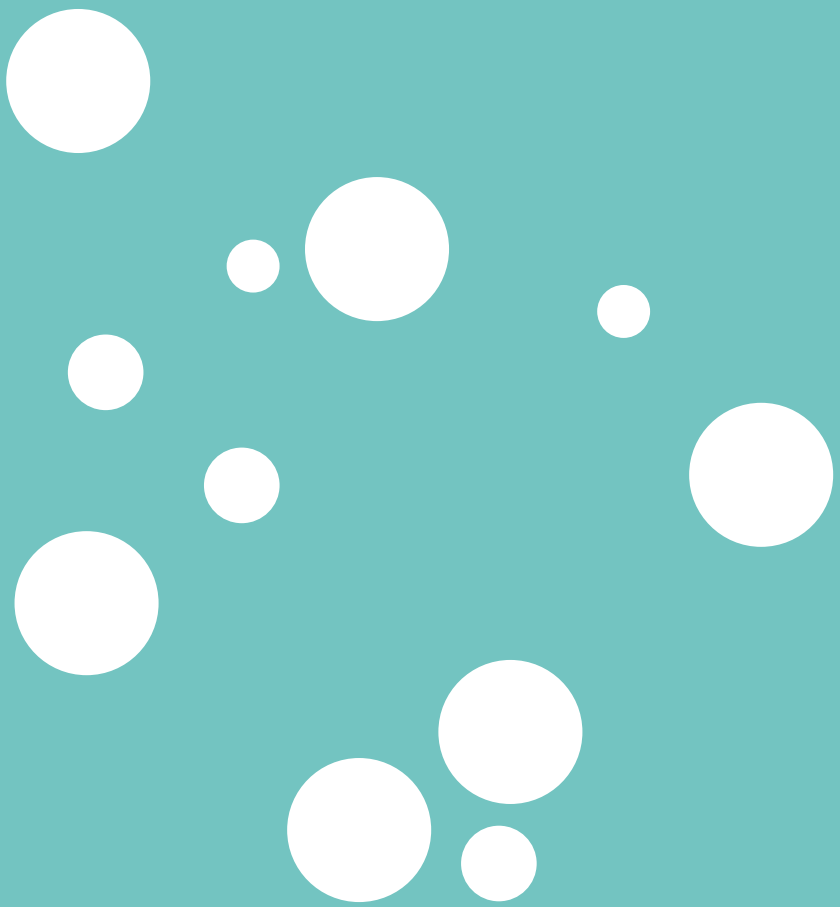
In response to environmental and social trends, economic systems across the globe are changing their practices by seeking to minimize waste and implementing regenerative design approaches. This new economic paradigm can be described as the 'circular economy'. The environmental challenges of our times also call for new forms of expertise and business models. BGIs such a biofiltration echo the principles of circular economy for water management.

The environmental challenges of our times such as climate change and biodiversity loss call for new forms of expertise and business models and are currently spurring a wave of green professions across a broad set of fields. In this regard, BGIs are set to ignite the economy of both urban and rural management, and farming and agriculture/aquaculture. This provides communities, businesses, and decision makers new opportunities for investing in ecosystems services.

TRENDS IN KNOWLEDGE SHARING

Knowledge relating to BGI is generated through different means, by a wide range of stakeholders. Academics usually gather data, develop software, and assess and evaluate case studies. Stakeholders at the policy level address BGI in policy implementation documents and guidelines, reports, brochures, and developmental rules. Practitioners who design and construct BGI produce spatial development plans, urban planning guidelines, and technical reports and specifications.

› Image 1 (next page) - 'Bosco Verticale', Milan, Italy (image credits: Chris Barbaris)



3. STAKEHOLDER ANALYSIS

The stakeholder analysis enables a clearer understanding of the knowledge-to-practice flow with regards to BGIs: how it functions, the stakeholders populating it, and their mutual interactions. The main outcome of this research investigates the main barriers hampering an effective bridging of BGI theory to practice as perceived by stakeholders, along with their insight on how to overcome them.

In order to do so, the partner organizations selected a long list of 64 stakeholders, narrowed then down to 11, according to both their availability and relevance in the BGI field. The process consisted of:

- a preliminary online questionnaire, followed by
- in-depth interviews.

The insights gathered along the two steps enabled a network analysis - specifically tailored to both the single stakeholder and in relation to their particular sector. The stakeholders interviewed during the analysis belong to different organizations across Europe, and are considered key in order to engage with and achieve a better understanding of the knowledge to practice flow in the BGI field. The interviewees were clustered into three key sectors: Researchers, Decision Makers, and Practitioners. The clusters and related organizations are pictured in Table 1.

STAKEHOLDER CATEGORY	ORGANIZATIONS
Researchers (R)	**1** University of Northumbria, Natural Environment Research Council (NERC) Knowledge Exchange Fellow **2** University of Antwerp **3** Instituto Politécnico Coimbra **4** International Union for the Conservation of Nature (IUCN) **5** Green Surge
Decision-makers (DM)	**1** Welsh Government - Planning Division **2** Anonymous European Institution **3** Welsh Government- Ecosystem Management and Implementation
Practitioners (P)	**1** International Society Of Cities And Regional Planners (ISOCARP) **2** Anonymous construction company **3** VolkerWessels

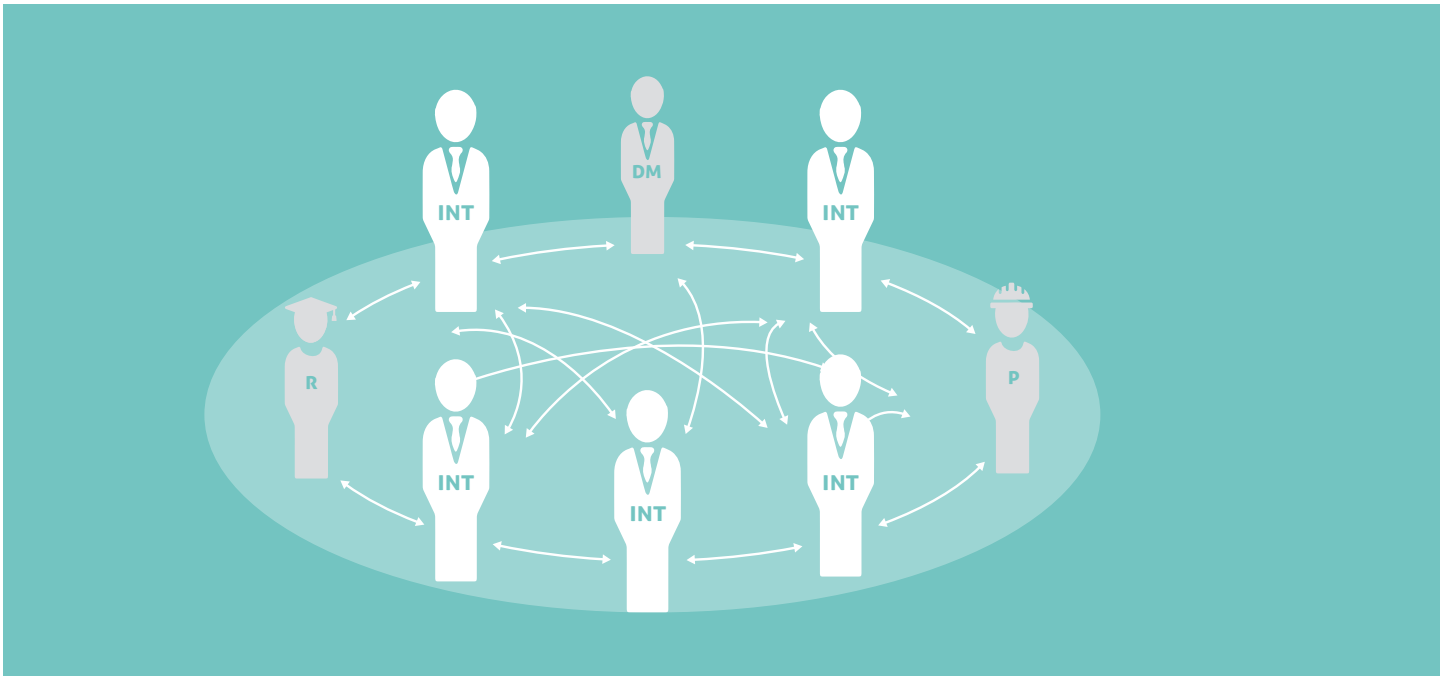
› **Table 1** - Overview of the stakeholder categories and the specific organizations engaged.

After a thorough sectoral analysis, the barriers and opportunities for bridging the knowledge-to-practice gap as perceived by each stakeholders were further analyzed to find common threads and patterns. This process identified commonalities in barriers and opportunities as follows:

1 **Vocabulary and Communication:** Stakeholders frequently highlighted that there's a lack of consistent language and terminology which hinders communicating ideas and concepts across the BGI value chain. The resultant confusion and lack of alignment between the aims of researchers and practitioners makes it challenging to start the conversation between stakeholders in the first place. Providing a common vocabulary for BGI, and an understanding of the practicalities involved in BGI implementation is therefore a key requirement.

2 **Standardization:** Setting standards for the construction of BGI, and increasing awareness of the topic is widely perceived as necessary by stakeholders. To enhance accountability, the integration of public concerns in the process of developing standards should be considered.

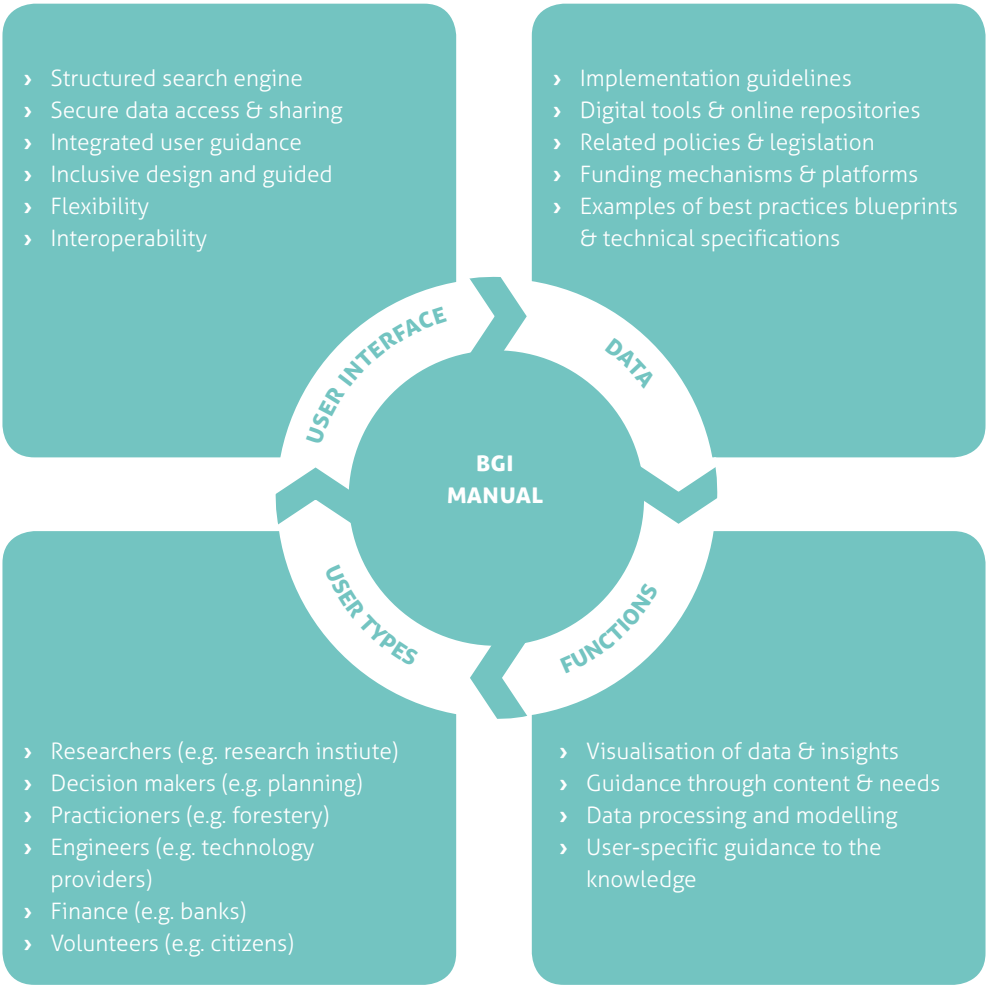
3 **Links to policy:** BGI needs to be underpinned by strong policy links at regional and local levels. This will assist in ensuring an improved cross sectoral implementation of BGI in addressing environmental and societal challenges such as water, health, biodiversity, and climate change. This can in part be achieved by emphasising the economic benefits of BGI and providing the 'business case' to decision makers. Regulations can be a key driver for the implementation of BGI, as exemplified by the mandatory green roof policy in Antwerp. Aligning BGI implementation with national or supranational policies is identified as a major factor of success. For example, the European Union's biodiversity strategy provides promising opportunities for BGI.



› Figure 3 - Conceptual overview of a complete value chain around BGI.

During the research, a number of "intermediary" stakeholders - deemed to be of key importance by interviewees in order to streamline the knowledge to practice flow, were identified in the financial sector, engineering, and NGOs. The insights retrieved enabled the depiction of a preliminary snapshot of the BGI value chain, with the mutual - virtual and physical - interactions between the stakeholders interviewed (displayed in Figure 3 on previouse page).

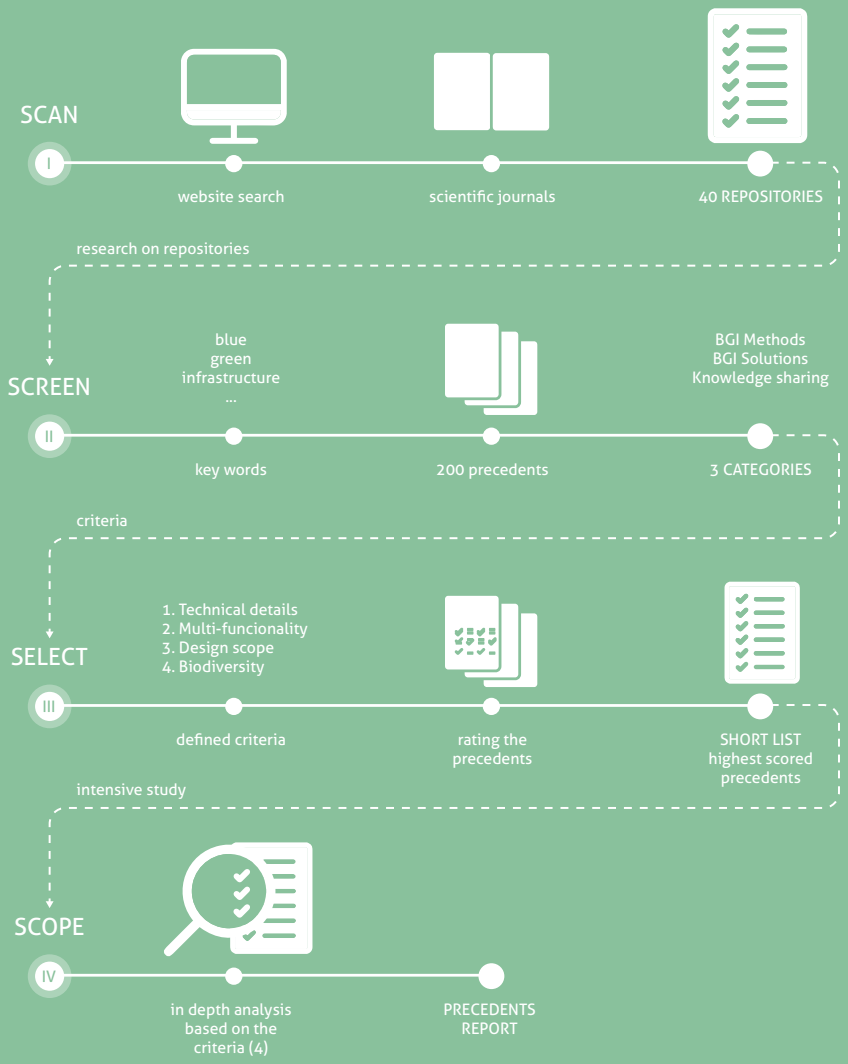
As an input for the next phase of the project, a range of stakeholders not included in this current analysis will need to be included, along with their input in terms of data, measurement systems and methods. Forestry, civil society/ citizens associations, community businesses and startups increasing commercial opportunities for nature-based innovation are the sectors identified for future inclusion, and key stakeholders to address. This is in order to enable a better understanding of the chain of interactions and enlarge the pool of resources, to bridge any perceived gaps and assemble ideas for the BGI Manual. Preliminary suggestions on the BGI Manual were received during the interviews with stakeholders, and are summed up in Figure 4:



› Figure 4 - Summary of stakeholders' requirements for the BGI Manual

4. PRECEDENT RESEARCH

BGI Precedents were researched in order to access and understand available knowledge on BGIs. The focus lied upon key sources for existing research and case studies, and the ways precedents provide insight on the methodologies of knowledge sharing, construction, and maintenance.



› Figure 5 - The process of structuring information and data for BGI precedents

During the research, a number of relevant repositories were identified and screened – including databases, scientific journals, search engines, and governmental websites. Further screening of the sources informed a categorization of BGI precedents into methods and solutions, and the identity of a number of related sub-categories. Addressing these methods and solutions provides hints, lessons and caveats for future attempts at improving knowledge transfer in the BGI field. After composing a (so defined) long list of methods and solutions, four criteria were used in order to score - and shortlist - them:

- **Technical details:** Design, construction, and operational data developed and provided as a result of a precedent.
- **Multi-functionality:** Amount of, and interaction between social, environmental and economic benefits of a precedent.
- **Biodiversity performance:** Depth of information related to biodiversity, and centrality of the theme in a precedent.
- **Design Scope:** Scales of spatial planning, and interconnectivity of a BGI with its surroundings.

Each precedent was scored on a scale from 1 to 3 points on each of the criteria. The highest scoring ones were shortlisted as "best practices". The report addresses a number of examples for each sub-category of precedents.

CATEGORIES OF SELECTED PRECEDENTS

BGI Methods

Precedents which address issues related to climate change, water management and biodiversity loss in urban and rural areas.

- **Online platforms:** Data repositories - scientific journals, search engines, web pages
- **Guidelines:** Technical and scientific documentations - strategic documents, government reports, brochures
- **Digital tools**: Applications and softwares employed by practitioners to search, design, and perform calculations on BGIs

BGI Solutions

Solutions represent physical manifestations of infrastructures, case studies that include green and/or blue functions such as green roofs, green walls, biofiltration system, management of riparian areas, or wild-passages. Solutions are scanned and clustered according to scale:

- **Nano:** 0 to 0.1 ha
- **Micro**: 0.1 to 1 ha
- **Meso:** 1 to 10 ha
- **Macro:** > 10 ha

The importance of crafting BGI solutions that inform implementation at differing scales, and which are innovative, accessible and informative / functional is highlighted along the report as a key factor for harnessing the benefits of BGI.

Knowledge-to-practice

Scoping of precedents related to methods and practices of knowledge transfer from other fields was deemed a valuable source of inspiration for future directions of BGI knowledge transfer.

LESSONS LEARNT ON PRECEDENTS AND THEIR CONTRIBUTION TO KNOWLEDGE TRANSFER

1. **Case studies:** The inclusion of case studies is a particularly effective means for transferring knowledge. Especially in the form of a brochure of infographics, case studies represent valuable bodies of information on a wide range of data.

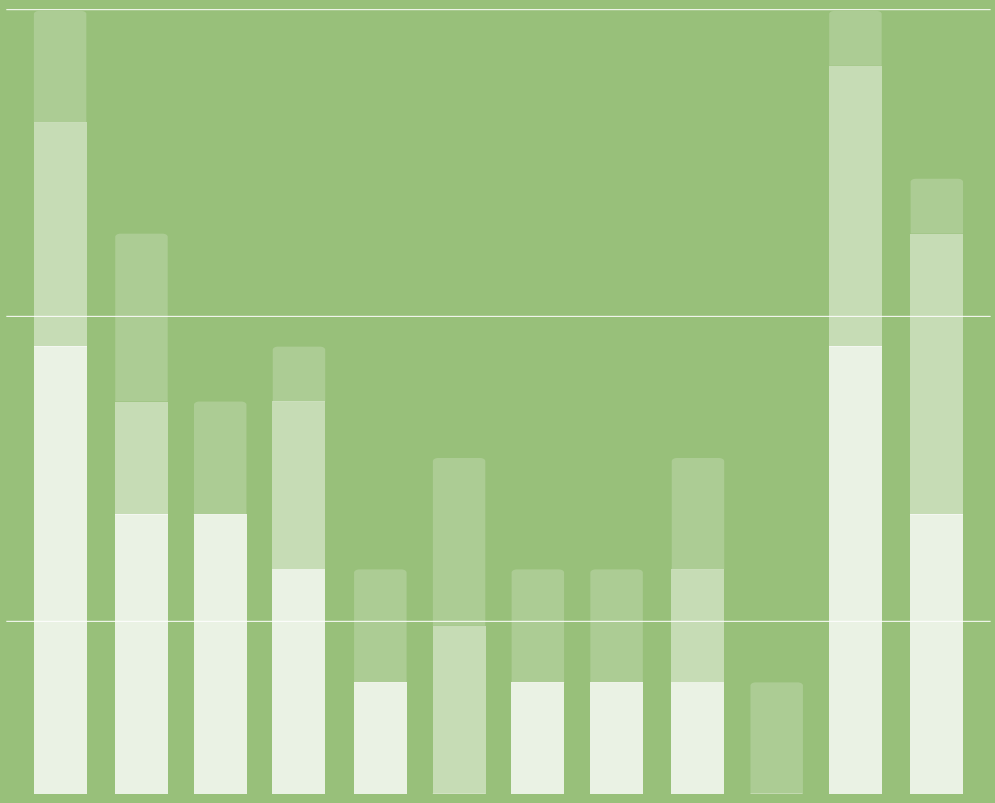
2. **Transdisciplinary approach:** The value of a number of online platforms and digital tools is to bring together professionals from different backgrounds, to exchange information. Other methods foresee online courses on BGI and NBS, to make sure knowledge is delivered to practitioners interactively.

3. **User experience:** More often than not, navigating the digital tools with ease requires a high level of technical expertise. Several online platforms feature user-experience related issues, in the form of difficult searching and navigation.

4. **Multifunctionality/ Multiscale:** Acknowledging the presence of multiple scales (nano to macro), along with multiple functions - e.g. water management and biodiversity enhancement, supports the potential for BGIs to be highly flexible. Interconnected networks of BGI solutions represent effective ways to capitalise on each one's multi-functionality and spatial scale, increasing performance over time in terms of shared value for biodiversity, along with social and economic ones.

5. **Multi-stakeholder collaboration:** Co-creation through both top down and bottom up approaches is highlighted as pivotal in the final implementation of several precedents - from BGI and from other fields. Users, knowledge institutes, public and private actors are indicated as pivotal in this sense.

The need is acknowledged for data on BGI to be structured in a format that is compatible and interoperable with data-modes and digital tools available online. This creates high-grade, multi-functional and multiscoped solutions for individuals and organizations. Combination of high level of detail and wide design scope enables better communication of knowledge to practitioners. Tools can provide life-cycle cost assessments, while platforms provide a wider perspective for other actors to join and realize the calculated values together. The BGI Manual should incorporate and reflect these insights, offering a selection of tools, data and guidelines that can be used by practitioners from different sectors and scales simultaneously.



5. DATA COLLECTION & ASSEMBLY

The goal of undertaking data collection and assembly was to analyze the existing research in the BGI domain. By creating a library of knowledge on stakeholders and precedents, the aim was to achieve an improved understanding on what types of data need to be considered when designing BGI projects.

The database - currently unavailable for sharing - was created via the previous research - stakeholder analysis and precedent research, and the main data therein collected are stored and organized. Particularly, the different types of data are structured along the categories of Stakeholders, BGI Methods and BGI Solutions. They include stakeholder roles, activities, dependencies, perceived bottlenecks, and requirements for the BGI Manual, as well as criteria for the BGI methods and solutions.

Additionally, the types of data related to the design and implementation of BGIs are listed. These are identified with:

- Climatological data
- Hydrological data
- Geological and spatial data
- Infrastructural data
- Economic data
- Biodiversity data
- Health and happiness data

Lastly, a reflection on what type of data is provided by the relevant stakeholders involved in the research, and what type is needed is undertaken. The key insights from this analysis are depicted in Table 2, below

STAKEHOLDER	DATA COLLECTED	DATA REQUIRED
Researchers (R)	› Statistics, designs of BGIs › Blueprints of BGI Solutions (technical)	› Long-term / strategic planning from decision-makers › Economic (cost and benefit) valuation of BGI Solutions' outputs.
Decision-makers (DM)	› Policies, incentives, strategic plans	› Technical data and indicators for various elements of BGI.
Practitioners (P)	› Technical data and engineering metrics	› BGI designs / blueprints › Policies

› **Table 2 -** Data exchange between key stakeholder groups

6. NEXT STEPS

The aim of this assembly of research was to lay the foundations for co-creating solutions with the participating organizations and other stakeholders in the field in the next phase of the project. The background information provided by this report serves as a starting point for informed conversations along the intended follow-up co-creation session, where clearer solutions to bridge the knowledge to practice gap on BGI and more straightforward definitions and formats for the BGI Manual will be collaboratively designed.

The systems-thinking based SiD framework has proven extremely effective at solving complex problems fast, providing all involved with a deep understanding of the challenges at hand. By enabling the development of roadmaps in systemic, integrated ways while building a strong, interdisciplinary team for long-term collaboration, the framework will represent the backbone for the development of the BGI Manual.

7. ACKNOWLEDGEMENTS

The final research report is the result of collaboration between the following partner organizations:

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biodiversa

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EXCEPT
INTEGRATED SUSTAINABILITY

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"Coming together is the beginning,
keeping together is progress,
working together is success."

Henry Ford