# ACCELERATING GREEN

## *How Small and Medium Enterprises can contribute towards Mainstreaming Urban Nature-Based Solutions*

Universiteit Utrecht

*(Cover: Congress Palace 'Europa'. The picture was taken by the author in Vitoria-Gasteiz, Spain, in January 2020)*

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*List of Abbreviations*

| | |
|---|---|
| GI | Green Infrastructure |
| NBIS | Nature-based Innovation Systems |
| NBS | Nature-based Solutions |
| PA | Public Administration |
| PPP | Public-private partnerships |
| SMEs | Small and Medium Enterprises |

# 1. Introduction

## 1.1 Problem definition & Knowledge Gaps

Cities are at the core of societal development. It is the place where to cultivate life and career since opportunities are abundant due to the accumulation of economic and human capital. Health, leisure and job opportunities attract more and more population, and the UN expects 68% of the world population to be living in cities by 2050 (UN, 2018). Cities are the result of complex urban systems in which urban actors and dynamic resource networks interact in order to carry out social and economic functions, and which are structured in relation to land use activities and structures, in other words, the built environment (Batty, 2009). However, as much as cities can function as catalysts for personal development, they can also take a negative turn, with people feeling locked inside cities or abandoning them due to challenges such as elevated rent prices and gentrification, excessive noise, traffic jams, crowded streets and inefficient transport systems, poor air quality conditions or the lack of space for leisure, including green spaces (Elsadek et al., 2019; Hoffmann, 2019; Jover & Díaz-Parra, 2019). These are indeed some of the most common urban sustainability challenges which cities face today. Not to mention that, as world cities grow, urban expansion and the related processes that city-building entail generate the greatest anthropogenic impact on the biosphere (Downton, 2008).

Global warming exacerbates most of these problems either directly or indirectly, impacting urban systems (Apreda et al., 2019). One example of a direct impact are the rapidly shifting weather patterns which account for longer and warmer summers. Heat waves combined with traditionally dominant grey infrastructure in cities, where the pavement 'rules' over the soil or grass, have led to what is known as the 'heat island effect', which can have severe impacts on the health of dwellers (Singer et al., 2016). Another example of the effects of climate change is the heightened risk of surface flooding (Kaspersen et al., 2017).

From a governance point of view, cities are centres of decision-making which can influence decisions at the provincial and regional levels, and which 'permeate' in society by influencing national policy and legislation. Urban decision making is a result of complex interactions among heterogeneous networks of public and private actors, which generate institutions, and can create new ones or transform existing ones (Block & Paredis, 2013).

Therefore, urban actors, are capable of transforming urban systems. In fact, they are the ones carrying out the urban transformation towards sustainable cities (Romanelli, 2017). The most visible urban transformation is that of the urban landscape into a more sustainable urban environment. Recalling Wolfram's concept of urban transformative capacity (2016), urban transformation has similar implications as it acknowledges the urban environment as an urban system including both physical and human elements, in the same way as the literature on socio-technical systems (Bergek et al., 2008; Boons et al., 2013; Hillman & Sandén, 2008; Jacobsson & Bergek, 2011; Jagt et al., 2019; & Truffer, 2008; Mitleton-Kelly, 2006). Hence, urban transformation, is understood as the combination of actions towards reshaping the current system, and steering its functions so as to reach a state of urban sustainability.

However, confronting complex urban sustainability challenges requires urban actor's efforts to be combined. SDG 11 is dedicated to 'Sustainable Cities'. Its purpose is to steer stakeholder's activities and decisions towards sustainable development, through the attainment of resource efficiency, climate mitigation and adaptation, integrated policies, and inclusive and participatory measures for urban development (UN, 2016). The urgency to confront urban sustainability challenges has been recognised at multiple levels, also highlighting the opportunities that a transformation towards sustainable cities could bring such as climate adaptation, health benefits, increased aesthetics and job creation. For instance, megacities around the globe have participated in city networks such as C40 to acknowledge their crucial role in transforming cities to more sustainable trajectories, healthy and liveable spaces (C40 Cities, 2019). At the national level, similar types of networks have emerged such as the Spanish Network of Cities for the Climate (RECC, 2017). Forte et al. (2003) highlighted the fact that cities have been shifting from being mostly "engines of development" to "agents of social change".

Furthermore, the EU launched a variety of projects for sustainability research, including urban sustainability, that fall under the Horizon 2020 project (EC, 2019). For instance, EU *Naturvation* is a sustainability research project focused on exploring the enablers and barriers to the implementation of *nature-based solutions* (NBS), green and blue infrastructure that uses the natural properties of ecosystems whilst generating environmental, economic and social value (Naturvation, 2019). On the pursuit of solutions, different technological innovations have been developed with the potential to significantly contribute to realising the transition towards sustainability, such as PVs or electric vehicles, with these becoming relatively mainstreamed in some cities around the world. Urban NBS, however, are particularly relevant for the study of urban transitions, as they interact with the built environment and the urban space, whether substituting it or adapting to it (Kabisch et al., 2016). They are characterised by multifunctionality and are context specific. Some of the issues they aim to tackle are biodiversity loss, flood and heat wave risks, energy waste in buildings, or ecosystem degradation (Dorst et al., 2019). Examples of NBS are green roofs, green walls, city lagoons, urban forests, horticultural community gardens, semi-permeable pavements or city parks, among others (Bulkeley & Raven, 2017; NATURVATION, 2019).

When considering their development and diffusion, NBS can be studied as the innovative components of a transitioning system, becoming the core element in what has been defined as nature-based innovation system (NBIS). The NBIS perspective offers a more comprehensive alternative to traditional technological innovation systems (TIS) when analysing urban development, as it introduces new analytical dimensions that explore the role of place-based factors, governance structures and stakeholder's agency. (van der Jagt et al., 2020). Of course, technological innovation can contribute to improved sustainability. However, the context specific and multifunctional character of NBS involves a more direct and diverse relationship with the environment and society, thus, incorporating more environmental and societal value due to their capacity to deliver solutions to the broad array of urban sustainability challenges, e.g. health, air quality, biodiversity and even environmental justice (Kabisch et al., 2016; van der Jagt et al., 2020). Different dimensions influencing NBS development and diffusion have been outlined under the NBIS framework. The framework is an effective tool to analyse these several

aspects of this system, such as resources, governance structure, collaborative agreements, policies, place-based factors, etc. (van der Jagt et al., 2020). It was inspired by core concepts of the Technological Innovation Systems (TIS) framework. However, it differs from it in the attention paid to specific contexts and place-based factors, stakeholders' agency and governance structures. Because NBS are considered more contextual than other types of technological innovation such as solar panels (see Bergek et al., 2008), and, thus, they are completely integrated with their environment when installed, the authors considered a new framework that incorporated these dimensions was necessary (van der Jagt et al., 2020).

Back to the overall picture, it is generally accepted that a shift in the existent urban system's structure is needed in order to achieve urban sustainability. In fact, changing the way in which different public and private stakeholders interact through policy and market processes is necessary if a rapid transition is to be attained (Boons et al., 2013). From a local governance approach, and in the context of urban development projects, it has been highlighted that organisations in the urban landscape (municipality, private actors, third sector) lack the authority, knowledge and capacities to carry out green infrastructure projects individually (Salet et al, 2006). Most finished urban greening projects are the result of collaborations between traditional stakeholders, mainly municipalities and other local authorities, urban designers and architectural firms and developers, such as engineering and construction firms (EC, 2015; Carbonara & Pellegrino, 2018; Sanesi et al., 2017). These tend to be large scale projects with aims that were largely aesthetic and societal, which means there was less room for the environmental dimension (Davies & Lafortezza, 2017. This allowed to generalise most urban GI solutions in a one-size-fits-all fashion, so that very similar projects could be undertaken in completely different urban settings. For NBS, the local environmental, economic and social aspects are much more central.

On the other side of the spectrum of private actors, although the role of civil society and social enterprises has been important in promoting the transition to a green economy (Affolderbach & Krueger, 2017; Smith 2005; Seyfang and Smith 2007; Davies and Mullin 2011; Shear 2014), and despite some urban NBS having been implemented in the past and have endured, most of these innovations are put forward as grassroots initiatives dependent on special subsidies or tax breaks to survive, (Food For Good, 2020; Grow Green,2017). Alone, they are incapable of bringing about a transition in the green infrastructure at the city level.

If current urban systems are to be rapidly transformed given socio-environmental pressures and as agreed under Agenda 2030, mainstreaming urban NBS might be one relevant way in which to meaningfully contribute to the urban sustainability transformation and the economy, given the potential contribution of urban actors. However, the support for mainstreaming NBS likely cannot be left to grassroots initiatives on their own, neither to authorities. The inadequacy of policies and financial resources supporting NBS could hinder their development and diffusion, for which more holistic governance is deemed necessary (Dorst et al., 2019; Frantzeskaki, 2019; Xing et al., 2017).

In the NBS literature, growing attention has been given to the role of the private sector in developing, incorporating and diffusing NBS (Xie & Bulkeley, 2020; Toxopeus et al., in press).

However, the private sector clusters a vast array of very different organisations, with varied compositions, philosophies and business models (BMs), and the NBS literature is not yet exhaustively explored the different capacities of a diverse private sector.

It is well accepted that entrepreneurs, whether in small and medium enterprises (SMEs) or big firms, have the potential to initiate innovative projects able to challenge and transform existing markets (Burch et al., 2016; Smith, 2001). In this sense, there are plenty of examples of enterprises that began to incorporate sustainability in their business strategy (Burch et al., 2016). Although not limited to SMEs, entrepreneurship is usually associated with them (Dollinger, 2008; Massa & Testa, 2008). From a sustainability approach, due to the fact that globally most firms are SMEs, and because these are largely responsible for a great portion of current environmental stresses, there is an impulse to captivate SMEs towards environmental improvements whilst encouraging sustainable entrepreneurship (Burch et al., 2016). Perhaps, this could be an opportunity to widen the governance efforts towards developing and diffusing NBS, by incorporating NBS. Some SMEs focus on the exchange of knowledge and the diffusion of methodologies, which when applied to bigger firms, can accelerate transitions within the workplace and establish new and more dynamic processes of working, even affecting their long-term vision (Martínez-Costa et al., 2019; Vătămănescu et al., 2020). Thus, SMEs have the ability to work with niche innovation on the one hand, and the power to influence larger firms on the other (Affolderbach & Krueger, 2017). Furthermore, SMEs are said to actively contribute to economic recovery (Affolderbach & Krueger, 2017). The EU is encouraging debate about ways in which SMEs could partner with municipalities and other stakeholders with the goal of creating sustainable and resilient cities (EC, 2017). However, although a desire to involve SMEs as urban change agents exists with academia paying attention to the role of 'unique' urban characteristics enabling or hindering innovation from small enterprises, this approach is not yet put in practice that often (Burch et al., 2016). And, most importantly, there is a lack of concrete evidence about the role that SMEs could potentially play (or not) in the mainstreaming of urban NBS.

Following this line, it would be interesting to further explore the role of SMEs, since, although initial indications of the potential for small businesses on urban sustainability transitions have been pointed out (Burch et al., 2016), little attention has been paid to the role of SMEs as relevant actors among urban private actors within urban governance structures.

Nonetheless, the NBIS does not include yet a dimension that looks particularly into the role of the private sector, entrepreneurs and a potential market formation. This is surprising given the attention that the TIS framework gives to market formation as a core dimension. Perhaps, this could be explained by the fact that the new framework (NBIS) was developed based on a literature review, and the role of the private sector has been understudied in regards to NBS development and diffusion.

From the approach of mainstreaming urban NBS, it seems essential to test out whether or not market formation is a relevant dimension to include in the framework. One could argue that such a dimension must be present, due to the current system's inefficiency to deliver progress in the provision of urban NBS. SMEs are profit oriented enterprises which operate within the competitive market and could perhaps play a role in forming markets for NBS. Indeed, SMEs

might have the potential to promote NBS as profitable and competitive innovations. After all, SMEs are firms that emerge as a product of individual entrepreneurial activities (Lucky & Olusegun, 2012). And such entrepreneurial activities could include a decision to invest in NBS.

## *1.2. Research Objective*

Involving more actors to the current governance of NBS in cities can enrich existing networks, which might in return accelerate the transition to greener cities through the mainstreaming of NBS. According to the literature, SMEs play a crucial role in innovation and market formation processes (Boons et al., 2013; Burch et al., 2016; Hockerts & Wüstenhagen, 2010; Schaltegger & Wagner, 2011). Moreover, in the context of urban sustainability transitions, there is a notion that SMEs could be an important player, underlining that their involvement must be premeditated, considering their potential, but also the vulnerabilities that such processes might involve (Burch et al., 2016). Therefore, it is worth exploring the potential of these enterprises in accelerating the development and diffusion of urban NBS towards mainstreaming NBS in cities.

The NBIS framework is a comprehensive tool which aims to analyse existing and potential nature-based innovation systems in cities and elsewhere (van der Jagt et al., 2019). Moreover, it identifies focal points or factors which are considered crucial for NBS to be developed and diffused, but also those that might be preventing the system from delivering the NBS. However, a knowledge gap has been identified here in relation to the lack of research on the specific and diverse role of the private sector in the development and diffusion of NBS**,** which could explain why processes of market formation have not been explicitly included in the NBIS framework as a dimension.
In the given scenario, SMEs, and particularly those with a focus on sustainability, might present an opportunity to diversify the NBS market and to promote the added value that NBS have to offer to municipalities, other businesses and society as a whole. The focus on SMEs in particular, instead of looking into larger firms, has to do with the fact that SMEs are the ones who operate in niche markets, whilst big firms tend to work in well-established markets with mainstream products (Boons & Lüdeke-Freund, 2013).

Therefore, after studying the NBIS framework's validity, it is explored if market formation could be a relevant factor to add. The authors argue that market formation, as factor, is less central to NBIS than to traditional technological innovation systems (TIS) because many of the benefits provided by NBS are public, long term and diffused in the environment (such as clean air or biodiversity increase) compared to explicitly private interests of businesses commercialising technological innovation (van der Jagt et al., 2019). However, although the mainstreaming focus on NBS has been mainly put in public actors which can use incentives and regulations, it might as well be possible for private investment to take place voluntarily if different urban actors collaborate towards the type of benefits (both private and public) that NBS can provide.

Indeed, due to the existing system dynamics (traditional understandings of urban development and collaborative arrangements among traditional actors), there is a risk of limited NBS mainstreaming taking place in the near future. Thus, the aim of this research is to understand the potential contribution of SMEs to mainstreaming urban NBS in cities. Furthermore, studying the role of SMEs in the development and diffusion of NBS in cities through the lens of the NBIS framework might provide insights on how the different urban NBS system structures currently function. These findings may also inform the debate of whether a market formation dimension is deemed necessary for a deeper and more comprehensive NBIS framework. Finally, such knowledge might translate into specific pathways or recommendations in which current systems could be transformed through relevant stakeholders in the field by investing on or incentivising the market formation for NBS.

## *1.3. Research Questions*

Main research question:

*What is the potential of SMEs towards mainstreaming urban nature-based solutions in cities?*

In order to answer the main research question, the following sub-questions will need to be answered:

*1: To what extent are SMEs investing in mainstreaming urban NBS?*

*2: Which could be the potential role of SMEs in promoting/facilitating/supporting nature-based innovation systems?*

*3: What are some of the opportunities to increase SMEs' involvement in mainstreaming urban NBS?*

*4: Which are the barriers that prevent SMEs from supporting nature-based innovation systems and from contributing to mainstreaming urban NBS?*

## *1.4 Research framework*

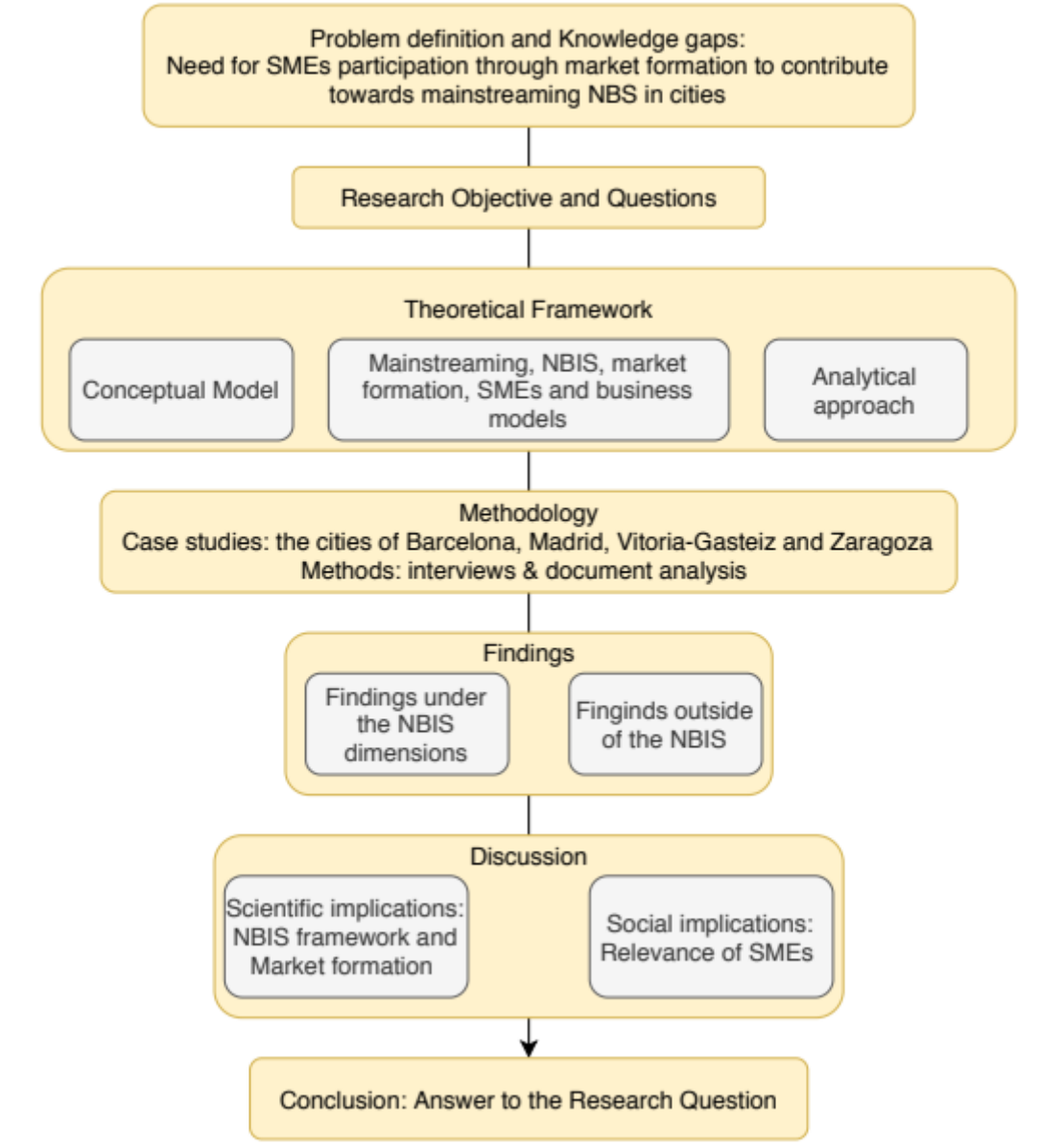


*Figure 1: Research framework*

# 2. Conceptual research design

## 2.1 Conceptual Model

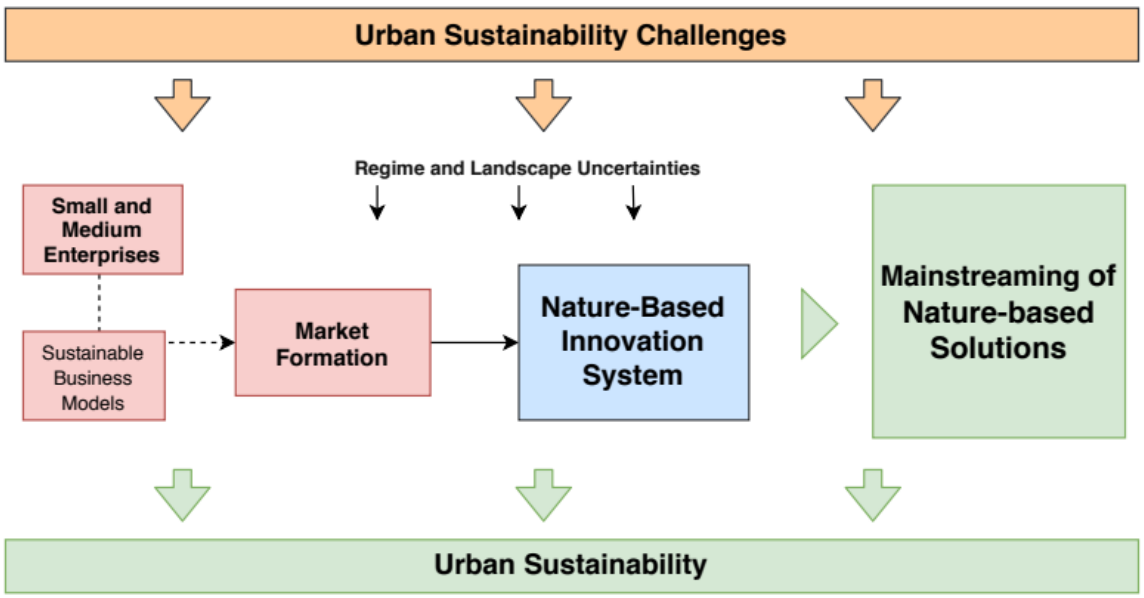


*Figure 2: Conceptual model*

## 2.2 Theoretical framework

### *Urban Sustainability*

As a field of research**,** urban sustainability has been developing for the last decades up to today. Evolving from the literature on urban ecology, it is partly concerned with ecosystem services, and how these interrelate with human well-being (Wu, 2014). Resembling resilience, urban sustainability explores the functions and capacities of urban systems, composed of socio-ecological and socio-technical networks, to cope with disturbances, adapt to changes and transform systems which hinder the adaptiveness of the system in the present and the future (Meerow et al., 2016). It portrays urban areas as dynamic socio-ecological systems and combines this perspective with a landscape approach. Similar to the concept of urban transformations, the urban sustainability comprises both the physical and the human elements. On the one hand, it can be defined as "the process of developing a built environment that meets people's needs whilst avoiding unacceptable social or environmental impacts'' (Hamilton et al., 2002).

Under the context of mainstreaming of NBS, these two definitions are helpful to grasp the important role that urban NBS can play in the development and adaptation of cities, as well as the agency of actors working in their development and diffusion.

### *Mainstreaming*

With mainstreaming we refer to the acceptance, normalisation and legitimacy of NBS as a well-fit alternative to grey infrastructure and, occasionally, as an add-on to the built environment. According to the Oxford Dictionary, mainstream can be defined as "the ideas, attitudes, or activities that are shared by most people and regarded as normal or conventional" ("mainstream", 2020). In a closer context, drawing on Berger at al. (2007) conceptualisation of mainstreaming CSR in businesses, mainstreaming NBS can be understood as having NBS fully embedded in infrastructure and urbanism cultures, processes and activities. When something becomes mainstream it means that it has been introduced and normalised into the organisation's agenda and daily activities (Berger et al., 2007). Building from the CSR and gender mainstreaming perspective, for something to become mainstreamed in an organisation, it has to be incorporated in the policy development, technical tools, evaluations and agenda setting (Grosser & Moon, 2005). In the case of NBS, this research explores mainstreaming in the wider urban system, as compared to individual organisations. Nevertheless, it assumes that initiatives by individual organisations are crucial to achieve mainstreaming. Moreover, mainstreaming in this context also entails securing continuity and maintenance of NBS after they have been implemented. This can be realised by combining private investment with new policy arrangements and restructured governance frameworks (Bai et al., 2018).

### *Urban Nature-Based Solutions*

Urban NBS is an umbrella concept that incorporates a broad array of new but also well-established interventions that aim to solve complex urban sustainability problems. Furthermore, the relevance of the concept lays in its capacity to gather knowledge and experience of urban greening that used to stay as separate approaches from different sectors, from urban planning to mobility, health to urban ecology, in a way that it aims to generate a vision of how to realise sustainable urban development by bringing together practice and academia (Dorst et al., 2019 ). As the adjective indicates, these are solutions which emulate nature and try to introduce natural processes aiming at generating environmental, social and economic benefits (EC, n.d.). Many of them are incorporated or linked to green or blue infrastructure, with the main difference being that they aim to solve specific complex problems faced by society (Kabisch et al. 2016). In this endeavour, NBS offer a multifunctional approach to tackling urban challenges, addressing social, economic and environmental issues concurrently (Dorst et al., 2019). Much of this is due to their initial take of the city as an urban ecosystem, a complex system of social, economic and environmental elements. NBS provide co-benefits, and moreover, they are able to bridge social and economic interests bringing distinct stakeholders together and generating new green economies (Raymond et al., 2017). In regards to the environmental aspect, NBS have the potential to increase the delivery of ecosystem services in cities, contributing to, e.g. climate adaptation or biodiversity increase (Biodiversity Premises, 2019; Matthews et al., 2015). Moreover, the provided ecosystem services can be used as indicators to signal the present and future state of green spaces (Lovell & Taylor, 2013). Therefore, NBS could play an important role in tackling urban sustainability challenges. Such claim is backed by the way in which NBS are

currently enclosed in both policy and practice domain, with a particular push from academia and EU programmes to advance urban sustainability (Biodiversity Premises, 2019; EC, n.d.; Growgreen, 2017; Naturvation, 2019; Operandum, n.d.)

### *Nature-based Innovation Systems framework (NBIS)*

The NBIS framework (van der Jagt et al., 2020) is used to operationalise the mainstreaming of NBS in cities. In this sense, NBS are seen as the innovation component within what van der Jagt et al. (2020) have coined a nature-based innovation system (NBIS). Such system is composed by different factors that either enable or constrain the development and diffusion of NBS. The development of the NBIS framework as an analytical tool represents the "first attempt to apply an innovation system perspective to the study of NBS" (van der Jagt et al., 2019, p. 11). In this way, researchers can take a panoramic view on the system driving NBS development and uptake. Such systems include different networks of actors, institutions and resources that define the processes and outcomes of the system. The NBIS framework focuses on the following enabling or constraining factors: agency, discourse and vision, legislation and policies, governance structure, collaborative arrangements, learning, resources and place-based factors. These are the dimensions that the framework studies and considers relevant to mainstreaming a particular NBS (*See Table 1*). The framework was inspired by the technological innovation systems framework (TIS) and takes from it concepts such as actor networks, institutions, infrastructures, diffusion and mainstreaming.

Overview of the dimensions and associated subcategories of the Nature-Based Innovation System (NBIS) framework.

| Dimension | Dimension subcategory | Description |
|---|---|---|
| **Agency** | *Leadership and power* | People and organizations in the stakeholder landscape taking up leading roles to support NBS development, e.g. champions, mayoral leadership, frontrunners |
| | *Commitment* | Long-term support of NBS development by individuals and/or organizations is key to scaling of NBS |
| **Discourse and vision** | | Framing NBS as an approach to urban reinvention addressing multiple locally relevant sustainability challenges in order to strengthen actor networks around NBS |
| **Legislation and policies** | | The development of legislation, regulations, policies and strategies supportive of NBS or dissuading competing alternatives |
| **Governance structure** | | Processes of governing that involve a broad range of stakeholders across horizontal and vertical scales, and across different sectors, domains and disciplines, with a diffusion of responsibilities and power |
| **Collaborative arrangements** | *Networks and partnerships* | Learning and experimentation with NBS relies on the development of formal and informal coalitions between individuals or organizations, and attempts to strengthen and diversify these by boundary spanners and intermediaries |
| | *Participation* | Processes of involving and engaging citizens in the planning, development and maintenance of NBS contributes to experimentation and the integration of local knowledge and place-based factors in NBS development |
| **Learning** | *Education and training* | Actors and organizations engaging in a process of active learning, with a view on increasing confidence and capacity around NBS development and scaling |
| | *Research* | Knowledge production in relevant areas such as assessment of ecosystem services and environmental governance, and developing a science-policy interface, contribute to effective value delivery of NBS |
| | *Experimentation* | Testing or piloting local-level projects or governance arrangements aimed at nature-based innovation contributes to learning about how to effectively design and implement NBS |
| | *Monitoring and evaluation* | Systematically assessing outputs, outcomes and impacts of NBS is crucial to ensure ongoing alignment with place-based factors |
| **Resources** | *Knowledge and human capital* | The availability of explicit knowledge concerning e.g. technical implementation of NBS, values of NBS, established governance structures and tacit knowledge on socio-ecological systems, as well as skills to e.g. create and manage NBS and engage in partnership working contribute to the effectiveness of NBS delivery |
| | *Financial factors* | The availability of funding, financial incentives or market demand for the development of NBS |
| | *Technologies* | The availability of technologies supporting NBS development, implementation and knowledge management |
| **Place-based factors** | *Built environment* | Adapting to urban (infra)structures, amenities and their distribution influences the capacity for NBS development and scaling |
| | *Natural processes and endowments* | Responding to local soil conditions, local flora and fauna, climatic conditions etc. in the planning, design and maintenance of NBS |
| | *Societal conditions and dynamics* | Aligning NBS with population dynamics and socio-economic change across space by involved actors |
| | *Cultural frames of reference* | Aligning NBS with broadly shared (i.e. societal) practices, norms and attitudes in order to improve the use and uptake |

*Table 1. Copied from van der Jagt et al. (2020).*

However, although both TIS and NBIS initially serve similar purposes, van der Jagt et al. (2020) deemed a separate framework necessary for studying NBIS. Precisely, they questioned the suitability of the TIS to include and analyse the development and diffusion of NBS (van der Jagt et al., 2020). Van der Jagt et al. (2020) acknowledged that technological innovation is more concerned or focused around the idea of market formation, whilst nature-based innovation, in other words NBS, although also foreseeing the relevance of the market, is more concerned with contextuality, paying special attention to place-based factors, stakeholder agency and governance structures.

### Towards Hybrid Governance

All the distinctive dimensions of NBIS are equally relevant for predicting NBIS development and, potentially, mainstreaming. However, a look into the governance structure dimension appears to be key because a change in the governance structure within the NBIS might be desirable to boost NBS uptake. In this regard, different modes of governance have been highlighted in the literature: centralised, decentralised, public-private governance, interactive governance and self-governance (Driessen et al., 2012). For the purpose of urban development projects which aim to accelerate a sustainability transformation, interactive, multilevel governance (See Bulkeley & Betsill, 2005), as well as hybrid governance modes could be more suited for being most comprehensive of the complexities of urban systems. Hybrid governance in particular emphasises the role of mixed networks of public and private actors as well as civil society (Bulkeley & Betsill 2005; Driessen et al., 2012), which is similar to the perspective on the 'governance structure' in the NBIS framework. It differs from modes where most urban decision-making power falls under public-private partnerships mainly between municipalities and large corporations. In fact, although interdependencies exist among stakeholders and there is not a clear hierarchy in urban development projects, there is not an equal share of resources and decision-making power (Block & Paredis, 2013). Hybrid governance acknowledges that urban decision-making is the result of a complex dynamic process of mixed networks of public and private actors. Although this type of governance has been criticised for its fragmentation when it comes to urban political leadership (Block & Paredis, 2013), and realising that it could have potential negative justice implications (Toxopeus et al., in press), it might as well provide new opportunities in terms of allowing to develop new and diverse ways in which to accelerate the mainstreaming of urban NBS, in the context of the transition towards sustainable cities. The reason is that by acknowledging the potential relevance of non-traditional stakeholders in the field, and ensuring a 'just' hybrid governance, a new window of opportunity opens to explore the role that these stakeholders could play (Toxopeus et al., in press). Furthermore, it is relevant to briefly highlight the EU's support for hybrid governance in the urban space which it expects to propel new investment tools and business models to generate economic, social and environmental benefits to different urban stakeholders at a time, especially promoting a governing relationship between the state and market institutions, towards solving complex socio-environmental problems (EC, 2015a).

### *Market formation*

In the context of studying sustainability transitions, the NBIS authors argue that little attention has been given to the role of innovations as potential linkages between socio-technical and socio ecological systems, (van der Jagt et al., 2020). This argument comes after the realisation that socio-technical and socio-ecological systems have stood as separate fields of analysis in the study of sustainability transitions. However, although the approaches of the TIS and NBIS frameworks differ, they examine similar phenomena in distinct ways. In fact, seeing that both frameworks have different approaches which are not always exclusive of one another, the authors realised the subtle difference in between the two when it comes to certain phenomena affecting innovation systems. One example is that both TIS and NBIS identify agency as a factor affecting the functioning of their respective systems. However, the kind of attention given differs from TIS to NBIS because each studies a different type of innovation with distinct characteristics and objectives. For instance, when conceptualising agency, the NBIS framework pays attention to the functions of individuals and organisations within the stakeholder landscape towards promoting and supporting NBS, as well as the actions representing long-term commitment of these actors. TIS, on the other hand, holds a more socio-technical approach, mainly paying attention to the supply-side agency of innovation systems and processes of market formation. In regards to the latter, the TIS framework has indirectly incorporated agency in its structures when analysing the role of stakeholders taking leading positions and initiating a new TIS (van der Jagt et al., 2020).

In the case of market formation, a particularly central concept for this research. Contrary to TIS, the NBIS framework does not incorporate such a dimension, as market formation was not considered as playing a central role in NBIS development. In fact, van der Jagt et al. (2020) pointed out this important difference, whilst acknowledging that the NBIS framework can indirectly incorporate, under different dimensions, signals of market formation processes. For instance, under the dimensions of agency, collaborative arrangements or legislation and policies (van der Jagt et al., 2020). In this sense, and keeping in mind the recent development of the NBIS framework, it could be possible that other relevant dimensions might be missing from the NBIS framework, or that existent dimensions may need further revision and arrangements.

Market formation, as a set of processes including elements such as supply, user preference and demand, and exchange structures like price mechanisms, represents the stage during which novel markets emerge for innovation (Dewald & Truffer, 2017, 2012; van der Jagt et al., 2020). It has been acknowledged that the mainstreaming of urban NBS mainstreaming cannot be carried out by public actors alone, and furthermore, that public-private contracts with big firms are not sufficient to bring about NBS mainstreaming fast-enough due to increasing socio-ecological pressures in cities. For these reasons, the rapid transformation of the urban socio-ecological system through the development and diffusion of NBS would benefit from new market formation processes. Especially when exploring the role of SMEs in the overall mainstreaming of these solutions. Just as in the context of technological innovation (Dewald & Truffer 2012), mainstreaming NBS entails the necessity of the nature-based innovation system to mature and create sectoral structures, in other words, different professional sectors must become involved in the NBIS for it to get stabilised and prosper. In fact, the attempt to mainstream NBS could present an opportunity to enable job creation and allow more (private) stakeholder' participation during the NBS mainstreaming processes. Moreover, initial processes

of market formation for innovation systems are influenced by several factors such as the creation of support and supply networks or the presence of supportive, or non-hindering policies and legislation (Dewald & Truffer, 2017). Highly specialised firms usually take such role, as they are the ones with the capabilities and intention to forward a novel and specific innovation technology.

Therefore, although there are reasons to consider market formation as a dimension playing a less central role in NBIS analysis compared to TIS (van der Jagt et al., 2020), it could be analytically helpful to dedicate one separate dimension to the market formation processes of NBS when exploring the role of private actors within NBIS and given their potential role in mainstreaming NBS. Given the complexity of NBIS, such dimension could ease the analytical process, helping to discern matters such as demand and supply, as well as to better understand the specific role and diversity of private stakeholders involved in market processes affecting NBS development and diffusion.

### *Small-and-Medium-Enterprises (SMEs)*

In the urban system, just like in any socio-technical and socio-ecological system, institutions and processes are unconceivable without the actors that create them, stakeholders which become constituents of these norms and interactions. The strengthening of a socio-technical and socio-ecological system like a nature-based innovation system in a city, therefore, cannot be realised without the agency and interactions of stakeholders within that urban system. The point of departure was the realisation of the need to diversify and incorporate new actors into the NBI system in order to mainstream urban NBS in cities. The incapacity of municipalities to realise this transformation alone calls for further public-private interaction. However, acknowledging that traditional big enterprises are limited when it comes to delivering local and contextual solutions, the focus of this thesis is put on small and medium enterprises (SMEs). Within the private sector, SMEs differ from big enterprises in size, but also in their basic requirements and resources (Pillania, 2008).

It has been demonstrated that large incumbent firms, those that can participate in bigger markets are the ones capable of mainstreaming innovation technologies. However, most innovations come from firms operating in niches, usually SMEs, and it is mostly after these SMEs proof such innovations profitable that larger firms could decide to mainstream that innovation (Boons & Lüdeke-Freund, 2013). Also, SMEs can be frontrunners in regards to state of the art technologies but also methodologies, knowledge and discourses. Innovation can therefore also apply to work dynamics and organisational structure, for instance adopting a less hierarchical organisation within the enterprise, cultural changes within the organisation, new business strategies, alliances and new collaborative agreements are also considered innovation (York & Venkataraman, 2010). In this regard, Boons and Lüdeke-Freund (2013) pointed out that social innovation is as relevant as environmental innovation in order to transform markets towards sustainable development, and that social innovation can be linked to technological but also to organisational innovations. Of course, however, although it probably entails more effort due to their bigger structures, large firms can also change their organisational form and work culture.

In fact, according to Boons et al. (2013), larger firms tend to have trouble when the innovation they are confronting is architectural. Architectural innovation means a change in how sets of product components are interlinked, meaning a shift in the network of elements that compose their product. Moreover, it entails that the promoters of innovation in a socio-technical system will have to reach out of their present socio-technical system, and explore the bigger system in order to thrive as innovators (Boons et al. 2013). In this sense, SMEs might present an opportunity as they have a greater innovative and adaptive capacity and might be able to act as intermediaries or mediators between municipalities, companies and other organisations (Boons & Lüdeke-Freund, 2013). Accordingly, SMEs could potentially play an important role within broader actor networks in urban systems in the road towards mainstreaming NBS. As an adaptive and dynamic stakeholder, SMEs can become part or even contribute to the creation of formal and informal coalitions connecting relevant stakeholders, bolstering their bonds and even diversifying them (Robu, 2013). Furthermore, through the intervention of SMEs in socio-technical systems, the diversification of these networks could imply a shift in traditional governance structures in these systems, redistributing agency among more stakeholders. Moreover, this would result in the participation of a richer variety professional sectors and disciplines. These wider networks could result in a redistribution of responsibilities and influence in the system, resembling a more decentralised, hybrid type of governance which, as mentioned earlier, could potentially accelerate the mainstreaming of NBS.

### *Innovation & Business Models*

In relation to the collaborative power of businesses in the sustainable innovation domain, the importance of involving stakeholders in the development of new business models that shift from single to multiple objectives has been highlighted, proposing the concept of sustainable business models as a framework to focus the research on sustainable innovation (Boons et al., 2013). Moreover, in the context of sustainability challenges, the realisation of sustainable innovation linked to new business models is usually identified as a win-win scenario (Kramer & Porter, 2011). Indeed, business models work as comprehensive frameworks for enterprises that aim to develop sustainable innovations. From the researcher's view, it allows to analyse and evaluate the interaction between different economic, societal and ecological aspects that the enterprise puts together to create added value (Boons & Lüdeke-Freund, 2013). Structurally, every sustainable business model has the following components: value proposition, the configuration of value creation and the revenue model (Gummesson et al., 2010). Furthermore, in the context of endorsing SMEs within wider actor networks, business models provide the bond between the firm, SME in this case, and the broader system of production and consumption in which the firm operates (Boons & Lüdeke-Freund, 2013).

Nevertheless, at the early stages of market formation processes, firms do not have stable business models, and thus, a variety of novel business models and relationships with suppliers can develop interrelatedly (Dewald & Truffer, 2017). Because of this, the involvement of both well established and emerging SMEs through a market formation for urban NBS may present an opportunity to introduce innovation through new business models that incorporate, for instance, societal or environmental value to their enterprise, and which could potentially develop into a well-established market for NBS. In principle, this could lead to a relatively stable

supply and demand for, and normalisation of, NBS, which would positively affect the mainstreaming of NBS in cities. Therefore, the analysis of current business models could inform about how different SMEs are contributing to market formation.

In this regard, sustainable entrepreneurs, also known as ecopreneurs, could play a significant role in defining new NBS markets, through the inclusion of environmental and social justice dimensions in their business models (Affolderbach & Krueger, 2017. In this way, entrepreneurs can become activists by adopting a business model that reflects their environmental and social justice concerns (Agyeman, 2013). What is common to most ecopreneurs or sustainable entrepreneurs, is their reduced interest in business growth versus a growing concern about quality in the business growth process, considering the effects their business has on supply chains, markets and surrounding industry sectors (Bocken & Short, 2016; Rodgers, 2010). Such conceptualisation entails a change of paradigm in the private sector organisations' goals which, by transforming their business model and objectives, could bring about changes in the way that NBS projects are realised, affecting their social and ecological impacts in the long-term, against non-comprehensive and dysfunctional green-infrastructure interventions. In this regard, the ability of ecopreneurs, as SMEs, to internalise environmental and social justice aspects into their business model could influence the mainstreaming of NBS. Furthermore, it has been acknowledged that ecopreneurs can operate as catalysts for green transitions, as they have the capacity to influence the business community (Affolderbach & Krueger, 2017). Furthermore, the concept of ecopreneurs connects to what was previously mentioned in regards to SMEs' capacity to deliver social and environmental innovation as key to generate new markets towards sustainable development, since business models have the transformative power to bring about such innovations (Boons & Lüdeke-Freund, 2013).

New business models are currently being tested in this respect. As an example in the context of NBS, researchers from the Horizon 2020 *Naturvation* project identified eight different business models for urban NBS after analysing 54 case studies of urban NBS: the risk reduction model, green densification model, urban offsetting model, vacant space model, local stewardship model, green health model, green education model and the green heritage model (Toxopeus, 2019). Some of these models, laden with ecological and social motivations, were adopted by SMEs, among other stakeholders. Therefore, the work of *Naturvation* also represents a recent example of the ability of SMEs to develop and diffuse NBS through innovative business models, showcasing how some of the applied business models could look like, and potentially motivating the development of improved business models contributing to the mainstreaming of NBS.

### *Uncertainties affecting NBIS*

Up to now, the particular role of SMEs as innovators within stakeholder networks in NBIS in the context of mainstreaming NBS has been conceptualised. However, little attention has been given to aspects external to the NBIS as defined, which influence the mainstreaming of NBS. Undoubtedly, the development and diffusion of NBS occurring through NBIS can be affected by other changes in socio-technical systems as well as other external events occurring at the urban, national or even global scale. Many of these events are difficult to predict or estimate, which is why these are referred to as uncertainties.

Uncertainty is inherent to innovation processes due to the inseparable link between innovation and the future, and because the future always carries uncertainties (Jalonen, 2011). Equally important is to realise the difference between risk and uncertainty. A risk entails something unknown, but which we can measure by granting probabilities. On the other hand, an uncertainty entails risks to which probabilities cannot be granted (Knight, 1921). In a similar fashion, uncertainty can be said to appear when "details of situations are ambiguous and complex; when information is unavailable or inconsistent; and when people feel insecure about their own knowledge or the state of knowledge in general" (Brashers, 2001). It is relevant to point out the division between '*known uncertainty*' and '*unknown uncertainty*' as introduced by Ellsberg (1961). In situations in which key variables and outcome probabilities are known but their factual values remain unclear, then there is *known uncertainty*. In such situation, different potential outcomes can be traceable through the analysis of probabilities. On the contrary, if cause-effect relationships are not clear, different actors struggle to agree and support clashing interpretations, and struggle in identifying reliable sources of information, then there is *unknown uncertainty* (Jalonen, 2011). In the NBS domain, uncertainty has an effect on the actors participating in the NBIS. Whether we can speak about *known* or *unknown uncertainty* would depend on the specific aspect of the system we focus on.

Overall, although there are some positive considerations of uncertainty as something inherent to innovation and which triggers changes towards economic, social and environmental improvements, the innovation literature mostly perceives uncertainty as a negative element, something "detrimental to, or problematic for, innovation" (Jalonen, 2011). In this line, Jalonen (2011) sees innovation as a way to cope with uncertainty, a view linked to the evolutionary take on uncertainty, which can be read as a condition for innovation to occur, meaning that its presence allows for further evolution to occur in the given innovation sector (Foster, 2010). In fact, although it might appear self-evident, if uncertainty entails a situation in which information is unavailable or insufficient, it can be said that with an increase in the quantity and quality of the available information, uncertainty can be reduced (Jalonen, 2011).

To have SMEs contributing to the mainstreaming of NBS through NBIS implies a change in existing technological systems, and these systems are vulnerable to exogenous effects. Hillman and Sandén (2008) reflect on uncertainty at the landscape level and how it affects change in technology systems. From a technology systems perspective, change can be related to problems that appear in the *regime* which is affected by issues taking place at the *landscape level,* referring to *exogenous factors*, aspects that are out of your direct control in the given moment (Hillman & Sandén, 2008). In this regard, exogenous factors affect particularly the functions of innovation systems because "in comparison to the entrenched system, emerging tech systems are very unstable and are vulnerable to, and dependent on exogenous forces" (Hillman & Sandén, 2008).

Zooming in, we can also discern uncertainty generated at the regime level. In developing the foundations of the Technological Innovation Systems framework (TIS), Markard and Truffer (2008) gathered the complementary strengths of both Innovation Systems (IS) literature, on the one hand, and the multilevel framework to study the transformation of regimes, on the other (Markard & Truffer, 2008). IS help analyse the functions of actors and institutions within an innovation system, and contributes to explaining innovation dynamics at different levels of aggregation. The multi-level framework incorporates and develops the concepts of socio-

technical regimes, niches and landscapes, allowing to analyse technological transitions from a wider perspective, in a scenario in which interactive changes occur at the micro-level (niches) and at the meso-level (socio-technical regimes) and which are simultaneously affected by different exogenous factors at the macro-level (landscape) (Markard & Truffer, 2008). The authors realised that the IS is an inward oriented approach, simplifying external institutions that might require a more attention. Thus, it could benefit from acquiring a wider perspective on the environment (comprising both regimes and landscapes) surrounding the innovation system. Here, the concept of regime becomes relevant for the following reasons. First, that innovation systems (just as a NBIS) can be considered to interact with one or more socio-technical regimes. Second, that these regimes tend to protect the entrenched technological system when noticing the challenge posed by innovation and, hence, set barriers as a result (Markard & Truffer, 2008). In turn, regimes themselves can act as sources of uncertainty to innovation systems. This is because, contrary to the supportive actors within the innovation system, regimes incorporate actors that support rules and institutions which can potentially resist the innovation, and thus, generating uncertainty around the innovation, in this case, NBS.

It must be noted that the NBIS framework allows the researcher to disclose even more uncertainties than the TIS lenses. Although the TIS has looked at how functions and structures interrelate and influence each other, the increased complexity of the NBIS emanates from surpassing the dualism of structures and functions, which allows to reveal further connections and interdependencies in systems by incorporating both the innovation process and product phenomena, but most importantly, due to the high contextualisation of NBIS compared to the traditional approach of TIS (van der Jagt et al., 2020). Moreover, “nature-based innovation arguably harbours an even stronger dependence on local conditions such as urban ecosystem features (e.g., species and soil features, climatic conditions) and socio-economic and -cultural dynamics such as urban densification and changes in recreational patterns” (Dorst et al., 2019).

## *2.3 Analytical Approach*

This section introduces the analytical approach followed in this research to assess the potential of SMEs towards mainstreaming urban NBS in cities. The analytical approach is built upon the theoretical framework presented in the preceding section. As a big portion of this research aims to validate the analytical power of the NBIS framework developed by van der Jagt et al. (2020), a great deal of the analysis is covered by the NBIS framework itself, through its dimensions and subcategories. In addition, analytical lenses provided by the theory on market formation, SMEs and business models serve to scrutinise the other bulk of the investigation. In this way, the analytical framework consists of three phases.

Phase 1 analyses the current investment of SMEs towards mainstreaming NBS, which serves to answer sub-question 1. SMEs’ investment, in terms to resources and participation, are scrutinised with the use of the market formation concept, observing a set of processes like supply, user preference and demand and different exchange structures (Dewald & Truffer, 2017,

2012; van der Jagt et al., 2020). The sustainable business model concept is also used in this phase as it helps explore the linkages between the SMEs and the broader system of production and consumption in which it operates (Boons & Lüdeke-Freund, 2013). To a lesser extent, dimensions of the NBIS framework also contributed to carry out this analysis.

Phase 2 deals with the potential of SMEs in promoting, facilitating and supporting NBI systems, use to answer sub-question 2. The SME concept is used here, in order to explore the capabilities of SMEs. In fact, as stated in the theory section, SMEs have the potential to initiate innovative projects able to challenge and transform existing markets (Burch et al., 2016; Smith, 2001) as well as the power to influence larger firms. Their adaptive and dynamic character (Robu, 2013) is scrutinised in this analytical phase. Moreover, the aforementioned focus of some SMEs on the exchange of knowledge and diffusion of methodologies will also be analysed. The second phase, however, also makes use of the sustainable business model concept for analysis as business models allow to analyse and evaluate the interaction between different economic, societal and ecological aspects that the enterprise puts together to create added value (Boons & Lüdeke-Freund, 2013).

Phase 3 serves to analyse some of the opportunities to increase SME involvement as well as the barriers to having SMEs supporting NBIS and contributing to mainstreaming to urban NBS, relating to sub-questions 3 and 4. Through the use of each of the NBIS framework dimensions, this study explores different barriers and opportunities in the system.

Therefore, based on the combination of these approaches, this research developed an analytical approach which primarily makes use of the NBIS framework and combines it with the concepts of market formation, SMEs and business models (See *Table 2*). Thus, the analytical approach provides the necessary categories to analyse the data gathered to answer the research sub-questions.

| **Phase 1** | **Phase** 2 | **Phase** 3 |
|---|---|---|
| Market formation | SMEs | NBIS framework |
| Business models | Business models | |
| NBIS framework | | |

*Table 2: Phases of the Analytical approach.*

# 3. Methodology

## 3.1 Research Strategy

This research follows a descriptive research approach, as it aims to give an answer to the research question and sub-questions, formulated in a "*what is*" fashion. It also combines with a theory-testing approach, as it collects facts from a selected case study in a first attempt to prove the NBIS framework's applicability in practice, and to refine its analytical power by exploring the potential inclusion of other dimensions. Moreover, the investigation follows a qualitative

methodology, in which the researcher analysed the content retrieved from the interviews and pertinent documents with the support of an analytical software tool to finally present the results in a descriptive fashion, following the different NBIS dimensions as guidance.

### *Case-study selection*

The selected case study is Spain, particularly a selection of Spanish cities, namely: Barcelona, Madrid, Vitoria-Gasteiz and Zaragoza. In the ideation phase, the study aimed to cover more cities aiming to get the most representative picture of NBS development in the country possible. However, this was unattainable due to the unresponsiveness of a few stakeholders. Nevertheless, some of the interviewees also shared insights about other two Spanish regions, Galicia and Valencia. The choice of Spain as a case study is interesting due to the participation of some Spanish cities in EU NBS related projects such as *Naturvation* in Barcelona or *Grow Green in* Valencia. In broad terms, the current presence of NBS in the country is yet at a very early stage of development, which gives reasons to explore ways in which to facilitate further NBS development and diffusion. Also, the past and present involvement of Spanish cities in NBS varies heavily. For instance, a city like Vitoria-Gasteiz, which was designated as *European Green Capital 2012* by the European Commission (EC, n.d.) whilst cities like Zaragoza have only had very limited interventions. Lastly, the disparate geography, urbanisation, population dynamics and climatic conditions in between Spanish cities makes them interesting case studies as NBS must be adapted to different place-based conditions. Moreover, it is logic to explore the role of SMEs in Spain, as they represent the vast majority of firms in the country, with over 99% of the registered companies in Spain in 2008 leaving out only the fishing and agriculture industries (Romero-Martínez et al., 2010). Lastly, both the researcher and his supervisor had a special interest in researching about NBS development in Spain. The supervisor has previously participated in NBS research in the country, as part of the *Naturvation* initiative. Besides, the researcher is from Spanish nationality, which contributed to make the logistics of the interviewing and document analysis process much more fluid.

## *3.2 Data Collection and Processing*

The researcher conducted 17 semi-structured interviewees with varied urban stakeholders, which had a more or less direct relationship with the NBS field. The sample covered from municipal stakeholders in environmental, urban ecology and housing departments, to different kind of private actors including NBS and innovation developers, researchers, architects and designers, consultancies, lobbyists and even a one firm dedicated to public participation processes. *Table 3* presents a shortened overview of the interviewees (for the complete version, including interviewees' names and websites, see the table in *Appendix 1*). Of course, the sample is not fully representative of the whole stakeholder landscape in the NBS domain in Spain, but it served to give an ample and contrasted overview.

| ***Int.*** | ***Name and profile of the organisation(s)*** |
|---|---|

| | |
|---|---|
| 1 | Landscape engineering and planning S.L. & Polytechnical University of Madrid (UPM) |
| 2 | Municipality of Madrid – Climate Change department |
| 3 | Soulsight – Design Strategy |
| 4 | Municipality of Barcelona – Ecology, Urban Planning, Infrasructures and Mobility department |
| 5 | Municipality of Barcelona – Urban Ecology department |
| 6 | LavolaAnthesis – Environmental Consulting |
| 7 | Barcelona Regional – Urban Development Agency |
| 8 | Zaragoza Vivienda - Municipality of Zaragoza |
| 9 | Environmental Studies Center (CEA) - Municipality of Vitoria |
| 10 | Tecnalia – Technology and Innovation |
| 11 | Bioo – Technology and Innovation |
| 12 | Ecodes – Foundation (advisory and research institution and lobby) |
| 13 | Creando Redes – Environemental Consulting, Natural Capital Restoration |

***Table 3: Intext list of Interviewees****. This is a shortened version. For the full version including organisation typology, interviewee names and websites see Appendix 1.*

The purpose of the interviews was to gather insights from varied sectorial perspectives, in order to learn about the current state of NBS in Spanish cities, the types of stakeholder participation and support in NBIS, and ultimately, to learn about the potential role of SMEs in contributing to the mainstreaming of urban NBS. Interviewees agreed to participate in this research through the signing of an agreement form, thus, complying with the university's rules for research. Up to interview 9, the interviews were carried out in person in between the 13th of 24th of January 2020, with the researcher travelling to the interviewee's offices in Spain. A second round of interviews got delayed due to the Covid-19 pandemic and the subsequent restrictive measures, for which interviews had to be adapted to be carried out via telephone, Google Meets, Jitsy, Microsoft Teams and Skype, fitting the possibilities of interviewees. Finally, interviews 10 to 17, took place from the 25th of May to the 10th of June.

The sample of interviewees was selected through desk-based research exploring previously existing datasets on municipal NBS interventions as well as public and private stakeholder involvement in EU collaborative initiatives such as *Naturvation* or *Grow Green.* Desk-based research was also undertaken to find stakeholders that had participated in other GI related projects at the city level, or which worked in sustainability dissemination. Crucially, during the first round of interviews, snowball sampling was used in which interviewees themselves

suggested a list of entities which they believed could provide relevant answers to the questions, which ultimately conformed part of the list of the second round of interviews.

A base interview scheme of 9 questions was developed to be used during the interviews. However, these were adapted according to the interviewee at hand, putting more emphasis in those aspects in which the interviewee had more expertise or was more knowledgeable about, and always allowing interviewees to speak about other factors they considered relevant. Interviewees were asked about:

1. Individual understandings of and experience with NBS
2. The current situation of NBS in Spain and their city in regards to innovation, finance and regulation
3. The role of multi-actor collaborations and governance arrangements towards supporting NBS
4. The extent to which a market is being formed for NBS and if so, who is participating
5. The way in which SMEs could contribute to a market formation for NBS, whether directly or indirectly
6. Accelerating and decelerating factors for market formation
7. The potential role of business models in driving firms to engage in a market for NBS
8. The perceived role of ecopreneurs
9. The potential role of entities working on dissemination and knowledge sharing in a potential NBS market.

All interviews were recorded and then transcribed with the support of the Express Scribe Transcription Software which allowed to slow down the speed of recordings.

Furthermore, document analysis also took place after the recurrent mention of two relevant documents during the first round of interviews. The first analysed document was the draft of the new National Strategy on GI and Ecological Connectivity (MITECO, 2020), which was necessary to comprehend the reach of national strategies involving NBS. Following, the Spanish Public Procurement Law (Ley 9/2017) was also analysed, as it was necessary to understand why a law, in principle not so related to the GI and NBS fields, could impact the potential of SMEs to contribute to NBS mainstreaming.

The data processing took place through the use of the NVivo software. With it, data gathered from the interviews' transcriptions was categorised, as well as the analysed documents. The software allowed to analyse the gathered data through open coding, for which several nodes or categories were developed. The initial coding nodes and subnodes followed the dimensions and subdimensions of the NBIS framework combined with the analytical categories falling under phases 1 and 2 of the analytical framework. However, after the first round of interviews, other categories were incorporated as they were deemed necessary to categorise aspects not directly covered by the NBIS dimensions, neither by the aspects under the first and second phases of the analytical framework. As a result, 13 nodes and 22 subnodes were created as illustrated in *Table 4*.

In the first coding rounds, much of the data fell under more than one category, for which the researcher's analytical interpretation of the data was crucial, as to determine which category better captured the type of data. The analysis of the data focused on the facts shared by interviewees as well as their believes and opinions. Moreover, the researcher translated the results of the analysis from Spanish to English.

| Main Nodes | Subnodes |
|---|---|
| Agency | • Leadership and power<br>• Commitment |
| Discourse and vision | |
| Legislation and policies | • EU Strategies<br>• National Strategies<br>• Regional Strategies<br>• Municipal Strategies<br>• National legislation<br>• Municipal ordinances |
| Governance structure | • Hybrid governance |
| Collaborative Arrangements | • Networks and partnerships<br>• Participation |
| Learning | • Education and training<br>• Research<br>• Experimentation<br>• Monitoring and evaluation |
| Resources | • Knowledge and human capital<br>• Financial factors<br>• Technology |
| Place-based factors | • Built environment<br>• Natural processes and endowments<br>• Societal conditions and dynamics<br>• Cultural frames of reference |
| Market formation | |
| Business Models | |

| | |
|---|---|
| **SMEs** | |
| **Ecopreneurs** | |
| **Politics** | |

*Table 4: list of nodes and subnodes created in NVivo to categorise data from interview transcripts.*

*Blue indicates nodes and subnodes based on the NBIS framework dimensions and subdimensions combined with the analytical categories under phase 1 and 2 of the analytical framework; Red indicates nodes and subnodes added by the researcher.*

# 4.Findings

This section collects the findings of the analysis of the interviews realised through open coding. The section is divided in two main blocks. The first block, *Findings under the NBIS framework,* presents the main results of the analysis under sub-sections titled after each of the NBIS dimensions and sub-categories[1]. To a large extent, the results serve as a practical validation of the dimensions of the NBIS framework (van der Jagt et al., 2020), as it integrates real examples of the Spanish case under its dimensions and associated subcategories. Most importantly, however, the findings under this first block serve to tackle both sub-questions 3 and 4. The

[1] Under the dimension Agency, the subcategories Leadership and Power and Commitment have been merged. The reason was the difficulty to separate both concepts in practice: most cases of support for NBS development and diffusion through the exercise of leadership and power involved efforts for long-term support, which, by definition would fall under the commitment sub-category. Furthermore, in their paper, van der Jagt et al. (2020) explained these subcategories jointly under the dimension Agency in text.

second block, *Findings outside of the NBIS framework,* presents findings in regards to market formation, SMEs and business models. In this block, sub-question 1 is firstly explored through the findings grouped under the *Market formation* heading. Secondly, both sections on *SMEs' Potential* and *Business Models* tackle sub-question 2. Finally, in the discussion, the most relevant findings are again highlighted and merged with the literature in order to discuss the potential of SMEs towards mainstreaming urban NBS in cities, give recommendations and suggest pathways for future research.

For ease of reading, it is suggested that readers make use of the shortened version of the list of interviewees, presented in Table X under section 3.2

## *4.1 Findings under the NBIS framework*

### *Agency*

#### Leadership and power & Commitment

##### *Municipalities*

The interviewees indicated the presence of organisations and individuals taking leading roles to support the development of NBS. Authorities were mentioned the most, usually referred to as 'the public administration' (PA), with a mayor focus on municipalities and the relevant role of municipal technicians in setting standards in procurement in order to stimulate NBS development, but also the involvement of other organisations, including specialised SMEs. Int. (1) indicated how 90% of NBS carried out in the urban sphere happen in municipal projects, with the exception of some taking place in private constructions, pointing out the importance of having an engaged municipality:

*"If the municipality does not demand NBS nor understand them, we cannot get anywhere".*

Furthermore, he explained how bigger municipalities pave the way for smaller ones, which traditionally follow and replicate their interventions, unless there happens to be a particularly sensible politician.

In this context, the leadership and commitment of municipalities will be presented first for being the most highlighted. Among Spanish cities, the municipalities of Barcelona, Madrid and Vitoria were pointed to be leading in the support for NBS. For instance, the municipality of Barcelona was acclaimed to be playing a leading role by several interviewees for many reasons, from which Int. (1) highlighted their new € 340 million investment in green infrastructure, their powerful

technical and policy teams, as well as their instruments, strategies and government measures that demonstrate commitment and promote NBS. Int. (5) stressed the same idea when saying:

*"Barcelona is very lucky because we have many people working on biodiversity, green infrastructure, naturalisation strategies… we are a great team, but other municipalities do not even have one green-oriented technician".*

Int. (4) explained how Barcelona has been enhancing civic participation projects throughout the last five years, and also, all the urban greenery is managed from an ecological perspective. According to Int. (1), the previous government in Madrid had a ten-year plan for GI of € 660 million, showcasing a strong commitment effort. Currently, the municipality is also working on urban ecology from its department of environmental education with an important investment. The leading role of the municipality of Vitoria was highlighted by most varied interviewees, (15) and (17), in regards to their obtention of European Green Capital title. Int. (9) showcased the leadership role of Vitoria in deciding to incorporate GI and NBS in unused vacant lots due to the economic crisis, as well as the adoption of 'participatory budgets' through which citizens propose interventions to the municipality. (See *Image 1*).

The role of municipal technicians in developing technical policies was presented as crucial. These technical policies are exported to politicians, e.g. biodiversity plans and strategies have been developed at a technical level, to then elevate them to a strategic need, and then become part of a plan which lastly politicians shape and (sometimes) accept. Also, Int. (2) pointed out that municipalities have the power to support NBS development in both the private and the public space through municipal ordinances which can establish compulsory standards for private actors (e.g. following the example of a municipal ordinance on air quality that speaks about incorporating renewables and other requirements for certain type of buildings), as well as procurement specifications (for public works) which facilitate the involvement of specialised firms, as pointed out by Int. (8).

In order to install these standards, Int. (2) highlighted the boosting role of the Climate Change Department within the municipality of Madrid in demonstrating and enhancing NBS-type projects in those municipal areas that have a direct competence and a clearer executive power, like the areas of urbanism and/or parks and gardens. Furthermore, they highlighted the importance of having an individual within those teams that is willing to integrate this vision in their department, someone with certain agency. This is needed since there is an overall lack of leadership from most municipal technicians who choose not to try new things. Nevertheless, they exposed how the dependence on a single "visionary" turns problematic the moment that person is absent, for which they underlined the need for governance. Also in this regard, Int. (12) pointed at the limits of the current working culture, mainly in the PA, in which people tend to wait to have finance to use for a prescribed aim, instead of taking leadership to decide which projects they would like to realise, to then adjust the available finance opportunities.

Comprising these aspects, Int. (2) expressed how there is a lack of leadership to bridge the current development of pilot NBS to having NBS become mainstream, with no municipal area taking on this responsibility, because it is not strictly under their competences or responsibilities.

*Mayors*

The figure of mayors was only mentioned twice, with Int. (2) and (4) briefly referring to the both the mayors of Madrid and Barcelona acting as champions of NBS, with the previous municipal government of Manuela Carmena, and that of Ada Colau respectively. During their rule, programmes and platforms supportive of NBS were launched such as:

- The overarching *'Madrid + Natural'* Strategy, which aims precisely to increase the uptake of urban NBS projects, which includes other platforms such as *'Madrid Agroecológico'*.
- Barcelona's *climate emergency declaration* and compromise in *Paris COP21*.
- Barcelona's *Green and Biodiversity Plan 2020*.
- *'Barcelona + Sostenible'* platform, aiming to involve as many urban stakeholders as possible in the road to a sustainable city.
- Barcelona's *Green Roof Subsidy programme,* with the mayor committed to developing another 40 in municipal buildings for its demonstrative power.

*Private sector*

Secondly, a series of frontrunners from the private sector were mentioned to be taking a leading role in supporting NBS development. Sustainability consultancy firms, advisory bodies on ecology and development, GI & NBS developers, design and engineering studios, firms running participatory processes and philanthropists are actively contributing to NBS development. Developers, designers and engineers demonstrate a more tangible, direct support as they themselves design and/or execute NBS. Others, such as consultancies, advisory bodies or citizen participation firms work indirectly, but not less importantly, as intermediaries and facilitators in the process of developing and diffusing NBS. Following are some examples of the aforementioned private frontrunners:

Environmental consultancies, specialised GI developers, architecture, design and engineering studios as well as firms carrying out participatory processes were indicated as the main kind of private firms showing leadership. Also, private collaborative groups were indicated to be playing a strong advocacy role. For instance, Int. (6) pointed at the influence of big sustainability consultancies like *Lavola-Anthesis* exercise over other companies and/or public administration (e.g. municipalities) through their guidance via the delivery of strategies and action plans that can incorporate NBS.

The influential role of certain private bodies on the decisions of the public administration was also highlighted by Int. (12). In this line, *ECODES* is a foundation dedicated to promoting ecology and development which at times works as a SME. Int. (12) explained that through its consulting role and due to its experience and rigour, it could deeply influence decisions of the PA in regards to NBS uptake, through their 'cities and ecology' department. This foundation has played an active role in different national projects related to ecology promoted by other foundations of big firms such as *BBVA, Ibercaja*, *EP* or *Endesa*, as well as in EU research projects.

Int. (17) stressed the capacity of SMEs to play a leading role in NBS development and diffusion contributing with their knowledge. When asked, most interviewees perceived SMEs as venturous entities which possess a higher flexibility and innovative capacity than bigger entities. Furthermore, they have the attributes and knowledge needed by municipalities in order for them to partake in EU H2020 projects involving NBS. When it comes to specific projects,

specialisation is another key factor that puts them in a leading position within the private sector. The case of *Naturalea*, a firm dedicated to GI and NBS specialised in ecological restoration, soil bioengineering and landscape architecture, serves as a perfect example of a leadership and commitment from a SME in the field of NBS. Int. (14) highlighted their 25-year experience realising over 1200 infrastructure works and generating technical knowledge that they openly share, and which other firms are now applying as a result. They believe that they have opened a market through sharing their knowledge in a free and accessible manner, aiming to have more companies doing a better job. Undoubtedly, this represents solid long-term, bottom-up case of leadership and commitment to NBS development:

*"There are many technical reports available at our website, documents showcasing techniques, how to do them completely, how to undertake conceptual techniques. There are many things about SUDS, NBS… We hold to the idea that we are trying that people incorporates these things as theirs, right? And to not be the only ones doing it, evidently."*

Additionally, Int. (4), (16) and (17) touched upon the crucial role of design and engineering studios. Int. (4) shared the example of *MataAlta*, a design studio in Barcelona working on green roofs and applying the concept of 'rewilding'. Their proactiveness was highlighted since, through *'Barcelona + Sostenible'* (See Mayoral Commitment above), they gathered support and funds, and managed to develop an important green roof in Barcelona, alongside a diverse professional team, including university experts which assessed the environmental and vegetation variables.

Firms undertaking participatory processes were also referred to as crucial in new urban transformations by Int. (2), (10), (12) and (17), as levers to ensure democratic processes that legitimise the instalment of NBS in public spaces by citizens themselves. A good example is the work of Paisaje Transversal, as explained by Int. (17). This SME is an architecture and design studio which currently focuses on civic participation and project design, mainly working in Madrid and Valencia (within EU Grow Green). However, it was also stressed that both SMEs and other private actors' leadership, although important, is limited to the PA's generation of momentum for NBS mainstreaming. For this, they are very dependent on policy support and political and administrative commitment.

On another note, the role of philanthropy was emphasised by Int. (16), who gave the example of the *Carasso Foundation* which destines funds to art and sustainable foods projects, supporting NBS development through their urban horticultural gardens usually ran by communities and SMEs. In this regard, Int. (16) considered that actions by potent philanthropic foundations have the capacity to penetrate and generate profound impacts, especially when compared to smaller organised groups like neighbourhood communities.

Back to *'Barcelona + Sostenible'* platform, Int. (4) explained how private collaborative subgroups emerged through it, and highlighted one subgroup specifically dedicated to reflect on biodiversity in the city and on how to enhance actions of interest:

*"This group pretty much works as a lobby for the municipality, making proposals. For instance, before the elections, the group reflected on what they wanted to propose to politicians in regards to new green and biodiversity policies. Thus, they came up with a manifesto used to inform*

*politicians from all political parties on what actions to take by the time that parties were drafting their electoral programmes. Then it was their choice to include those action lines, but they made sure politicians had this information".*

The group worked separate from any business and/or political biases, but found support from the municipality who provided a mediator to help with the organisation. In the aftermath, the same group analysed the final political programmes, to judge the results of their advice. They reached some conclusions which they shared these on social media. Their impartial insights, Int. (4) explained, are greatly valued and deeply contribute to the development of Barcelona's green and biodiversity plans.

Briefly touching upon SMEs falling out of the NBIS, Int. (16) pointed out how, although not working directly for NBS, they undoubtedly collaborate towards supporting NBS development and diffusion. *Dark Matter*, for example, carried out the monitoring of some EU Climate KIC projects to guarantee democratic project processes. From a broader sustainable business point of view, Int. (13) noted that,

*"New SMEs are born incorporating the sustainability principles and discourse, for which they are a great competitor to classic firms" (Int. 13).*

To a lesser extent, actors of the third sector were also mentioned to have a powerful and committed role. Int. (7) explained how third sector organisations are crucial to advance and generate open debates in society through their insisting role. As an example, Int (7) indicated how plenty of roofs with vegetable gardens in Barcelona are product of third sector agreements with the municipality. However, he also noted their limitations, as they often depend on the public and/or private sector's support.

### *Academia*

Thirdly, the influential role that Academia could play within wider stakeholder networks was mentioned as crucial, particularly to give that scientific rigour and legitimacy they provide to these projects. Int. (1) himself as an academic has participated in several projects, also working as a knowledge disseminator in the Spanish Network of Healthy Cities (RECS), which is linked to the Spanish Federation of Municipalities and Provinces (FEMP) delivering conferences about biophilia and how to transform urbanism in order to improve public health. In this context, he highlighted the passive role of municipalities as entities which only aim to get the project done, for which he believed universities have a leadership role in changing the way in which people in government think.:

*"All the technical-scientific part is incorporated through professionals together with collaborators [such as academics], otherwise, the municipality does not do anything"*

Int. (15) further stretched how universities also play an influential role enriching the private sector and, from a mid-term perspective, in teaching their students about the potential of NBS.

### *European Union*

Fourthly, the leadership role of the EU was agreed among most interviewees a crucial in order to forwards NBS in Spanish cities. Int. (14) highlighted that the EU has given them the opportunity to realise those innovative NBS projects in which nobody is currently investing:

*"We believe it's important to work on this (NBS) and the best way in which to develop these demonstrative things is sometimes through EU investment, but of course being part of their project, otherwise it's impossible. For instance, in EU OPERANDUM with the OALS (living labs)".*

Int. (1) indicated how the EU shapes the way in which municipal governments think, a statement also supported by Int. (14) when stating:

*"For municipalities to access certain EU subsidies, they had to introduce changes which in principle were very difficult to install, but once introduced, they stay. The EU does a great job with projects like LIFE. The technical level in Spain is good, there are very good professionals, but many are not given the chance to do much. It's difficult."*

Int. (16) remarked that EU support is as crucial for ensuring continuity regardless of political shifts. Furthermore, Int. (2) highlighted how they help normalise new collaborative ways of working, involving more stakeholders than traditionally (e.g. researchers, firms from unusual sectors) which enrich the project. Nevertheless, Int. (16) advised about the lack of political commitment within EU legislation, which tends to be problematic due to its ambiguity and can slow down sustainability change processes.

### Politics

One aspect under the Agency dimension of the NBIS framework that got very little attention in Van der Jagt et al. (2020) paper was politics, perceived as linked to mayor's leadership role within NBIS. During the interviews, politics was mentioned several times in regards to the leadership needed to foster necessary changes and gather support for NBS development, particularly in connection to the public administration. Politics are found to be both enablers and obstacles to NBS development and diffusion, mostly depending on whether their agenda incorporates GI and NBS, or not.

Int. (17) pointed out that both at the political level as well as the technical level in institutions there is always the possibility, although it is not the usual, of having a newcomer that brings in innovative ideas and is committed to the climate agenda and who is willing to realise this type of interventions. This could be a councillor, a mayor, a technician from the environment or the urbanism departments, etc.

At the political level, during the interview with Int. (2), interviewees stated that some projects under Madrid's initiative '*Madrid + Natural*´ (which includes a series of NBS interventions) had been stopped. In asking why, the answer was:

*"Well, there is a change of government and some projects keep running whilst others have not been granted continuity so far." (Int. 2)*

A similar experience was shared by Int. (1) with the example of Coruña's provincial plan in which the municipality of Coruña did not participate because of political discrepancies, against another 39 municipalities in which different parties were ruling. Int. (2) stressed that, although it is not all dependent on politics, if there was a clear political support, political decision-making has a greater impact, for which all the administrative changes bellow that decision-making level would flow easily:

*"If a government arrives with an electoral programme which incorporates things related to participatory processes for instance makes it easier. If you do not have that, the process is slower as you need to generate trust in different ways."*

Moreover, Int. (2) indicated that political inclination does matter in regards to the levels of leadership taken by a municipal government. They explained how during the previous political term, more projects were taking place with the collaboration of socially compromised firms which incorporate aspects of sustainability, social justice, circular economy, etc. However, many of these entities have been denoted as tangent groups with the change in government. They explained how if these priorities are present in political agendas, entry would be easier for ecopreneurs**.** In the case of Barcelona, Int. (4) explained how the change towards much more action took place with the change in government, with the rule of *Catalunya en Comú* (political party) combined with the climate emergency declaration. Government programmes were pointed as most important, because they integrate those policy changes to be done in the coming 4 years, indicating a schedule and quantifying budgets and other resources.

Furthermore, Int. (4) pointed at the tight link between policies and legislation with political leadership.

*"With a solid government programme, you activate the municipal machine, and this one launches new projects and delivers them to the citizenship". (Int. 4)*

In this line, Int. (1) explained how politics is a pillar in regards to forwarding changes in legislation, ordinances and regulations, through which guidelines to include NBS in spatial planning can be made compulsory, something highlighted by Int. (15) too, who pointed out the accelerating capacity of legislation to mainstream NBS. Also highlighting the important provision of finance.

## *Discourse and vision*

Interviewees framed NBS within broader discourses of urban sustainability and the benefits of green spaces. They pointed out varied aspects, however, most of them followed a similar line of thought, agreeing on the need for urban reinvention and the enhancement of greening in cities. Their framings of NBS development and diffusion indicated the existence of current social

momentum building towards NBS enhancement. They pointed out current discourses on ecological and climate adaptation, *naturalisation* and biodiversity increase as a way to tackle multiple urban sustainability challenges, NBS capacity to increase people's access to green spaces and long-term visions and the generation of support across the stakeholder landscape. Moreover, relevant discourses and visions of urban reinvention were also discerned, with interviewees paying particular attention to strategic design and innovation approaches, in which they believed aspects such as aesthetics, experience, affection and health would play a significant role in framing NBS as a type of intervention able to tackle relevant sustainability challenges as well as to involve actor engagement. All of these visions contribute to momentum building for an increased development and diffusion of NBS. Last but not least, a few hindering discourses and visions were presented too, in order to take them into account to improve future NBS development and diffusion.

Firstly, Int. (1) explained how everything related to ecological adaptation is becoming an imperative in the context of urban planning, enticing companies to get involved in this emerging market and work "within these coordinates". Int. (4) explained how government programmes in Barcelona have incorporated '*naturalisation*' discourses of nature enhancement in the benefit of citizens, fauna and flora, as well as to resist climate change impacts through the ecological management of green spaces. All of this under the umbrella term of GI, shifting the old paradigm in which urban greening was only incorporated for ornamental and hygienic purposes. Moreover, the interviewee stated that this route of action will be even more profound during the new political term. Int. (8) and (9) framed naturalisation and green spaces as the solution to multiple urban challenges, contributing to aspects such as $CO^2$ sequestration, reduction of atmospheric pollutants, noise reduction, combating the heat island effect, increase of water absorption or biodiversity increase among other ecosystem services. The ecological management of these spaces also entails the elimination of damaging fertilisers and other chemicals in gardening (e.g. glyphosate), taking all environmental variables into consideration, reducing trimming, not-getting rid of spontaneous weeds, etc. Thus, naturalisation means a much wilder management of green infrastructure as well as the introduction of natural processes in the urban space. As Int. (5) put it,

*"This represents a complete reinvention of the urban green discourse because it involves the retreat of certain established cultural practices." (Int. 5)*

Interestingly, Int. (8) indicated his observation that SMEs are increasingly getting involved with socio-environmental themes. Int. (15), on the other hand, explained their observations on how big firms are changing their discourse and actions in regards to the integration of biodiversity in the business life cycle:

*"Before, there was an empty banal discourse and now there is a discourse that begins - and I highlight begins - to generate content further than the discourse." (Int. 15)*

Nonetheless, some interviewees expressed sceptic views on the role of big firms, stating how they, more than other private actors, always look for profitability and functionality, in many instances not taking into account many qualitative aspects, as indicated by Int. (2).

*"Whilst some private entities are employing a lot of their resources on environmental projects doing a good job, other firms are only doing 'greenwashing'." Int. (4)*

About NBS specifically, Int. (14) stressed the current momentum for change, and that the work is now about convincing municipal technicians and some politicians, to get the NBS discourse integrated in their workings. In regards to discourse integration, although not sufficient, some already do. For instance, Int. (9) expressed at the municipality of Vitoria how NBS are perfect to increase the access to green and the well-being of people with reduced mobility living in the city core. On a brief note, it is worth mentioning Vitoria's vision, which led the city to become the European Green Capital. In this context, Int. (15) expressed the importance of long-term visions of ten years or more, as well as the generation of support across different stakeholders for these discourses to permeate into policy.

Some of the interviewees' framed NBS from an innovation and design stance. They focused on innovation in NBS design and management as well as urban reinvention, highlighting the power of discourses on health, affection and aesthetics in normalising the uptake of NBS, the potential of new ways of working that enhance NBS mainstreaming or, for instance, the need to transform people's expectations around urban landscapes from green nature to more arid Mediterranean looking nature. Also, Int. (4) pinpointed the need to innovate in the design of Barcelona's green plans for climate adaptation, as they can no longer expand for which all potential interventions translate to little opportunities and actions where it is most needed in an already compact built environment. Innovative design cannot go without innovative management for which the concept of *naturalisation* was previously explained.

Aesthetics, experience, affection and health fall under an umbrella of urban reinvention discourses and visions, and appear to be key for mainstreaming NBS. Int. (4) underlined health and beauty as the main discourses which *"will seduce people to want and accept the new green interventions"*. Moreover, Int. (16) gave the example of the *Cyborg Garden*, an experimental project in Madrid merging art, cultural studies and NBS towards innovation and reinvention, as well as the urban tree which works on citizen's affection as channel for further engagement (See *Learning* section). Also, Int. (15) currently aim to merge aesthetics with the ecosystem component in their workings, stressing the fact that in Spain, most ecosystems are present in a Mediterranean habitat and green landscapes are only visible in the northern regions. For this, Int. (15) are engaged in a disruptive change of discourse about the urban greening that is to expect by firms and individuals. In their work on biodiversity increase through *EU LIFE Boogi-BOP,* they are bringing Mediterranean species back into gardens, which by the way need a much less intensive care:

*"We want to change the discourse and idea from 'green is fantastic to 'Mediterranean is fantastic'". (Int. 15)*

Nevertheless, different hindering discourses were presented too. Namely, problematic visions and discourses of urban greening and NBS, overemphasis on NBS hindering more integrated approaches to urban reinvention, contrarian discourses to urban greening and the private sector's lack of attention to content and quality were the most relevant.

To begin, clashing visions on green spaces are seen as an important limitation. Int. (13), for instance, stated that whilst living in bigger cities, citizens demand spaces with high spiritual and cultural value, for leisure and joy. This vision, explained Int. (13), becomes problematic because we prioritise that over having a space in which pollination occurs because these benefits are

difficult to see for neighbours. Int. (5) made a similar comment about wrong conceptualisations of *naturalisation* by which people carry preconceived ideas of romanticised rural landscapes and try to apply them in the city. These become problematic in practice because instead of working on transforming naturalisation concepts into practice in the city, people pursue unrealistic images. Also, naturalisation practices can generate hindering attitudes and discourses opposed to greening practices. E.g. green spaces where trimming is reduced might look like they are not being taken care of, which might lead to the appearance of resistances from citizens and politicians. For this, Int. (5) explained that,

*"Pedagogy is insufficient and you need to work on changing the vision that many people have of nature and the city through social involvement of local entities and citizens, participation, volunteering, etc." (Int. 5)*

The NBS discourse can also become problematic even within the group of professionals involved in the NBS domain. Int. (5) indicated how in some instances, professionals use NBS concept in a rhetorical way, justifying stagnation in their work by defending that they have always been implementing NBS, whilst past interventions might not be always multifunctional. Also, it was indicated that when working areas not very acquainted with the NBS knowledge use plants as a naturalising element, they do so in a counterproductive manner, e.g. creating a green surface for people to do every sorts of activities which results in the destruction of the surface itself, hampering the environmental purposes of NBS.

Int. (12) argued that, as obvious as it may seem, it is pertinent to understand that NBS are the means and not the end to urban regeneration, and thus it is necessary to keep an integrated project approach taking all of variables into account and remembering that NBS are not panaceas, and that tackling other sources is crucial, e.g. reducing the number of car lanes in the city. Int. (17) followed a similar line of argument saying that, although the NBS discourse of the EU is comprehensive, we should be less strict with the idea of NBS and incentivise vegetation and biodiversity increase in a broader way. The example of EU Grow Green in Valencia was shared, and according to the interviewee:

*"so much effort and money are being wasted in getting NBS to adapt to urbanisation problems, whilst, in fact, we could be doing a gigantic green forest with the same money, much more powerful in generating biodiversity." (Int. 17)*

Besides, contrarian discourses and visions to the green city were mentioned too. For instance, Int. (5) indicated how some believe that there is no room for green space in a city like Barcelona. He explained:

*"They argue that the Mediterranean city is different, which is again based in a preconceived fallacious idea. […] So, if you have an erroneous image of the past, it's likely that your image of the future is erroneous too" (Int. 5)*

From a more systemic perspective, Int. (2) stressed how current exponential growth visions of entrepreneurs and the private enterprise are hindering sustainability advancements, including NBS development and diffusion. They believed that too often private enterprises put too much focus on business strategies and techniques and too little on the content and quality of their job, hence many times delivering lower quality services.

## *Legislation and policies*

This section discusses the findings in regards to the presence or development of legislation, regulations at different scales (European, national, regional and municipal) and policies, but also non-binding strategies and plans supportive of NBS. EU Strategies were said to be mainly contributing through funding and the development of guidelines for NBS plans and project development. In regards to national strategies, the National Green Infrastructure and Ecological Connectivity Strategy was the centre of attention, whilst national legislation was mostly recognised as hindering, highlighting the perceived negative impact of the Spanish Public Procurement Law on NBS development, particularly at a small scale. Regional strategies and ordinances came up in the conversations too, highlighting the importance of regional land-use and urbanism ordinances which could incorporate NBS elements to foster their use. Municipal strategies were pointed as the most supportive, with specific programmes for NBS development, not to mention the current development of GI municipal plans, but also holistic strategies aimed to tackle urban sustainability issues which collaterally support NBS. In terms of municipal ordinances, however, an important lack of support was found in regards to the lack of regulatory instruments, private-public negotiation platforms, and most importantly, a lack of clarity on administrative responsibilities between regional and municipal administrations.

### EU Strategies

First of all, EU strategies were mostly highlighted to be playing a crucial role supporting NBS primarily through finance, via the European Regional Development Fund and through projects falling under Horizon 2020 Research and Innovation programme (H2020) as well as the EU LIFE programme. In addition, guidelines given under the new 2030 Biodiversity Strategy were also found supporting for NBS development among interviewees.

For instance, Int. (1) indicated the availability of EDUSI funds (Integrated Sustainable Urban Development Strategies) from the Regional Development European Fund, which are directed to environmental projects that incorporate the NBS philosophy and currently represent an important economic source of income for Spanish municipalities. Also, in Valencia, the Grow Green project received funding from H2020, specifically 3 out of 11 € million dedicated to NBS development.

But together with the finance, some EU strategies also work as catalysers, advancing very specific experimental projects in relation to NBS development. For example, projects like OPERANDUM, following Int. (14), are financing opportunities that allow organisations to take risks which they normally would not, aiming to generate technical information and NBS demonstrations to stimulate public engagement of NBS. Also, the EU LIFE Boogi-BOP project, as explained by Int. (15), searches for alternatives to incorporate biodiversity throughout the business' life cycle of firms in industrial places, incorporating GI at a green connectivity level too. The ultimate aim of the project is to have firms incorporate natural capital and biodiversity as part of their strategy.

Furthermore, the EU is also trying to encourage municipalities to develop their own green plans, like in the case of the recent 2030 Biodiversity Strategy, which, following Int. (13)'s explanation, calls municipalities with a population above 20.000 citizens to work on their own green infrastructure plan.

Also, EU strategies have indirectly supported the work of SMEs. For instance, Int. (17) explained how when the municipality of Valencia applied for the H2020 funds, it had to ask specialised SMEs for collaboration in order to meet the participation requirements. Moreover, the participation of *Eco@csa* in EU Boogi-BOP, *Elii*'s coordination of the '*Cyborg Garden'* under Madrid's Climate KIC or the work of *Dark Matter* in Deep Demonstrations within Climate KIC, as pointed out by Int. (16) and (2) respectively, showcase the usual involvement of specialised SMEs in EU strategies supportive of NBS.

### National Strategies

Int. (1) indicated that the Ministry of Ecological Transition of Spain is about to publish the new National Green Infrastructure and Ecological Connectivity Strategy (MITECO, 2020). In its draft, the strategy foresees support for GI and NBS pilot projects, which Int. (1) read as a strategic and economic opportunity to involve more stakeholders. The interviewee explained how in Spanish legislation, the concept of GI was first introduced in the law 33/4/2015, fixing a deadline for the new strategy to be published in 2018, but which has been delayed due to national politics and "more urgent" matters. However, once the strategy gets approved, it will become mandatory for the Autonomous Communities (regions) to prepare their individual strategies during three years, and once these are ready, municipalities will have to draft their own. Int. (7) and (10) perceived the national GI Strategy as an opportunity, but stressed the need for it to influence regional plans through the incorporation of a financial package, since urbanism and land-use ordinances fall under regional decision-making, and otherwise the strategy may stay as mere recommendation.

In the context of the national strategy, Int. (13) pointed out the need to upscale current efforts, coordinating municipal GI objectives with regional ones. Once a plan is present, it is possible to scale down and begin to design different interventions through NBS that work to generate *"a real GI"* (Int. 13). Usually, however, the opposite happens. Municipalities begin by executing a few disperse interventions in emblematic buildings but which, from an ecological approach, do not interact with one another neither they follow an ecological logic. Therefore, it is worth to invest in holistic planning in order to intervene in a correct way. Here, Int. (13) found the trajectory of EU funded pilot projects problematic for realising individual projects and staying niche, unable to permeate into more ambitious plans. For this, they trust the new National GI and Ecological Connectivity Strategy will mean a boost to holistic regional and national planning, engaging regions and their municipalities to design their own GI plans.

### National Legislation

Int. (2) stressed how the legislative context can stimulate or hinder NBS, and shared the example of energy consumption in buildings where, as soon as regulations were in place, self-consumption was enhanced. In this line, the interviewee indicated that a similar case could occur with in-building NBS.

However, aside from the aforementioned law 33/4/2015 which introduced the concept of GI, at this moment there is no more legislation supportive of NBS.

In fact, Int. (5) indicated an important barrier in regards to legislation. He explained how legally in Spain, all points on urban management together with the guidelines on waste management, fall within the same section under the *local administrations' basis law*. The interviewee suggested that in order to work strategically from a governance approach, there should be a part of green management under the urbanism section of this law, instead of leaving it next to waste management. This would improve the uptake of multifunctional green solutions since, according to Int. (5), urbanism is mostly driven by lawyers, architects and engineers which fundamentally follow an urban land exploitation logic. Furthermore, he stated that:

*"The law is separating urbanism as something that develops the land, and the city management as problem management: waste pickup and green management. This duality should be merged at a governance level. In other words, there should be a management part in the strategy, and a strategic part in the management." (Int. 5)*

### *Public Procurement Law*

In several occasions, the Spanish Public Procurement Law (Ley 9/2017) was explained as a key factor affecting NBS mainstreaming, mainly because NBS requirements or conditions facilitating its uptake can be introduced through procurement specifications under the law when applied for public urban development works (e.g. parks, urban forests, rehabilitation of streets, blue infrastructure, etc). Therefore, the law works as a channel which can be used to enhance NBS uptake, but in many instances, it becomes a barrier.

Int. (10) explained how in order for the market to offer NBS, these must often be included in public procurement. This means that, specifications that prioritise the uptake of NBS, such as minimal green requirements (e.g. having a set % of permeable land and/or green land) can, and should be present. Int. (4) explained that the public administration renders its philosophy and mission in the technical procurement specifications, which are binding. Then, firms have to fulfil these specifications in their proposals in order to get the chance of being selected to participate in the project. Moreover, in regards to these specifications ensuring the application of NBS in procurement, Int. (10) believed that:

*"These are essential because otherwise it becomes too difficult to access these contracts, and a big firm like Acciona [big infrastructure developer] takes it all".*

Int. (13) and (17) stressed the need to move away from the tendency to reuse the same templates for any GI contract, as it currently occurs, and instead aim to incorporate specific requirements such as the generation of biodiversity and ecologically functional impacts suited to a particular environment.

Int. (12) and (16) believed the law obstructs the way, particularly due to excessive bureaucracy in matters related to innovation, and criticised the tendency to apply generalised solutions in procurement, instead of making them place-specific. Furthermore, Int. (12) indicated that the law hinders innovation, generating problems to specialised SMEs, which usually have a higher innovative component. According to Int. (2), (8) and (13), this occurs partly due to current

demanding procurement specifications, which for example require that all the team members in a project must have 15 years of experience and have realised 7 green plans before. This leads SMEs with lesser resources to partner with academia or with other SMEs, but still does not solve the problem due to the settled criteria on the volume of projects and their correspondent assumed price under the law (See *Annex 1*. The main issue, thus, is generalisation. Int. (5) explained that most problematic requirements in current contract specifications are present due to custom, and reflected on the public procurement law by stating:

*"It's very curious… laws aren't always written from the practice-upwards, they are written in a top-down fashion, right? And following this way, there'll be a tendency to generalise some concrete problems of the great public works." (Int. 5)*

However, Int. (17) believed that precisely because of generalisation and the tendency of municipal technicians to reuse contracting templates, if ecology or social specifications were introduced in the law more often, these elements would permeate in the works of municipalities which would facilitate access to specialised SMEs. Hence, pointing out that the law itself is not the issue, but the way it is often applied.

Int. (13) explained how the problem is more systemic by indicated how the fast-paced environment in which procurement occurs does give pace for deep research previous to contracting. Furthermore, Int. (5) indicated that this speed has led to work almost on the go with little planification, hence losing opportunities to work with specialised SMEs, the social sector and third sector. On an interesting note, Int. (12) and (14) explained that this law was drafted from a fearful stance, being its aim to avoid corruption in public procurement processes. They described how this collaterally blocks the realisation of very interesting innovative projects as these usually entail collaborating with less-financially capable stakeholders like SMEs.

This points to another problem within the law, unjust competition among private actors. Big firms have more financial means which allow them to take certain risks that SMEs simply cannot afford, according to Int. (13). Moreover, big firms are able to cut costs more easily, thus offering a much more competitive price for their services. In this regard, Int. (16) gave the example of how many times in public procurement for architecture cheaper labour is prioritised, which affects those projects that need particular dedication.

*"It's like a reverse auction." (Int. 16).*

In addition to this issue, Int. (5) explained how when technicians draft the contract, wrong calculations of the social conditions of the contract lowers contract prices, which makes SMEs unable to participate:

*"If we want to naturalise, to innovate, we want to introduce SMEs in public procurement, and then these prices need to be better calculated, but we need more support to do this well." (Int. 5)*

This connects to the lack of commitment explained in the Agency Section. In this line, Int. (14) believed the problem is not the law itself, but the fact that generally auditors and technicians do not apply it correctly, sticking to the same philosophy of valuing price above the other equally relevant criteria.

*"As an SME, all our creativity and technical value is lost simply because we cannot access these contracts." (Int. 13)*

Another impediment of the law in regards to SMEs comes when the municipality faces a diverse project that would require different services. Here, technicians would have to make multiple contracts for different specialised professionals as separate SMEs, but this is forbidden by the law, even though, as indicated by Int. (2) and (6), this would be the most interesting thing to do in order to address the project with different specialists.

In these cases, the municipality has to draft a major contract since otherwise auditors can accuse technicians of trying to fragmentate the contract into several minor contracts (See *Annex 1*) to choose who you are working with and thus diminishing the principle of free competition. Therefore, even if technicians justify that the selected firm is the best fit for a specific purpose, auditors will oppose because it is simply not allowed. Int. (2) believed this is regrettable because, in many instances, it would be better to have more diverse and specialised professionals to enrich the project. It must be mentioned that specialised firms can apply as a consortium of firms, but this tends to be also problematic because, as long as the volume of the project does not increase vastly, the procurement salaries for these consortiums tend to be insufficient in practice (See *Annex 1*). As a result of the current legislation, most specialised SMEs have to associate with big firms in a sub-contract form to access projects of a value superior to €15,000. But this adds an intermediary to the process, meaning that the budget gets divided, with SMEs usually working in a precarious way.

On a positive note, however, Int. (5) indicated how 'special framework agreements' can provide more stability in public procurement for the mid and long-term (8-10 years), which in his words, *"saves the life of an SME".* Int. (12) indicated how the law can also be beneficial for highly specialised SMEs if aspects such as social or environmental requirements are set. Moreover, Int. (8) believes that procurement specifications are progressively prioritising the work of SMEs, particularly those choosing to adopt environmental measures, also due to their job generation capacity. Moreover, Int. (8) indicated how in contracts for rehabilitation projects, they are prioritising those firms doing NBS. In brief, the law can have specifications that facilitate contracting specialised SMEs.

### Regional strategies and ordinances

Aside from what was previously stated on the need to coordinate relevant municipal, regional and national strategies, there was only one more relevant aspect identified in regards to the role of regional ordinances. As indicated by Int. (10) both land-use and urbanism ordinances at the municipal level fall under regional competences in Spain. Given this context, Int. (7) expressed how one of the ways to advance the mainstreaming of urban NBS is to integrate NBS elements in the different plans of regional administrations, although this does not guarantee that NBS will get implemented due to factors like costs and cost overruns. Nevertheless, the interviewee explained how guidelines of these regional plans can be reformed and reoriented towards incorporating more greenery in both the private and the public space.

## Municipal strategies and ordinances

### *Strategies*

A variety of municipal strategies supportive of NBS were discussed too. For instance, Int. (2) pointed at the *'Madrid + Natural'* plan which aims to increase the uptake of urban NBS. Under it, some other projects exist, like the '*Madrid Agroecológico'* platform boosting urban agroecological practices, tightly linked to NBS. Madrid's *Sustainable and Healthy Diet Strategy* (developed after the signing of the Pact of Milan 2015) also closely relates to climate change adaptation and NBS. Int. (4) mentioned also highlighted the mayoral commitment in Barcelona with the climate emergency declaration and the development of the Green and Biodiversity Plan 2020. Furthermore, the city is aiming to involve as many stakeholders as possible in the green transformation of the city through the '*Barcelona + Sostenible'* platform.

Furthermore, the powerful communication campaign launched in Barcelona during 2019, *'Donem pass al verd'* or '*Giving way to the green'* was emphasised. Several signs were distributed throughout green spaces in Barcelona with messages like, *"if a weed grows, it's a good sign",* as explained by Int. (4). These messages were appealing to health and working towards the elimination of chemicals in gardening that have been proved to be harmful to humans. Other signs state *"the management of this green space improves biodiversity" (Int. 4).* Then, under these bold messages, substantiated reasons supporting these claims are given. As a result, the public is more informed, dramatically lowering resistance to naturalisation practices. Also in terms of communication strategies, Int. (2) themselves are elaborating a website from the climate change department showcasing existing NBS in Madrid, in which different municipal departments who have realised NBS in the past can add up their experiences, as a way of visualising NBS, enhance interdepartmental communication and motivate further NBS uptake and continuity.

On another note, from his advisor and academic perspective, Int. (1) ensured that some municipalities are currently developing their green infrastructure plans. This is relevant because municipal green infrastructure plans, as explained by the interviewee, are umbrella documents under which other documents can be organized, including: e.g. a plan for urban tree management, a biodiversity improvement plan, a plan for upgrading the water cycle and a plan for climate change mitigation through GI among others. Withal, in Int. (1)'s expert opinion, green infrastructure plans should stand above general urbanism plans because the natural capital should be the maximum conditioning factor of urban constructions, which would likely boost the mainstreaming of NBS.

### *Lack of ordinances supporting NBS*

A lot was mentioned in regards to shifting the rules of the game to stimulate further NBS uptake. Municipal ordinances play a crucial role here in stimulating certain interfaces between public and private actors. In terms of the current diffusion of NBS, Int. (2) and (7) pointed to two different approaches at the municipal level. One in which the NBS concept permeates in some areas of municipalities and then that these areas find external actors with which to collaborate. Other interventions have a bigger scale (neighbourhood, city area or city as a whole). In these cases, certain rules of the game which favour or foster NBS could be made compulsory. At a regulatory level in Spain these elements are lacking at the moment, according to the interviewees. There are some subsidies, but not a regulatory mechanism that obliges to incorporate NBS in plans, or which allows the PA to negotiate with the private sector for them

to incorporate NBS. On the latter point, Int. (7) highlighted that the municipality of Barcelona could engage in more public-private negotiations to stimulate NBS uptake in private spaces through the establishment of new rules of the game and objectives, to then negotiate, e.g. with building owners:

*"You can add a floor to your building but only provided that you incorporate a green roof or that you recover and green the inside patio of the building".*

Int. (7) proposed to the municipality to engage in these types of negotiations more often, finding inspiration in policies of the kind which have been applied in cities like Berlin (Biotope Area Factor) or Stockholm (Green Area Factor). At the moment, only municipal technicians supportive of NBS can oblige firms to incorporate NBS through the establishment of specific requirements during the revisions of urban development projects through municipal compensation boards, given municipal land rights.

Because new interventions like those of NBS have to be aligned with current regulation, Int. (17) indicated how municipal ordinances can become hindering of NBS projects, sharing the example of Grow Green in Valencia, where 1/4 of their budget had to be destined to street lighting due to inflexible urbanism ordinances. This is only one example out of many legal requirements to meet in terms of security, accessibility, etc. Therefore, Int. (17) expressed that NBS must be developed coupled with the city´s regulation in terms of realising works in public spaces, street design, etc. Furthermore, Int. (7) stated that municipal regulations ban productive (business-like) green solutions (vegetables, honey production, etc.) in urban spaces in Spain, unless these are connected to a social entity, e.g. working on labour integration. This was pointed to be problematic because otherwise, for instance Barcelona could have plenty of SMEs creating NBS like green roofs and generating ecosystem services whilst producing vegetables, for instance. There is a legal vacuum and therefore it is not encouraged.

An important barrier to NBS uptake in the municipal and regional context is that in attempting to scale up successful NBS pilot projects, a legal vacuum on which administration holds the responsibility for it can interrupt the project. For instance, Int. (2) explained how certain matters fall under Madrid's regional competences**,** whilst others fall under the municipal, and this divide generates restrictions when it comes to applying NBS. In fact, projects are being left without leadership. On a hopeful note, interviewees explained that if the responsibilities of launching these strategies fell under a specific department, then there would be better chances for continuity.

## *Governance structure*

In regards to NBS development and diffusion, Spain has a multi-level governance approach in which the steering of actors towards NBS development and diffusion occurs at different governance levels: national, regional, municipal and EU levels. However, the effectiveness at each of the levels varies.

At the national level, Spain plays an important role in setting broad urban sustainable development aims, showcasing vision and commitment from the top. However, that vision has not yet taken the shape of solid plans or actions in relation to GI and NBS. Nevertheless, the new

National Strategy on GI and Ecological Connectivity (MITECO, 2020), which does incorporate GI and NBS elements in its guidelines, will finally be published this year, impacting on the current governance structure. As explained under the *National Strategies* section, the Strategy will provide guidelines, deadlines and funding for the development of new GI plans at regional and municipal levels to implement GI and NBS. There is not much commitment in regards to NBS support at the regional level. However, the integration of NBS elements in regional land-use and urbanism regulations appears to be crucial as these regulations rule over land-use and urbanism plans in Spanish municipalities. At the local/city level, municipalities demonstrated most engagement among all other governance levels, so far having taken most actions and steering actors in the city: the realisation of NBS themselves through municipal teams; developing NBS through collaborations with private actors (big firms, SMEs, third sector) through public procurement, grants and subsidies; experimentation with NBS via EU research and innovation projects and funds; the development of commitment-for-sustainability programmes which allowed to carry out actions like horticultural gardens, promote citizen participation or even worked as platforms fostering multi-stakeholder networking and collaboration. However, it must be noted that only a few municipalities are taking such clear leading roles, e.g. Barcelona, Madrid and Vitoria. Some other municipalities are currently developing their new GI plans, and many others are delayed, yet slowly joining the wave. The private sector's role has been highlighted not only as important, but necessary in order to reach a faster urban transformation and the mainstreaming of NBS and meet broader goals of urban climate adaptation. Most of the mentions referred to the work of private actors in the public space, thus, through public procurement. Therefore, most of the private sector's work in NBS comes by the hand of municipalities. The private sector is key in providing specialised knowledge and technical skills, research and innovation, finance and technology, and even advocacy. In short, many resources from which the PA benefits vastly. In fact, the private's sector role in relation to GI and NBS development and diffusion has been growing, coming to the realisation that a much more interactive-hybrid governance is taking place at the city level in Spain.

Therefore, a multi-level governance structure is present in Spain in regards to NBS development and diffusion. However, the municipal level holds the most agency nowadays, observing weak governance at the regional level, but foreseen the potential strengthening of it and all other levels under the national level, with the coming national strategy. A more hierarchical governance may then occur, but the national level seems to be the weakest in its impact on NBIS for now. Most actions are taking place in municipalities, in between municipalities themselves and private actors, under the lead of municipalities and EU support in steering stakeholder action and collaboration, demonstrating that interactive-hybrid governance is presently the dominant governance structure in Spain.

### *Stakeholder landscape*

A broad array of stakeholders ranging from the EU, to the different scales of the PA (national, regional and municipal) to other institutions and entities such as universities, the third sector and varied actors within the private sector including both big firms and SMEs are part of the current interactive-hybrid governance structure for the diffusion and development of NBS, as indicated by Int. (1), (10), (13), (15) and (17). As stated above, different levels of power and responsibility towards forwarding the development and diffusion of NBS were identified. Nevertheless, Int. (2) and (6) expressed how the mainstreaming of NBS faces the challenge of

creating a more stable governance in order to scale up NBS projects from pilot projects to normalised interventions, meaning that aligned objectives and commitment must be strengthened and maintained at different levels to take this step.

From a governance perspective, Int. (1) pointed at the role of FEMP (Spanish Federation of Municipalities and Provinces) in disseminating knowledge on state-of-the-art interventions on NBS and GI for professionals within the PA. Indeed, municipalities implement most urban NBS in Spain, up to 90%, according to Int. (1). However, they also hold most responsibilities in paving the way for other stakeholders to engage in NBS development and diffusion, mainly through the provision of finance and guidelines via plans, strategies and programmes, as indicated by Int. (5) and (7), who stated that these instruments allow all actors to advance. The same point was forwarded by Int. (4) who highlighted the power and responsibility that municipal technicians have in the promotion of sustainability through guidelines, such as the programme for the commitment to sustainability in Barcelona (*Barcelona + Sostenible*) which ultimately engages a broad array of institutions and stakeholders (schools, universities, businesses and NGOs). Furthermore, the role of public-private agreements was highlighted by Int. (2), who explained how the municipality of Madrid signed an agreement for the impulse of the energy transition with incumbent energy leaders (*Iberdrola*, *Red Eléctrica* and *Naturgy*).

Also, through requirements, as mentioned earlier, municipalities can steer the direction of sustainable urban development. For example, Int. (4) indicated how for new GI projects, the municipality is requiring working teams to be comprised by professionals from diverse domains:

*"Not only architects but also experts in landscape, fauna and flora, water management, citizen participation, etc." (Int. 4)*

Recognising that big developers like *Ferrovial* hold much power since quite often they manage those green zones they develop, Int. (13) stressed that the municipality can impose a set of requirements for them to meet, such as the realisation of GI and NBS sticking to ecosystem and biodiversity criteria. Therefore, being able to limit the role of big private actors, but capable of steering towards desired goals.

On another note, Int. (17) believed that although big construction and architectural firms realise most visible projects in cities at specific points in time when big rehabilitation or development opportunities appear, the "real" transformation of cities takes place by the hands of municipal teams, particularly through technicians and civil servants in the departments of parks and gardens which realise multiple small-scale interventions in parks, squares, roundabouts and small streets.

Therefore, municipalities hold most of the responsibility for the development and diffusion of NBS. However, other stakeholders are increasingly taking responsibility, which is progressively transforming the governance structure towards a less centralised and more interactive governance in most Spanish cities. One exception is Vitoria, which follows a more centralised approach with responsibility almost fully allocated to municipal departments, with few attempts to broaden the stakeholder landscape. However, Int. (9), as a technician from the municipality of Vitoria, shared some constructive criticism when stressing that NBS could be enhanced with good planning and with a governance structure that allows all those actors somehow involved in NBS to work in a much more coordinated and effective way.

The role of the EU was mostly perceived as imperative from a governance perspective too. Firstly because of the availability of guidance and funding, but also due to the promotion of innovative collaborations for experimental NBS projects, as indicated by Int. (12) and (14). For instance, Int. (17) pointed out how through EU projects, in many instances, SMEs have become crucial actors for municipalities. According to Int. (17), in some instances, SMEs provide the qualities and knowledge that municipalities need in order to access EU funds for NBS development, as in the case of *Grow Green* in Valencia. In this, the interviewee highlighted how SMEs provide expertise, but most importantly, an innovative and risk-taking capacity that many other entities in the public and private sectors cannot.

The move towards a more collaborative governance was perceived as positive by all interviewees, with many indicating that hybrid governance is desirable for Spanish cities. In this regard, Int. (12) stressed that hybrid governance is basic, considering that complex problems require complex solutions, away from simplified sectorial solutions. Moreover:

"*All stakeholders have to collaborate, especially engaging in more public-private collaborations which the interviewee pointed that can be crucial in bringing about NBS for the general public's interest."*

Further to this, Int. (5) spoke about a current hybrid responsibility, with the public sector launching initiatives and the private sector responding with means to realise them. Moreover, citizen or bottom-up governance was also mentioned by Int. (12) as a growing phenomenon, as well as important collaborative projects in which non-traditional urban development actors are taking responsibilities. For example, the experience with the Cyborg Garden in Madrid, through which Int. (16) explained how professionals from EU Climate KIC, consultants, designers, the university and foundations (contributing with funds) held all the project's responsibility.

Last but not least, the distribution of power and responsibilities within individual organisations was pointed out to be crucial in order to drive effective changes in governing the development and diffusion of NBS at the city scale. In this context, Int. (1) and (10) indicated how currently there is a lack of inter and intra departmental dialogue in Spanish municipalities, e.g. the urbanism department in Madrid is not communicating well with parks and gardens. He highlighted the need to reach intra-municipal agreements on their responsibilities, and to develop guidelines towards more coordinated action. Moreover, Int. (2) from the Climate Change Department in Madrid, specified that the adoption of NBS should permeate in all the objectives of all diverse municipal management areas. They even shared some examples of good collaborative governance that have taken place in Madrid, such as the governance table for the healthy and sustainable food strategy developed after the Pact of Milan 2015, which involved all related municipal areas (consumption, economy, green areas, environmental education, urbanism, municipal markets, schools…) plus other municipal platforms, institutions such as FAO Madrid, universities, the third sector, private associations and more. They emphasised how collaborative governance is key to succeed, especially when it comes to NBS. Nevertheless, this desired horizontal governance within municipalities is still in an early stage of its development.

Notwithstanding, some non-public entities also distribute their responsibilities and power within their organisations with the aim of generating a positive impact for sustainability. For example, Int. (4) explained that entities that showed commitment to sustainability through the '*Barcelona*

*+ Sostenible'* municipal strategy are restructuring their responsibilities, working from within their own institution to bring about transformations in the organisation for the sake of citizens and sustainability.

## *Collaborative arrangements*

### Networks and Partnerships

With the focus on having more varied stakeholder involvement in support for NBS development and diffusion, interviewees pointed at the existence of previous and current collaborative arrangements, mainly public-private partnerships (PPPs), taking form through networks and platforms, but also through procurement practices. Many of these act as a science-practice interfaces, in which different practice-oriented stakeholders, such as municipal technicians or private developers nourish their knowledge with state-of-the-art science and techniques from academia and cutting-edge firms. On most occasions**,** knowledge exchange turns into a learning process for all stakeholders involved. In some cases, NBS projects are carried out through the work of transdisciplinary teams, whether due to the model and self-initiative of individual organisations or because this is a set prerequisite for the project as a whole. As a result, transdisciplinary knowledge systems for NBS development and diffusion are becoming progressively normalised, with a focus on experimentation as in the case of NBS laboratories. All these types of collaborative arrangements were said to be contributing towards trust- and commitment-building among stakeholders, acting against fragmentation within NBIS and improving (to a greater or a lesser extent) the development and diffusion of NBS. The aforementioned types of networks and partnerships are described in more detail in the following paragraphs:

#### *Public-private Partnerships*

Int. (9) stressed the importance of the private sector in accelerating the transition towards the green city. Since both public and private parts are interested, it is desirable to exploit more collaborations.

*"From the public sector's perspective, the innovative and developmental capacity of the private sector is particularly interesting, also because the private sector is the one able to bring technological innovation to the municipality's hand". (Int. 9)*

Int. (5) shared his experience of one PPP between the municipality of Barcelona and two SMEs, experts in biological control and landscape design engineering. The municipality needed seeds for replanting which the SMEs provided, but additionally offered expert services on areas of the project in which the municipality lacked expertise on. Finally, all parties benefited from this collaboration and their contract was extended. In this line, Int. (5) shared his belief that there is plenty of room for SMEs to enter PPPs to deliver GI and NBS related services more effectively. And also stressed that the relation between SMEs and local authorities will likely be smoother compared to that with other authorities due to lesser bureaucracies and the bigger chance for establishing closer links and trust.

Importantly, in regards to private actors' involvement in NBIS, some interviewees stated the necessity of involving local and diverse SMEs against the current reductionist paradigm and

dependency on big development firms. Int (2) believed that if municipalities collaborated more with SMEs, more involvement of local actors in NBS development and diffusion would occur. Nonetheless, they explained how this is not the norm, as most SMEs prefer not to work with the PA, unless it is a pilot project co-funded by the EU, due to difficulties in the application of the procurement law (*See Annex 1*).

*Science-Practice interface*

*"The best future prospect in regards to mainstreaming NBS would be to have SMEs collaborate closely with universities, which is what I currently do, to ensure that the scientific part of the project is never missing." (Int. 1)*

As seen before, most actors are highly interested in collaborating with scientific organisations. For instance, Int. (6) explained how they closely collaborated with *IS GLOBAL,* a health institute in Barcelona that applies science to urbanism. Also, Int. (13), as an SME working on ecosystem restoration, explained that their usual clients are big firms and PAs, but how they also maintain a close relationship with academia. Moreover, they stressed how to collaborate with academia means a great opportunity for the private sector.

*"I am highly interested in connecting PhDs with the business world. Not only research groups, but all professionals that come from an academic background. I believe they have so much to contribute to the private sector". (Int. 13)*

Int. (5) boldly stated that collaborations are key, especially those activities oriented to the exchange of knowledge, experience and discourses where businesses, professionals and PAs participate, such as congresses and seminars.

Other transdisciplinary examples are the following. Int. (1) exposed a project in which he collaborated with another two SMES, the university and one foundation, working on the development of recycled sods for green roofs. Int. (16) pointed out the experimental collaboration at *Matadero*, in Madrid, with actors such as the innovation institute of UPM (university), the municipality of Madrid, the *Matadero* cultural organisation, *Carasso Foundation,* and different interdisciplinary working tables formed by SMEs and coordinated by Int. (16) themselves. Similarly, Int. (17) spoke about the varied stakeholders participating in *Grow Green* Valencia which included big technological firms like *Tecnalia*, design studios (SMEs), academia, the municipality, or Int. (17) themselves running public participation. Furthermore, at a regional level, Int. (1) worked as an independent technical expert in a collaborative project with 31 municipalities of the metropolitan area of Coruña, Galicia. Here, they identified ecosystem services of the zone to then launch a GI proposal to be implemented by 2050, which incorporates NBS such as urban forests and vertical gardens. The project was realised by an interdisciplinary team conformed by engineers, architects, sociologists, doctors and professionals from the humanities, which Int. (1) deemed crucial due to the interdisciplinary nature of NBS. Lastly, although not part of the case studies, it is worth mentioning a novel arrangement that occurred at the municipal level in León, as described by Int. (1), where the council of health signed a collaborative agreement by which practitioners can prescribe the use of green space to improve public health to patients, as a way to advocate for more and better green areas.

The supportive role of the EU was again highlighted, with Int. (10) stating that real varied stakeholder collaboration is happening in EU projects. Universities, PAs, SMEs and big firms are co-working under these, which was perceived as ideal by all interviewees in the sense that new ways of working are allowing to discover new possibilities. In cases like *EU Boogi-BOP*, as explained by Int. (15), SMEs and the university collaborate to influence big firms for them to incorporate biodiversity in their business' cycles. *ECODES* (Int. 12) provides expert ecology consulting services to the PA but also participates in EU research projects. Furthermore, EU projects support experimental projects that would otherwise not take place due to insufficient interest and/or funds, something highlighted by Int. (14), who currently partake in *EU OPERANDUM* with their open-air labs for NBS. Therefore, transdisciplinary, multi-actor work occurs under EU projects, promoting rapid knowledge exchange and trust-building through the realisation of demonstrative projects. Furthermore, Int. (2) pointed at the key role of EU projects (*Climate KIC*) in normalising new types of PPP among municipality and a variety of stakeholders.

### Participation

Many cases of public participation were indicated during the interviews. They regarded public participation in planning and decision-making as desirable to a certain extent, indicating the importance of having citizen's acceptance and support for green interventions as well as the related positive feedbacks of civic support for NBS on other political and economic support systems, which to some extent translate to creating shared understandings of the city as a socio-ecological system.

In regards to citizen inclusivity, Int. (5) pointed out that participatory processes as well as volunteering experiences are needed in order to educate citizens about nature and the city, and most importantly, to forward a transformation towards a system in which citizens become responsible and active stakeholders. Similarly, Int. (4) and (9) highlighted that citizen inclusivity in design phases is essential to legitimise interventions since the public space is for all to use. At an analytical human-nature relationship level, Int. (1) explained how society is inclined to NBS for health and well-being purposes. Also, Int. (4), from the Urban Ecology Department explained that citizens demand more and better services from urban authorities, but they can also participate and contribute to defining how things are done. She explained how in the last five years, public participation has been present in all big development projects in Barcelona, with processes lasting up to two years at times. This, she said, lengthens the project but makes it richer. Municipalities have boosted citizen participation through sustainability platforms. A great example is the '*Madrid + Natural*' program, as explained by Int. (2), which gathers urban community gardens of Madrid as well as *Madrid Agro-compost project*, in which many aware and committed citizens participate. According to the interviewees, these citizens, who receive training by the municipality, work as human amplifiers of those activities launched by the municipality. Also, Int. (4) referred to a citizens' lobby group for GI which helps the municipality of Barcelona, as they inform about citizens' concerns and expectations for municipal technicians to consider when revising and drafting policies. Thus, civic participation in these projects has a positive effect on the broader support systems for NBS. For Int. (10), the model to implement NBS should include the citizenship at times. Also, the interviewee stated that ecopreneurs could gain demand in the future, especially due to the progressive normalisation of participatory processes with citizens.

*"Now cities are more concerned about their projects being accepted by the citizenship". (Int. 10)*

Int. (10) pointed at the role of SMEs like Paisaje Transversal (Int. 17), who focus most of their work on citizen participation and dissemination. From the PA perspective, Int. (9) explained how in Vitoria the authorities ask dwellers what they would prefer from a list of predefined NBS: horticultural gardens, urban forests, fruit forests, etc. Moreover, the interviewee also talked about the so-called 'participatory budgets', through which citizens propose what they believe are necessary projects and the municipality selects according to their goals and budgets. For instance, the urban horticultural gardens of the Lakua neighbourhood (*See image 1*).

As an interesting remark, Int. (16), talked about citizen participation through the design of strategic NBS that enrol dwellers in the urban sustainability problem (linking to the concept of '*nudge*', which will be introduced in the *Learning* section).

*"Trough affection and experience people can get involved in caring for the urban green, and moreover, can feel encouraged as they become part of the solution of climate change related problems." (Int. 16)*

However, public participation does not go without some limits (int 12), as municipalities and firms working on NBS development will not be able to accommodate all citizens' desires, and, as mentioned above, involving the citizen can slow down projects. To tackle this issue, the interviewee highlighted the relevance of asking adequate questions, as to avoid the appearance of resistances. Int. (17), who mostly work delivering public participatory processes, believe there is further potential for participatory processes since people are generally reasonable about urban greening. However, some barriers such as the lack of knowledge about urban challenges were signalled too.

*"They don't know about the heat island and worry about their day to day life and needs" (Int. 17)*

*Image 1: Neighbourhood horticultural gardens in Lakua, Vitoria-Gasteiz. The intervention was realised through 'participatory budgets'. Picture taken by the author.*

## *Learning*

Learning processes were seen as crucial in helping to build capacity for NBS development and diffusion in urban areas. Educating, training and identifying best practices as well as learning from previous mistakes is crucial to improve NBS uptake. Changing mental models to consider benefits other than those thought to be purely economic was seen as paramount. When talking about public-private collaborations, Int. (10) stated how it is crucial for the PA to understand that NBS can be more cost-effective than grey solutions, since they present co-benefits (economic, societal and environmental). On the topic of co-benefits, Int. (2) shared the example of the M30 highway renovation project in Madrid, which relocated the highway underneath the city's river and installed NBS and GI along the river. In this case, maintenance savings were very clear due to water filtration mechanisms and the recycling of the river's water, the biodiversity increase, plus the social benefits of being in contact with nature and the joy of seeing a living river. These examples give justification for improved assessment of NBS, as shedding light on their co-benefits can help generate more support for them. Furthermore, research activities are considered crucial, highlighting the usefulness of bridging research and practice in designing, monitoring and evaluating projects. Thus, experimentation, represented a key element for NBS development as well as to prove new ways of working and stakeholder arrangements. Examples of these findings are presented in the following paragraphs.

### Education & Training

Efforts to improve the understanding and awareness of stakeholders regarding alternatives were deemed as necessary by interviewees. For instance, in the context of *naturalisation* practices, Int. (5) stressed the need to re-educate those managing urban greening (e.g. educate gardeners in biodiversity and less-intensive practices), to invest in their trainings and also to reorganise the management model. Similarly, Int. (7) deemed that all what is related to environmental education is a bit delayed in Spain, for which there is room for improvement.

*"Broad education is needed, not only training teenagers and adults, but also the private sector. I believe we struggle with this due to traditions. We deliver good environmental education at the school level, but we have a hard time jumping to the working world and educating private agents. We should be gathering private actors to suggest them alternatives for them to test out and learn." (Int. 7)*

Nevertheless, relevant activities were indicated to be taking place in regards to the improvement in understanding and awareness of alternatives. One example comes from Int. (6), which, as an environmental consulting and training firm, has worked on generating content and messages for the PA to use in municipal campaigns aiming at tackling public resistances and improving understandings of, e.g. new municipal waste or green management strategies. However, they also indicated how the idea of campaigning particularly for NBS is quite farfetched from the current reality. According to them, NBS are relatively complex and educating the public on NBS would require that people first reaches a higher average knowledge of environmental processes before getting into NBS. Nonetheless, Int. (6) has also directed educational programmes with important private foundations such as *Cosmocaixa*. Likewise, Int. (9) explained how the social foundation of the Basque bank *Kutxabank* has collaborated with the municipality with the provision of funding to carry out educational programmes for the youth. In this regard, the interviewee disagreed with Int. (6), and believed that in the same way that these educational programmes have been financed, GI-related programmes could be financed in a similar fashion to improve awareness of NBS.

Other aspects of education and training relating to NBS were also introduced. For example, in speaking about the diffusion of urban horticultural gardens as a way to contribute to NBS mainstreaming, Int. (5) argued that there is an important social and educational task to carry out in terms of returning productive agriculture to the city. The need to educate and train within municipalities was also highlighted by Int. (1) when saying:

*"There is a need to spread awareness, disseminate, train (municipal) technicians and to improve the knowledge and technical capacity of SMEs." (Int. 1)*

Int. (1) pointed also at universities. He explained that in most universities NBS are not yet part of the curriculum and also mentioned the fact that because NBS involve interdisciplinary work, it becomes difficult to incorporate them into existing university programmes. Furthermore, there is also a lack of a professional training directly oriented to bringing nature into the city (int 5).

*"Certain professions like agricultural engineering, forestry or landscape engineering are more sensitive to the NBS discourse, whilst civil and industrial engineers, traditionally the technical arm in urbanism departments, encounter problems to comprehend what this is about." (Int. 5)*

On a positive note, Int. (1) and (14) indicated that more content on urban NBS within lectures on GI have been incorporated in landscape engineering and ecosystem services master programmes, something perceived as necessary by Int. (15).

*"This is key because, in the end, our students are the engineers of the near future, and they will be managing different projects in which they will have to choose which direction to take." (Int. 15)*

Besides, Int. (1) stressed that the present lack of knowledge at PAs and universities creates an opportunity for consultancies, which could fill the gap. However, there are not many SMEs working on these aspects yet, and among big developers and construction companies there is very little experience in NBS, due to uncertainties associated to new interventions.

From a **strategic design perspective,** Int. (16) highlighted the importance of problematising climate change and the sustainability issue in society when designing NBS. At *Elii* (Int. 16), they believe that these are complex concepts which people need to comprehend from their own experiences and that, through socialisation and problematisation, citizens can get involved in both the problem and the search for solutions. Also, they hold that this is crucial to reinvent the way we work in order to tackle these problems.

*"We realised that, whilst being constructed, NBS have to be problematised. Otherwise, we run the risk of operating within the logics and vocabulary used from modernity until now, which have brought us to this situation." (Int. 16)*

Furthermore, Int. (16) explained in brief the idea of '*nudge*' within the design paradigm and how design hints can help innovate NBS and forward the aforementioned citizen engagement and problematisation of urban sustainability issues. The example of the "urban tree" (which they developed) is very helpful to illustrate this concept:

*"The tree has PVs and plants at the top, and a water tank and bicycle pedals at the bottom. When you pedal, your mechanic energy is transformed into electric energy which, combined with the PVs', pumps water that waters the plants. The tree was also pink, some sort of a giant Hello Kitty which aims to activate affection among citizens to enrol them. It is not a guideline like "recycle paper", it's different. When the tree is running out of battery, it has a device that says "please, pedal me".*

The main point of the design approach, following the insights from Int. (16) is that it is crucial to understand that climatic challenges cannot only be tackled through technology and expert solutions, and therefore, new interfaces that progressively enrol actors through experience have to be developed.

Different outreach activities aimed at generating commitment and engagement were additionally presented. In fact, Int. (2) indicated the existence of current educational and outreach programmes directed to the broader public, with most of these focusing on schools and high schools. Activities like workshops, or the 175 school horticultural gardens under the programme *'Educate today for a more sustainable Madrid'* are good examples. Int. (5) expressed the importance to re-educate in order to confront citizens' expectations and fears of alternative management measures such as *naturalisation* practices, e.g. phobias to insects. The municipality of Barcelona has engaged in pedagogic activities, progressively finding more acceptance among

citizens- who show increased support for NBS. Moreover, as part of this outreach, Int. (5) stressed the need to start a conversation with citizens affected by the instalment of GI and NBS, through e.g. allergic responses. Interviewees (5) and (13) stated that the benefits of urban greening and biodiversity increase have to be well explained through different educational activities, e.g. social inclusion projects, volunteering and participatory processes, in order to find consensus about green interventions.

At a dissemination level, Int. (1), as an academic and technical advisor on landscape engineering and NBS, collaborates with *FEMP* (Spanish Federation of Municipalities and Provinces) in sharing knowledge on NBS and GI, which he believes progressively permeates in PA workers (councillors, technicians and majors). According to him, after these events, PA actors increase commitment towards realising NBS and find advise through technical experts like Int. (1) himself. In addition, Int. (1) disseminates knowledge at *RECS* (Spanish Healthy Cities Network) on how good urbanism can improve public health through the argument of biophilia, as touched upon in *Academia* under the *Agency* section. Undoubtedly, these networks allow practitioners like Int. (1) to activate learning and knowledge exchange as well as to build trust among participants in regards to the multifunctional role that urban NBS can play, which affects stakeholders' readiness to uptake NBS.

From what was gathered from the interviews, the main media outlets used to communicate knowledge on NBS are online websites. These mainly have disseminative, demonstrational and training purposes. One example is the aforementioned objective of the Climate Change Department in Madrid to develop a website showcasing finished NBS to increase visibility and to encourage more participation among municipal stakeholders from different departments. Moreover, Int. (9) explained how technicians in Vitoria publish technical dissemination materials on their website, in an attempt to reach out to the general public and professionals.

### Research

A few universities in Spain are currently undertaking research in NBS, since, as mentioned before, it is quite a novel topic, even for those programmes on landscape engineering, urbanism or architecture. Most of the research involving universities is supported by EU initiatives, and, for NBS being a practice-oriented topic, they mostly collaborate with public and private stakeholders. In this regard, the Technology Innovation Center for Development (ITD) within Polytechnic University of Madrid (UPM) is substantially involved in NBS-related projects, following Int. (1) and (15). Also, the University of Santiago in Galicia was mentioned to be participating in research and development projects, as well as the University of Valencia in Grow Green. Other knowledge institutions were mentioned to play an important role in applying research to public institutions, such as *ECODES* (Int. 12).

The private sector's role in researching for innovation in regards to NBS and sustainability was perceived as relevant by interviewees. Int. (1), explained how normally the private sector asks for funding to realise research and innovation projects, whether to the autonomic community (region), the Spanish state or the EU. The interviewee further indicated the existence of an emerging field of research and innovation projects involving SMEs. These are named '*R + D + I + d*' projects (research, development, innovation and diffusion). One good example which was briefly mentioned before is his involvement in the development of affordable recycled sods for green roofs where multiple stakeholders (SMEs, one foundation and the university) participated

in the research phase. Foundations like *ECODES*, according to Int. (12) help organise applied research projects on the broad issue of climate change, aiming to overcome the gap between research and practice. On another note, big development firms like *Ferrovial* or *Acciona* are highly interested in researching on climate change and sustainability related topics, same as insurance companies (e.g. *Axa* or *Reale*). The latter have realised that researching on climate change impacts and adaptation is fundamental for them from a risk management perspective. Int. (2) explained how it is very interesting for municipal technicians to learn how insurers assess risks, since this knowledge allows them to get acquainted with the costs and benefits of adaptation measures.

Science is collaborating closely with the private sector, as explained by Int. (13), but, as hinted before, this is something to be further encouraged. Indeed, Int. (13) stated that academia generates a lot of knowledge that becomes difficult to apply due to fast-paced working environments of both businesses and municipalities. In this sense, practice decouples itself from research, leaving a gap which is perceived as a barrier to NBS development. Regardless, co-creation processes between researchers and practitioners are currently taking place too, e.g. in Grow Green or EU Boogi-BOP. Moreover, there seems to be momentum, since Int. (2) pointed out that climate change is a fashionable topic in research at the moment, particularly among all Horizon 2020 projects, and, following this line, the new EU research projects for 2027 will be very influenced by climate change and sustainability topics.

### Experimentation

Int. (4) indicated how good practices have a great power to make changes, showing the case of green roof development in Barcelona where more stakeholders joined the subsidy programme as soon as they saw positive results from the first intervention. Currently, however, there are insufficient experimental projects involving NBS being executed in Spain, according to Int. (1) and (9), meaning a lack of experience. Despite such insufficiency, examples of multi-actor experimentation were found that contribute to social learning, awareness spreading and the rethinking of values and organisational strategies, as well as governance approaches and even business models.

For instance, Int. (16) explained how the Matadero cultural space was used as a laboratory to try out strategies for climate adaptation given that the space itself is public, and suffers from the heat-island effect.

The Technology and Innovation Center for Development (ITD) at the UPM university, explained Int. (16), is enrolling different firms in varied projects to help meet the shortfalls of the limited resources of the university. Some firms see a potential niche in the NBS field and try to explore it. Organisations experiment with and learn different ways of co-working, and negotiate their values, goals and strategies, since, as the interviewee stated “sustainability is a negotiation”. As a result, these firms are developing specific NBS, e.g. new small-scale systems to grow foods, or innovations in their organisational culture with the incorporation of agents from associations.

The demonstrative importance of EU experiments was also stressed. For instance, Int. (14) are currently developing novel techniques under EU OPERANDUM. Here, through the installation of living labs, they explore the effect of NBS on climate change in order to gather the complex data that is lacking and currently keeps conservative attitudes among urban stakeholders in regards

to experimentation with NBS. Experimentation in ways of working was also discerned. For example, Int. (2) explained how EU projects propelled collaborative ways of working within municipal departments too.

Iterative experimentation and testing of solutions were seen as imperative towards generating better NBS. However, interviewees thought interventions are insufficient at the moment. In fact, Int. (5) pointed at the lack of investment from the PA to sustain iterative experimentation carried out by small firms, which usually has to depend on European financed strategies. In his opinion, having more cases of public and private stakeholders making small scale neighbourhood experiments and assessing them would bring about faster improvements by giving plenty of lessons regarding effective interventions.

*"We need more experimentation to have more solutions that can demonstrate results and benefits more clearly." (Int. 2).*

As a broader critique, both Int. (5) and (6) stressed the fact that there is no room for trial and error in infrastructure works on the public space. Instead, there is a tendency to realise the same projects over and over again, blocking innovation, and only leaving little budget to subsidise green roofs, for instance.

### Monitoring and Evaluation

Whilst in all NBS and GI interventions Spanish municipal and private agencies carry out a basic follow up and maintenance of interventions, most interviewees agreed that there is a systemic lack of exhaustive, multi-indicator and long-term monitoring and evaluation practices of most interventions, which undermines confidence in nature-based innovation and thus, slows down its diffusion. However, a few good practices exist and, moreover, some of the interviewees stayed positive in the sense that to carry out some good NBS such exhaustive monitoring and evaluation is not always necessary.

For instance, in the making of an important private green roof in Barcelona by *MataAlta,* Int. (4) explained how the project managers contacted university experts for them to monitor certain environmental variables and follow up on the progress of its soil and vegetation, helping guarantee the correct development of this NBS. Several interviewees like Int. (17) explained how a big share of EU funding via EU Horizon 2020 is directed to monitoring the interventions.

Better understanding of outcomes of NBS was said to be leading to more effective strategies. In this aspect, Int. (1) indicated that in 2018 Madrid quantified the ecosystem value of the urban forests with the ITREE system, which summed around € 30 million of value delivery per year. By quantifying NBS value, its outcomes become more understandable to stakeholders.

In turn, however, most interviewees pointed at the lack of monitoring and evaluation practices as problematic. For instance, Int. (7), (9) and (10), showed disappointment about the general lack of monitoring and evaluating in the long-term, whilst explaining that no exhaustive assessments and comparisons of interventions are being done.

"*We are used to measuring less complex things, with less variables, for instance with photovoltaic panels you can measure your savings in € as well as non-emitted C02, but it*

*becomes difficult for a green roof. And if the return for a green roof is mainly in ecosystem services, the question is how to incorporate it in our market world?" (Int. 7)*

Int. (13) explained that the absence of solid monitoring and evaluation is mainly due to the fast-paced environment in which these projects occur, which leave no time to really test whether, for example, a vertical garden should really be in the place they put it in terms of generating co-benefits. On another note, Int. (5) pointed at the lack of indicators for biomass or biodiversity and explained that it is not being done due to the complexity that such a process entails. However, he gave an example of how monitoring could be carried out in a simplified yet useful way by repeatedly taking samples of insects in the soil in varied locations to track whether there is an increase in species or not.

As a result, current weak monitoring and evaluation is largely perceived as undermining commitment and limiting opportunities for learning and comparison, although experts stay positive. In this regard, Int. (14) expressed how municipal and private stakeholders sometimes use the perceived lack of precise monitoring and evaluation as an excuse to delay nature-based interventions, whilst they, as GI practitioners, confirmed the availability of enough technical information to upscale the development and diffusion of NBS in Spain (int. 14).

## *Resources*

In regards to the availability of resources, Int. (1) made a distinction between technical knowledge and technical capacities. The first has to do with knowledge and human resources whilst the latter is about technologies and finance enabling those with knowledge to further interventions. The interviewees discussion on the availability of knowledge and human capital, finance and technologies (to a lesser extent) is presented in the following subsections.

### Knowledge and human capital

In regards to knowledge on technical implementation of NBS, Int. (1) expressed that in general, there is a lack of knowledge about NBS.

*"Now SUDS are being boosted… some vertical gardens, green roofs… but NBS are being spread slowly, with difficulties." (Int. 1)*

Int. (2) agreed, stressing that their department alone does not have the knowledge and capacity, nor enough human capital, for which they try to work collaboratively with other municipal departments and external organisations. Furthermore, Int. (1) pointed out the lack of technical articles on NBS in Spanish language as an important barrier, due to the fact that most technicians do not know good English. Moreover, the lack of grey literature in the field was also pointed as a limitation. Int. (1) explained that grey literature is crucial as it brings scientific and technical knowledge closer to non-academics, but it is absent in this field.

Despite, firms like Int. (14) are purposefully going beyond the market logic sharing technical knowledge through reports and good practices online. They understand the importance to make technical knowledge available in order to normalise new concepts to accomplish a

transformation in urban GI. They also stressed how the overall technical level in Spain is good, with a lot of well-prepared technicians, which points out that, in regards to knowledge and human resources, the slow diffusion of NBS is not due to technicians not being well-trained but to innovative knowledge and trends not reaching them.

Int. (5), from the municipality of Barcelona, pointed at the lack of knowledge and time-resources in municipalities to realise specific tasks, for instance, the specialised monitoring of certain NBS. Moreover, he staunchly believed that those technically prepared to make that monitoring and evaluation are probably SMEs with two or three highly specialised professionals which can make exhaustive studies and provide insights and recommendations.

In relation to the availability of data on NBS to inform investment decision, Int. (2) reminded that both the private and the public sectors need to work with certainties, and indicated that in many occasions, there is not enough data on NBS performance, for which stakeholders still find investing resources in NBS too risky. As touched upon in *Learning,* experimentation and pilot projects are crucial to generate data and reduce uncertainties.

Soft skills were also perceived as important. Int. (2) explained how they had to make use of their negotiation and persuasive skills to convince some private owners to uptake NBS in their properties. Also, soft skills are used to generate trust-building, a crucial element to convince policy-makers of the incorporation of NBS into GI and biodiversity strategic plans. In this case, the climate change department holds most knowledge about the socio-ecological relevance of NBS and GI, and works through its soft skills to inform and persuade other departments about the benefits of integrating NBS.

### Financial factors

Diverse funding sources where identified, but also some limitations, such as the absence of financial muscle of entities from the third sectors and SMEs, or problems within the management of financial resources in the PA. For instance, on top of the relative lack of knowledge and capabilities of municipal departments alone, Int. (2) added the limited budget as one of the main factors limiting their possibilities to realise more NBS projects. However, they also highlighted that solving this problem alone would not improve the situation since, on the one hand more financial resources would be mismanaged due to the lack of personnel in their department, or on the other the money would be managed at the expense of losing workers in other important projects. In this regard, the interviewees believed that the problem of finance will be partly solved in the future thanks to private initiative. Widening the stakeholder landscape and collaborating with the private sector and local budgets can be beneficial for all, because otherwise, nowadays there is budget from the PA and the EU, but the municipal body is unable to manage the budget in the most efficient way, as explained by Int. (2). Importantly, Int. (5) pointed out the lack of financial knowledge in municipal departments, which leads to misleading calculations of the project's conditions and costs, which then affects salaries in procurement which are lower than they should be. This last point was said to specially affect SMEs negatively, due to their limited financial reach compared to bigger stakeholders. As explained under the *Public Procurement Law* section (*Legislation and Policies*), budgets for public contracts, particularly the pay to private actors participating in these projects, is very limited due to contractors paying more attention to price than content, as indicated by Int. (13) and (14) among others.

However, in regards to NBS development and diffusion in Spain, Institutionalised investments in the form of budget available for procurement, grant programmes and subsidies, are the most important in terms of weight and reach. The GI plans in Barcelona and Madrid (mentioned under *Municipalities* in the *Leadership and Power & Commitment* section*)* equipped municipal teams with 340 € million and 660 € million respectively. These plans are especially important because they work as umbrellas from which many other specific plans and actions hang. Although the sum appears generous, it does not mean that resources are distributed equally for all plans and actions, and neither that these funds are actually enough, as for that we would need to run a comparative study. However, Int. (6) stressed that currently the financial resources (budget) destined for strategic plans are definitely not enough for fostering novel collaborative arrangements with broader stakeholder involvement, which was perceived as an important limitation.

*"If we want consultancies, universities and other organisations to intervene, those resources must be multiplied by three." (Int. 6)*

Moreover, Int. (5), from the municipality of Barcelona, pointed at the lack of continuity in investment as something destructive for the private sector. Businesses need a horizon and certainty in regards of potential for investment, and this is something which, according to Int. (5), the PA is not doing well. It is not promoting certainty in the NBS market. The interviewee argued that funding could be invested more strategically and steadily, sending investment to smaller-scale but more varied projects to learn about what works and what does not faster.

*"This would be radically innovative for me, for companies to know that every year there is a process in which you can participate." (int. 5)*

Subsidies appear to be key in bringing more private actors on board and accelerating NBS uptake, although interviewees believed they could be upgraded. For instance, Barcelona's green roof subsidy is good example. At first, the municipality found difficulties to persuade private actors to participate, but once they did, participation started to grow exponentially, as shared by Int. (4). On the same example, Int. (5) stressed the relevance of having leadership through financial resources and objectives like with these subsidies, and explained how they found inspiration in the way green roofs were promoted in Basel, Switzerland. Interviewees, like Int. (5) believe that this sort of subsidies should be much more fostered as an effective way of public investment in Spain, against established perceptions that subsidies are considered expenditure and prevent actors from taking enough initiative.

*"Subsidies have a bad reputation in Spain because they were used in an abusive way. But for instance, the Swiss are very clear about the positive role that subsidies play in fostering the uptake of green roofs". (Int. 5)*

Int. (1) remarked the current importance of subsidies for NBS from the PA and the EU which encourage the involvement of the private sector. Him and other interviewees also stressed how SMEs are particularly dependant on this type of funding.

*"The European Commission's funding is key in supporting SMEs." (Int. 13)*

Moreover, Int. (10), (11), (13) resources for research and innovation from different EU programmes on climate change, health and air quality and sea level rise in coastlines. Particularly, those under *Horizon 2020*. Also, among others, the European *FETs* (*Future Emerging* Technologies) were mentioned by Int. (11) as important drivers that finance research and development projects, encouraging three or more organisations (from SMEs to universities) from different countries to join and develop innovation. As well as the mentioned *EDUSI* funds from the *European Regional Development Fund* (in *EU Strategies* under *Legislation and Policies*) which represent an important source of economic contribution for environmental projects for many Spanish municipalities (Int. 1).

Within the private sector, big firms have large financial resources, which allows them to face bigger infrastructural projects as well as to invest more money on research. In fact, many times they are able to afford whole research departments thanks to their resources (Int. 1). This contrasts with the limited financial capacity of specialised SMEs, which are much more restricted financially, yet strong in knowledge and human resources. Last but not least, philanthropic foundations were also pointed out in regards to funding, such as *Carasso Foundation* in *Matadero* (mentioned in *Private Sector*, under the *Agency* section) which invests generous funds into NBS projects as part of their portfolio, as shared by Int. (16).

### Technologies

Despite the barrier of the perceived lack of technological knowledge, interviewees indicated the availability of technologies supporting NBS development, but also diffusion, such as in the case of innovative technology providing useful data affecting decision-making in terms of NBS application. In terms of the most applied NBS, Int. (1) explained how SUDS are becoming normalised, being applied quite often. Other NBS, namely vertical gardens and green roofs also occur, but less often.

Usually, high costs are perceived as limits to the development and diffusion of NBS these technologies. However, there were a few examples of cheaper ground-breaking technology. For instance, Int. (1) shared his participation in the development of cost-effective sods for green roofs and urban embankments, as well as soils for green roofs made with recycled materials, e.g. rests of construction equipment, coconut fibre, pine tree rests.

Furthermore, technology can be supportive of other NBS processes, and so was indicated by the interviewees. Particularly in regards to inventorying and data gathering. Examples are the *Invest* system, used to quantify ecosystem benefits, or the *ITREE* system, which was used to quantify the ecosystem value of Madrid's canopy, as informed by Int. (1). Moreover, Int. (5) touched upon the role of databases like the *smartcity* planner in the near future. Although he trusts this type of technology will bring a variety of benefits in regards to resource management and effectiveness for GI and NBS in cities, he showed concern about potential future dependencies. He believed that we cannot only depend on the *smartcity*, as it is not a panacea for all urban sustainability challenges, and there must be constant work on people's perceptions and awareness.

## Place-based factors

*Built environment*

The infrastructure and structural context of cities was considered a key element to take into account, as it determines the possibilities for GI and NBS development. Moreover, aspects like population density in cities and the average use of public spaces was also pointed out as a decisive factor.

Int. (4) stressed Barcelona is a very compact city, which limits the feasibility to realise certain NBS. For this, the city needs to develop alternative greening approaches that seize opportunities within the existent built environment, for which green roofs represent a great alternative. As a note on the example of green roofs, however, Int. (7) pointed out the fact that it is usually much easier to implement NBS in new buildings due to new construction regulations than to adapt NBS into old buildings through rehabilitation, due to potential structural problems, e.g. the lack of structural support for vertical gardens or green roofs, as well as the absence of guidelines in policies and regulations ensuring available space and structural support for these types of interventions.

In addition to the indication of a city's built environment as a limiting factor, the average use of public spaces was pointed as a determining factor by Int. (9) at the municipality of Vitoria. Depending on public use, there are more or less chances to carry out certain types of GI, as well as to install NBS. The interviewee explained how in Vitoria there is not an exaggerate use of parks, which allows the municipality to advance more wildering or naturalisation practices than in more dense cities like Madrid, where users demand more man-controlled nature. This points out to the fact that not only the city's geographical size matters in NBS implementation, but also population density and green space use.

On another point, in Spain, city size matters in capacity building for NBS development and diffusion in terms of the availability of resources, information sharing and the availability of platforms connecting stakeholders. Cities like Madrid or Barcelona have consolidated networks which bring together a variety of stakeholders, whilst smaller cities like Zaragoza or Vitoria do not.

#### *Natural processes and endowments*

NBS have to comprehend and adapt to local conditions in regards to climate, soil, flora and fauna if they aim to become real place-based solutions, and not mere transfers of green innovation. In this regard, Int. (5), (9) and (15) expressed the need to acknowledge and spread awareness that green areas will not be green all year round in most cities in Spain, and instead, they will be more yellowish, as the country mostly hosts a Mediterranean climate and vegetation. Although it might sound redundant, culturally, Spanish people expects to find very neat green GI in cities, which often entails the intense use of unsustainable irrigation systems. Furthermore, Int. (4) stressed how local climatic conditions affect NBS development from a technical perspective.

*"A green roof in Barcelona is not the same as a green roof in Utrecht". (Int. 4)*

Thus, a country with diverse weather patterns and natural conditions like Spain calls for more comprehensive interventions, avoiding the replication of NBS if unfit to the context.

It was observed that environmental stresses and hazards related to climate change derive in a feeling of urgency for action through NBS. For instance, Int. (4) pointed to the need for a multifunctional GI given environmental stresses but also societal preferences.

*"We need a type of green that provides us with ecosystem services, comfort, shadow - given the amount of sunlight and the heat island effect, and which are resistant to climate change and to new plagues." (Int. 4)*

Moreover, Int. (5) stressed the urgency to act through NBS as a response to intense climate conditions of Spanish cities, where the focus is put on adapting GI to extreme temperatures and to provide shadow due to severe and even dangerous sunlight during spring and summer seasons.

Also in regards to health, Int. (8), from Zaragoza's municipality, pointed out the increasing rates of cancers and skin and respiratory diseases related to environmental issues in cities, such as low air and water quality. In this context, he believes that NBS can work as a strong lever to spread awareness among city dwellers and to activate change towards improving health and wellbeing. Int. (4) shared a similar argument, and further recognised that many parks with native plant species are providing very positive functions for the ecosystem and biodiversity, also pointing to the *naturalisation* approach to urban greening in Barcelona.

#### *Societal Processes*

The consideration of socio-economic changes in cities was exemplified by Int. (2), who, when explaining how the urbanism department in Madrid is responsible of drafting urban plans, mentioned how the urbanism department carefully addresses social and economic vulnerabilities of neighbourhoods in their plans to contribute to urban socio-economic justice and welfare, and how they incorporated climatic vulnerability too when the climate change department brought the issue to the table.

Interviewees also pointed at the appearance of problematic social dynamics linked to innovative urban greening. In this regard, Int. (1) showed concern about the wave of new requirements for NBS integration in urbanism plans, as these can act as a double-edged sword. On the one hand, these requirements can result in the development of well-operating multi-functional NBS contributing to climate adaptation. Whilst on the other, they might generate societal problems such as ecological gentrification, in which the provision of green infrastructure increases housing prices which attracts wealthier residents and forces displacement of previous neighbours, as it occurred with the vertical forest in Milan, according to Int. (1). Nevertheless, these types of social problems related to unequal distribution of wealth can be avoided by, e.g. assigning some floors of new buildings to social housing. And as mentioned above, NBS can be applied to contribute to the empowerment of socially and economically vulnerable groups. In fact, Int. (8) shared the example of the regeneration of an inside patio of social housing buildings in Zaragoza which was turned into a green area through a participatory process involving the neighbours with the collaboration of social workers.

### Cultural frames of reference

In regards to the alignment of NBS with place-specific shared norms, practices and attitudes, interviewees touched upon different aspects such as: people's attitudes towards urban nature and sense of urgency for climate adaptation measures; place-based practices and conventions affecting GI and NBS development; conventions at the workplace affecting attitudes towards

incorporating NBS; prejudices about public-private collaborations; and aesthetic preferences and expectations of urban greening and biodiversity increase.

Int. (1) indicated that society always leans towards these types of solutions following the theory of biophilia, which explains human's appreciation of nature from a genetics perspective. In addition, as mentioned above, many interviewees noted that the sense of urgency, particularly in relation to increasing temperatures and intensity of the heat-island-effect, but also in regards to the levels of air pollution, for instance in Madrid, have activated a change of attitude among many stakeholders towards acting against these perceived threats.

Place-based conventions were deemed important determinants for NBS diffusion, since they affect public opinion, which permeates in political decision-making. For example, Int. (17) gave the example of how people's expectations of green spaces affect decision making in urban planning. In Valencia, political decision-making is reactive to salient topics in the media, which, to some extent, reflect citizens' opinions. According to the interviewee, people in Valencia value the increase of green spaces not from its capacity to generate ecosystem benefits or capture CO2, but from the associated healthy activities that the space allows, precisely because running is a highly appreciated activity, almost regarded as a shared value among citizens, and this has political implications in terms of gaining support for the development of green areas.

Some conventions at the workplace were also said to be affecting NBS uptake. For instance, Int. (17) explained that, at municipalities, those who have been working for longer in urbanism departments at do not incorporate NBS because they follow a tendency to reproduce what has already been done, something highlighted by other interviewees too. Whilst, on the contrary, new technicians are more prone to innovate and to try with NBS. In this line, Int. (1) pointed at the ongoing change in the urbanism paradigm from a merely economic one, characteristic of both 19$^{th}$ and 20$^{th}$ century.

Int. (12) touched upon factors such as trust in government when collaborating with the private sector. The interviewee pointed at prevailing prejudices in regards to public-private collaborations and about capital gains in green infrastructure projects.

*"People think that generating benefit entails that someone is taking advantages over someone else, and fear speculative behaviours. But public-private collaboration is desirable provided that it is applied for the generating impactful NBS." (Int. 12)*

Another problematic point has to do with aesthetic preferences in green spaces. Although already mentioned under discourse and vision, it is worth to bring back Int. (13)'s explanation of how nowadays it is a challenge to prioritise ecological functions to ornamental and landscape preferences. Citizens demand aesthetics, cultural and spiritual experiences and joy from green spaces and prioritise these to functions of pollination, or climate regulation.

*"A neighbour has difficulties comprehending the benefits of developing a green space that absorbs torrential rain or impedes erosion phenomena" (Int. 13)*

In addition, Int. (13) expressed how to live together with biodiversity entails renouncing to certain conventions, and some revision of social norms, for instance, in regards to cohabiting with insects in urban areas.

## 4.2 Findings outside of the NBIS framework

### Market Formation

Considering that so far little attention has been paid to the role of private actors within NBIS in the NBS literature, the researcher decided to explore the potential of private actors to contribute to urban NBS development and diffusion, using the case study of Spain. Given that most private actors innovating with NBS fall under the category of SMEs and acknowledging that currently these are only able to operate in market niches heavily supported by public finance, as reminded by Int. (1), interviewees were asked about the relevance of mainstreaming NBS through the market, and about the potential role of more private actors, including SMEs, to participate in a market for NBS.

Interviewees spoke about the desirability and possibility of forming market, and the extent to which the increased participation of private actors would contribute to increasing the development and diffusion of NBS, which would affect their mainstreaming. Furthermore, they stressed the potential of SMEs to promote and support NBI systems, with some speaking about the added values of ecopreneurs and the relevance of business models in capturing value creation.

#### The Spanish Context

For a market to exist, as explained by Int. (15), three elements are necessary: offer, demand and a normalised and relatively regulated relationship between offer and demand. At the moment, offer is very limited in Spain, there begins to be some demand, and the relationship between the current offer and demand is not normalised and, what is more, the existent regulation is extremely limited for now. Therefore, according to Int. (4) and (15), the market for NBS is in an incipient stage in Spain, although some NBS developers are starting to compete. However, as touched upon earlier, NBS are not yet standardised, and knowledge has yet to permeate in policy and legislations in order to have the PA demanding these types of sustainable and multifunctional GI. Nevertheless, many begin to discern opportunities, just as Int. (5) at the municipality of Barcelona, who believes that a whole latent collaborative economy in between the PA and the private sector is not being explored.

Most interviewees believed that a time in which NBS developers do not have to depend on public support will come, and thus, a functioning market will exist for NBS. For example, Int. (1) expressed his belief that a moment will come in which there will not be a need to rely on grants and subsidies, and SMEs will be able to compete on NBS through the market. But he also stressed that it will take time. For Int. (1) both the present absence of content on NBS in universities as well as the fact that NBS interventions require interdisciplinary work are delaying this market formation. Others, like Int. (14), belief that it will come but only after convincing municipal technicians and some politicians.

#### Conditions to generate demand

In fact, as explained in the *Municipalities* section (*Leadership and Power & Commitment*), most of the NBS taking place in the urban areas are majorly product of municipalities, with only around a 10% happening in private constructions. Thus, Int. (1) explained how it is crucial that the municipality demands NBS in its projects, for which relevant municipal departments have to

be acquainted with the co-benefits of integrating NBS in their projects. The municipality has to demand NBS but also generate that demand in other urban actors, to drive the market formation. In this regard, Int. (10), from *Tecnalia* (research and innovation technology firm), agreed on the importance of the market, but doubted that it will be the main driver of the GI transformation. In her belief, PA must invest in NBS to accelerate the transition towards the green city provided they comprehend NBS functions and their cost-effectiveness compared to grey solutions (due to co-benefits). Then, the PA must integrate NBS in policy and regulatory standards (See *Legislation and Policies*) to ensure favourable conditions for NBS uptake.

Int. (10) also pointed out the present lack of global standards for NBS which to some extent impedes the generation of a competitive market. However, the interviewee also indicated that steps are being taken to create a global standard to be able to compare by the IUCN (*International Union for Conservation of Nature*) and the European Commission is accepting some basic indicators to generate common criteria too.

*"That's how markets are formed, generating conditions for their creation." (Int. 5)*

Apart from ensuring favourable conditions through regulation, other interviewees pointed at the importance of incentives to motivate market formation. A clear example is that of green roof subsidies in Barcelona, shared by Int. (4), which aimed to generate demand via motivating consumers. However, many were cautious of subsidies. In this sense, Int. (6) critically stated that,

"*If we let it all [NBS] depend on public subsidies, we are on the wrong path because we won't transform the current state." (Int. 6)*

Thus, there is a perception that the overdependency on subsidies is detrimental to mainstreaming NBS. In this regard, Int. (3) stated the need to incentivise the transformation but also to withdraw the incentive.

For Int. (15) the most efficient way to accelerate NBS uptake is to first normalise NBS within the market before diving into regulation and grants. Most importantly for them,

*"NBS should be increasingly promoted as beneficial alternatives to grey solutions which must be tested by architects and engineers' associations, following some established technical rules." (Int. 15)*

Furthermore, others like Int. (1) and (6) pointed at the current changes in consumer demand as key to push firms to incorporate more sustainable solutions, including NBS. It is worth reminding that not only individuals but also other private firms and entities can become consumers of NBS. For example, Int. (7) and (11) indicated the growing demand for functional green spaces from offices and hotels to have functional green spaces.

### Potential MF for NBS

The present need to transfer knowledge on NBS to public institutions as well as private entities was perceived by some interviewees as an opportunity for market formation. For instance. Int. (1) visualised an opportunity for consultancies to disseminate knowledge and deliver trainings on NBS in municipalities, knowledge institutions (e.g. universities) and private entities. One of their crucial roles would be to demonstrate clients that GI is not only aesthetic, and that NBS

can achieve energy savings in the long-term, as well as other resources, according to Int. (6). Furthermore, Int. (13) stressed the potential for firms to train and educate on the values of NBS as well as functional GI (generation of ecosystem services, biodiversity and health increase, etc).

Aside from working with NBS knowledge, (Int. 2) indicated that environmental consultancies and mediators could also play a role as boundary spanners, employing their bridging capabilities and skills to work on integrated project management. Int. (3) from *Soulsight* (consulting and strategic design firm) believed that firms like theirs have the potential to accelerate and dynamize market processes, including the development and diffusion of NBS. Big firms (their main clients) trust their advice and they have the chance to influence their business strategies. Moreover, through their initiatives, they promote new ways of working towards resetting the mindsets and improving the motivation of individuals to influence their teams, ultimately affecting the working culture. In fact, they argued that without highly motivated teams that find purpose in their job, sustainable solutions are difficult to attain.

Int. (5) pointed at those firms that can collaborate in the design and implementation of the city's ecology, such as landscape designers, specialised biologists or even firms involved in gardening (e.g. wild-seed providers). Also, renewable energy companies, which, as stated by Int. (7), will shortly start to incorporate GI within their photovoltaic installations to improve aesthetics and generate co-benefits. Furthermore, Int. (7) also pointed at a growing market in developing small NBS in existing buildings, in which he believes small firms are more fitted to do the job. Moreover, Int. (1) also indicated a great opportunity for emerging SMEs dedicated to '*R + D + I + d'* projects (Research, Development, Innovation and diffusion) in the field of GI and NBS, whose innovation are being increasingly demanded. Yet importantly, Int. (3) stressed that in order for firms not doing NBS to decide to get involved in the NBS market, there will be a need for so-called 'ambassadors', similar firms or firms from the same sector which decide to take the first steps to participate in the market, whether as offerees or as customers of NBS.

### A market for NBS already under way

Some interviewees believed that, to an extent, a market for NBS is already being formed. Not only with the participation of NBS developers and clients, but many other stakeholders that intervene (more or less directly) in processes of NBS development and diffusion.

Int. (1) indicated that consultancies, researchers, universities and many municipal workers who participate at the *FEMP* (*Spanish Federation of Municipalities and Provinces*) are already on board. Similarly, Int. (14) pointed at firms involved in commitment groups such as the Spanish Landscape Engineering Association, the Iberian Center of Pluvial Restoration or the Spanish shared the example of an urban furniture and equipment firm who is integrating green to their products. He also indicated the role of a few architecture studios, and thermal and water insolation developers which are now working on green roofs. *Naturalea* (Int. 14), who realises bioengineering, landscape engineering and ecosystem restoration, started to operate at the urban level a few years ago and developed NBS like their 'fiber-rolls' to green existing infrastructures. Int. (5) also exhibited the current work of SMEs co-working for a project to increase biodiversity from Barcelona's tree grates. These were specialised in three different areas: wild seeds and planting, biological control and landscape engineering.

On a different field, *Eco@csa* (Int. 15) is currently working on dissemination and diffusion of greening for biodiversity increase, bridging tendencies and firms. Also, in terms of bridging organisations, *ECODES* (Int. 12) and *Foretica* (mentioned by Int. 3) work on practice-oriented research, dissemination and awareness, but mainly advise and lobby for ecology and sustainability, and are starting to promote an increase in GI and NBS uptake.

Int. (15) briefly commented that big infrastructural development companies like *SUEZ*, *Ferrovial* and *Acciona* have also started to undertake NBS, but only carrying out disperse actions, as it is not their business focus. In this regard, Int. (15) explained that, in many cases, big construction and engineering firms are searching for distinctive elements like NBS to improve their market positioning, acknowledging that greening tendencies are here to stay.

Notably, a few firms not so intuitively related to NBS were said to be contributing to a market formation for NBS. For instance, Int. (2) highlighted the performance of *GEA21*, *Improvistos* and *Dark Matter* in EU funded collaborative projects, and explained the crucial role of these integrated project management firms can play to indirectly accelerate NBS uptake as they focus on changing modes of working and dynamizing organisational processes through efficient coordination and communication, thus, having transformational impacts that improve business performances.

Association for Public Parks and Gardens, in which professionals are taking steps too. Int. (11)

### Momentum

Urban infrastructure stakeholders were said to be progressively increasing the demand for green solutions over grey ones as they begin to understand the advantages of NBS, as stated by Int. (14). Also, opportunity costs associated with carrying out NBS were highlighted. Int. (15) explained how in conversations with GI development firms these pointed that NBS might not be cheaper than more traditional GI, but the opportunity costs of NBS make them interesting from a business perspective.

*"The costs you generate when anticipating future events by installing NBS mean that future costs may be lower." (Int. 15)*

From a socio-economic approach, Int. (5) highlighted with certainty that such market formation could generate many qualified job opportunities, which would contribute to tackle unemployment in Spain. He stressed that a lot of new technical positions could be created around the provision of environmental services for cities, for instance, having more firms monitoring urban NBS and generating data of their contribution to biodiversity increase. He believed that this would allow many entrepreneurs to contribute to this NBS market.

Last but not least, Int. (12) and (15) pointed out their believe that the current social distress provoked by the impact of the Covid 19 generates momentum for the diffusion and improvement of GI, including NBS. They stressed how, in Spain, after (at that time) almost two months of confinement, citizens are more aware of the value of green spaces and will demand more proximity to green infrastructure.

Nevertheless, a few limitations were also indicated. One aspect that Int. (13) pointed out is that most of the results from NBS monitoring and evaluation funded by EU research and innovation projects are not yet permeating in the work of GI developers. For which it will take time until

developers have enough confidence to implement innovative NBS. Furthermore, when asked about factors that hinder the mainstreaming of NBS, the same interviewee pointed to business-as-usual as the most decelerating aspect.

*"Those who keep thinking that we can keep living with these levels of pollution, that we can only give aesthetic uses to biodiversity… many decision-makers follow the growth logic, which I believe decelerates this transition. But I don't believe they will last long." (Int. 13)*

Regulatory limitations were also presented in relation to involving food-producing firms to the NBS market formation. For instance, Int. (7) explained that in Spain it is impossible to have productive urban NBS because, if a firm wanted to install a green roof in Barcelona which in addition produced something marketable (e.g. vegetables or honey), it cannot because it is simply forbidden by urban health and safety legislation. Entities can only install productive urban NBS provided that they are a social enterprise or an NGO.

Last but not least, Int. (7) mentioned the difficulty associated to assigning a monetary value to some of the more indirect and collective benefits from NBS, also highlighted as an obstacle to engaging the private sector, which usually looks for short-term benefits. Int. (6) stated how it is difficult to form a market because many firms will not acknowledge other benefits than the "responsible" corporate image.

### *SMEs: potential in supporting nature-based innovation systems*

*"When we began 25 years ago, there wasn't market for us. It is a fact that things are changing, and if we exist it is because there is a market allowing, I mean, we are creating that market too. Otherwise, if people weren't interested in what we offer, they wouldn't call." (Int. 14)*

Interviewees were asked about the extent to which SMEs are investing and supporting NBS mainstreaming through development and diffusion. As a response, a series of points were highlighted indicating different positive aspects in regards to SMEs' capacities and characteristics for supporting and contributing to mainstreaming through the market.

Firstly, Int. (13) stressed that overall, SMEs possess more innovative capacity than big firms. Moreover, Int. (4) stressed that innovative SMEs work as pioneers who open the way to other SMEs and big firms. They make innovation credible for bigger actors to integrate it after. Int. (14) stressed that, contrary to big firms, generally it is easier for SMEs to take risks and think and work differently, although, of course, there are SMEs that replicate what big firms do but in a smaller scale. In this line, Int. (5), (13) and (15) expressed that SMEs' participation is truly useful when they offer a highly specific service, idea or knowledge which has value alone or works as catalyser for other elements. Their continuous disruption, which they need to maintain in order to stay in markets of their interest, was perceived as an advantage. Examples are firms developing small-scale horticultural gardens, recycled sods, vertical gardens or green roofs (Int. 1, 14 and 16). Also, small consultancies as well as small firms that develop SUDS or urban furniture and equipment were said to be participating in the NBS market, following Int. (13).

Secondly, smaller firms have it easier to adapt to new necessities and unexpected problems, according to Int. (6). In terms of adaptability, Int. (13) gave an example explaining that when the European Commission gives indication about new pathways and the route that finance is going

to take, SMEs, like *Creando Redes*, can adapt much easily to the requirements than a big firm. According to Int. (15), SMEs do not have inertias, which allows them to change and adapt their business models and generate new products and services, compared to well-established firms. Additionally, Int. (15) briefly stressed that SMEs are able to break with the issue of liquidity. Therefore, Int. (15), as an economist, predicted a positive future for SMEs precisely because, although they generally do not have abundant financial resources, they do not have the inertias that characterise big firms.

Thirdly, SMEs ability to learn and apply new knowledge more rapidly was also highlighted by Int. (13) among others. Moreover, Int. (13) explained how they have the capacity to collaborate closely with scientists and research groups due to their personal links to academia. In this line, not only there are examples of SMEs working closely with academia, but also freelancer academics which function as an SME, and who work with NBS, like Int. (1) himself.

Fourthly, the trust-building component of SMEs was also mentioned as a key element compared to big firms. Int. (17) explained how SMEs are more capable of generating trust in their partners and customers. Providing the example of *Paisaje Transversal* (Int. 17) which focuses on participatory processes, the interviewee explained how their firm has a very ethical approach in which they deeply believe, and explained this is precisely why they get hired. They are able to convey real trust in their partners and the citizens with who they work. Something which according to the interviewee is very difficult for big firms to accomplish because of two reasons: First, because whoever does the job is an employee, and although these can also be highly committed professionals, it is unlikely that the project partners meet the boss personally, meaning that they rarely establish a close relationship and, moreover, in the moment that resources are short, they do not hesitate to take rough decisions; Secondly, big firms cannot run participatory processes because the citizenship does not trust them in this domain, whilst individuals in SMEs evoke more trust.

Fifth, the role of design studios like *Elii* (Int. 16) was highlighted too. They go beyond architectural design and use strategic design to innovate from an aesthetical and experiential standpoint. In this sense, they design specific technologies, which could be NBS, but also methodologies and strategies. For instance, improving efficiency through the design of alternative and attractive pathways for stakeholders, or designing spaces which stimulate people's affection for nature in the city.

*"Design can achieve desirable formulas, in other words, that sustainability stops being considered a punishment, something we have to deal with like a problem, and instead turn it into a wish." (Int. 16)*

Nevertheless, because SMEs are smaller players in larger systems, interviewees also pointed out limitations and/or dependencies. For instance, Int. (17) explained that unless society and local entities (municipalities) want their product, it becomes difficult for specialised SMEs to succeed in the market. For this reason, following Int. (17), SMEs constantly have to search for innovative social niches, or find private industrial zones willing to upgrade and integration their innovation. Here, the interviewee stressed that nowadays, Spain is not a country whose private sector invests much in infrastructural innovation. Moreover, SMEs' need for certainty was also pointed throughout the results section. Int. (10) explained how when they collaborate with the public

sector, SMEs need certainties about the demand of NBS by municipalities, for which it is imperative that NBS get integrated in plans and strategies, so when municipal technicians draft public procurement contracts, they can choose a specialised firm to realise a particular NBS (e.g. vertical gardens), instead of relying on public tender which would attract more generalist firms.

In fact, in regards to SMEs working in the public space, problems related with the application of the Spanish Public Procurement Law (Ley 9/2017) were perceived to be detrimental to SMEs participation in public projects, at times affecting SMEs capacity to get involved in urban NBS projects taking place in the public space (See *Annex 1 – Public Procurement Law)*. In this context, whilst policy-makers work to generate demand from the public sector, Int. (10) suggested that big development firms, e.g. *Acciona* or *Ferrovial,* can become a great opportunity for SMEs through outsourcing, since big firms are important drivers of the market.

### Ecopreneurs

As an interesting point, when asked about the potential relevance of ecopreneurs in the context of generating market for NBS, interviewees shared a few positive insights. According to Int. (10), ecopreneurs cover aspects of technology, circular economy and society. The interviewee believed they could definitely gain access to the NBS market since they specialise on fields like public participation, democratisation of processes as well as the development of ecological and ethical products. In this regard, Int. (13) believed that *Ecopreneurship* is here to stay, as many start-ups are now born with the ecological and social-justice principles. For instance, she explained how many little brands are selling products created with recycled materials, and in this way, they become competitors of traditional firms.

Also, the fact that ecopreneurs emphasise the social and ecological objectives over the profit, was perceived as an advantage in regards to participating in the NBS market by Int. (5). Firstly, due to current low salaries in the public GI sector. And secondly, because the Public Procurement Law facilitates the contracting of firms from the third sector, e.g. social entrepreneurs, and could in some cases involve ecopreneurs too. Moreover, Int. (13) stressed that firms like theirs (*Creando Redes*) or *Paisaje Transversal*, which she considers to be ecopreneurs, are not involved in the green and participation sector for the money, as these are not high-remunerated sectors. Instead, she explained that their commitment to contribute to major ecological and social purposes is at the core of their work, for which at times they have sacrificed more time and effort just to get the best result, going beyond schedules.

Int. (14) also considered themselves ecopreneurs, and explained that finding the balance between the ethics and profit was relatively easy for them. He explained how their salary is set, and even if they all of a sudden have a very prosperous period, they earn the same. Their objective is to keep the business running, in order to realise more greening projects. Here, they stressed that if for an unexpected reason a project ceases to be profitable but they nonetheless manage to finish the project perfectly, they will feel much more realised and also customers will value that commitment in the future. Moreover, they said to be following the philosophy of the "common good", meaning that this should be the driver of business operations, and they staunchly believe that not only governments and NGOs, but also SMEs can change the planet if their main objective is to execute a good project and not so much to generate benefits.

Nevertheless, in the GI and NBS field, the role is again restricted to the extent to which the public sector demands their services.

*"They (ecopreneurs) must follow a parallel process to that of the PA. They are not, nor will they be the drivers of a market formation." (Int. 10)*

### Business Models

In aiming to boost the development of a market for NBS, interviewees stressed the need to find ways in which to generate revenue from NBS. Following Int. (11), such revenue does not have to be direct as it can also come indirectly through marketing or other business strategies. Int. (11) expressed that to engage the private sector, it is imperative for them to clearly see the economic returns that the field can offer. In this regard, both Int. (11) and (15) pointed at the need for clear business models (BMs).

Some of the interviewees, like Int. (6), currently follow **a** traditional BM, with no long-term returns overtime: first, they develop a product (a research paper, a plan or an educative programme); then, they deliver it to the customer; and finally, they get remunerated. However, they were confident about the chance to incorporate the work with collaborators as part of their BM in order to participate in the NBS market, e.g. a local gardening firm or landscape engineers specialised in local ecosystem and climate.

In addition, it was previously mentioned how the present lack of knowledge can be used as an opportunity for knowledge-based firms. In this line, Int. (8) and (15) stated that NBS uptake could be boosted if firms manage to express well the value proposition associated to NBS in their BMs, as it is known that NBS have added values compared to traditional GI due to their co-benefits.

In terms of changing or adapting BMs for increasing NBS offer, the interviewees at *Soulsight* (Int. 3), who also work on BMs as part of their strategic design services, showed concern about having customers asking for their services for fear of getting obsolete or losing customers. Here they discerned in between firms which just want fast fixes for survival and firms which really aim to undertake a cultural transformation within in pursue of new long-term objectives, which then comes with a new BM.

Int (10) stressed the need for a BM focused on the whole intervention and not the product alone. A current example of a model with these characteristics, she explained, is the *Canvas business model*, which could serve as a guide to develop other BMs for nature-based innovation. From a broader perspective, she also referred to the existence of a list of cities which work with different modes of financing for NBS (e.g. through PPP, EU or investment banks), resembling Helen Toxopeus's *Finance and Business Models Catalogue for Urban NBS* within the *EU Naturvation* project (Toxopeus, 2019).

# 5. Discussion

## 5.1 Scientific implications of findings

The findings section presented the analysed data retrieved from the interviews. In the first block, *Findings under the NBIS framework,* findings were presented after the analysis of the data through the dimensions and sub-categories of the NBIS, and they were systematically presented under the same headings, with small variations. Numerous insights were shared by the interviewees that served to validate the analytical power of the NBIS framework.

Being the first study to apply the NBIS framework to practice, the framework was proved valid and helpful in analysing the development and diffusion of NBS in Spanish cities. As it was seen in the *Findings within the NBIS framework section*, data was present to fit all of the framework's dimensions, with some of the sub-categories more touched upon than others, mainly due to the primary focus of the research which translated in the interview questions.

As stated in the research objective, the NBIS framework was used to study the role of SMEs in the development and diffusion of NBS in cities, to help understand their potential contribution towards mainstreaming NBS in cities. Such input was helpful as the analysis through the lenses of the NBIS framework shed light on how the different actors and structures of NBS systems function in Spain. These actors and structures encompassed a variety of aspects influencing the development and diffusion of NBS, with many of them touching upon the current role of SMEs in these systems, their existent, but limited potential in promoting, facilitating and supporting NBIS, but most importantly speaking about the opportunities and barriers of SMEs to support NBI systems in Spain, which as a result speak about SMEs' capacity to contribute towards NBS mainstreaming.

Nevertheless, on a practical issue, the distribution of findings under some of the sub-categories within the framework's dimensions became problematic during the analytical process. In this regard, the researcher encountered difficulties when trying to categorise data under the sub-categories of *Leadership and power* and *Commitment*. The theoretical distinction between these two was made clear by van der Jagt et al. (2020). In practice, however, insights and facts which categorised under *Leadership and power* mostly happened to be examples of stakeholder's commitment too, and vice versa. The researcher finally decided to merge these sub-categories into one in order to ease the analytical process.

### *A market formation dimension for NBIS*

In the theoretical framework, it was argued that studying processes of market formation could be helpful in investigating NBS diffusion and development, as they represent the stage along which new markets appear for innovation. Furthermore, its use was pointed to be of particular interest as it could explain the underexplored potential of private actors to contribute to the development and diffusion of NBS. In practice, not only it spoke about private potential alone, but it also revealed the relationships between private and public actors through regulation and the presence or absence of favourable conditions to generate market for NBS.

Indeed, the inclusion of the category of market formation for the data analysis proved beneficial, as it gathered rich information about drivers and barriers to NBS development and diffusion and also informed about the specific contribution of diverse private actors.

In this regard, van der Jagt et al. (2020) expressed that the NBIS framework can indirectly incorporate signals of market formation processes, under different dimensions. According to the results, this proves right. However, having a dimension of its own would allow to explore market formation processes in more detail, for instance exploring demand, supply, user preference, or the presence or absence of supportive regulation between supply and demand, and the specificness of a diverse private sector which can contribute to develop and diffuse NBS in a variety of known, but also yet unexplored ways (as observed in the findings on SMEs). In this regard, the study of different professional sectors currently involved in NBS development and diffusion is enabled, but also the potential inclusion of alternative sectors, such as firms working on integrated project management, working cultures and coordination to improve business performance and orientation.

## *5.2 Social Implications*

Following the findings, currently SMEs involved in the NBS field are investing in mainstreaming NBS, in terms that they are developing and diffusing and disseminating knowledge of- NBS. Moreover, other SMEs and bigger firms which are not yet involved in NBS are starting to show interest, according to the interviewees, as they see visualise and emerging field.

In regards to the potential role of SMEs in promoting/facilitating/supporting NBI systems (sub-question 2), a variety of factors were highlighted.

Firstly, concordant with the theory section, SMEs were pointed to have a strong innovative and adaptive capacity, compared to the lack of organisational and financial inertias of bigger firms. In this regard, examples of SMEs developing innovative cost-effect NBS points to their potential to promote NBS as profitable and competitive innovations. Besides, their ability to learn and apply knowledge rapidly was highlighted too, as well as the trust-building component that some SMEs possess, allowing them to evoke more trust and closeness to their clients than bigger entities (especially in the case of firms running participatory processes). Lastly, an agreed cross-cutting factor that makes SMEs important agents in promoting/facilitating/supporting is their ability to provide specialised services and/or knowledge. Moreover, the findings provided evidence of the proactive roles that SMEs can play within actor networks, as most of the mentioned interventions which involved SMEs happened via collaborative arrangements, as in all the aforementioned EU research and innovation projects. In regards to NBS development and diffusion, SMEs can work as mediators, coordinators, developers, designers, disseminators and consultants, among other roles.

However, as explained by several interviewees, although their role can be relevant in specific service delivery and innovation, they are majorly dependant on the PA. If municipalities do not demand their work, their potential becomes very limited since most of the GI and NBS interventions occur in the public space.

In the theoretical framework is was stressed how SMEs play a key role in innovation and market formation processes (Boons et al., 2013; Burch et al., 2016; Hockerts & Wüstenhagen, 2010; Schaltegger & Wagner, 2011). This aspect was confirmed by the interviewees, some of which even shared examples indicating that a market is already being formed.

### *Future directions of research*

Further studies on the potential role of SMEs might contribute to discern more opportunities for their involvement in NBIS. Moreover, research on NBIS and the role of the private sector could be highly beneficial to explore new paths in which to mainstream NBS in cities. In regards to the use of the NBIS framework, as stated above, this is the first study applying it to practice. The framework represents a great tool which was very helpful for the analysis of this research. For this reason, it is recommended that more empirical cases get analysed with it. This would help refine the framework whilst enriching new studies. Lastly, research in some of the topics encountered during the development of this investigation would be desirable in order to increase the pathways towards mainstreaming NBS in cities, such as:

- Research on the role of ecopreneurs within NBIS in changing stakeholders' scale of values.
- Research on the role of philanthropy in financing the development of NBS projects as an add on to interventions occurring through public procurement and private interventions.
- Research on the role of design, aesthetics, emotion, affection and health as key factors to increase acceptance and support for NBS in cities.

## *6. Conclusion*

This research explored the potential of SMEs towards mainstreaming NBS in cities. The generation of knowledge on the role that SMEs could play in mainstreaming NBS contributes to

creating a wider vision of the factors enabling or impeding the spread of these innovations, thus also adding to the functionality of the NBIS framework. The theoretical framework provided the basis supporting the claim that SMEs can play an important role in market formation processes towards mainstreaming innovation. However, evidence was lacking in regards to the role of SMEs in the NBS domain.

Following the findings, the potential of SMEs to innovate and adapt as introduced in the theory, was confirmed in the NBS domain too. In fact, SMEs are able to innovate in technologies, but also methodologies. In regards to their adaptiveness, it was highlighted how SMEs are more flexible than bigger firms.

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## *Appendix 1 – Extended list of interviewees*

| Int. | Name of organisation | Organisation typology | Name of Interviewee(s)* | Website |
|---|---|---|---|---|
| 1 | Landscape Engineering and Planning S.L.; Universidad Politécnica de Madrid (UPM). | Freelance advisor; Academic | Pedro Calaza Martínez | N/A; https://www.montes.upm.es |
| 2 | Climate Change Department. D.G. Sustainability and Environmental Control.<br><br>Environment and Mobility Area. Municipality of Madrid | Municipality | Luis Tejero & Rafael Ruiz López De la Cova | https://www.madrid.es/portales/munimadrid/es/Inicio/Medio-ambiente/Energia-y-cambio-climatico?vgnextfmt=default&vgnextoid=0ca36936042fc310VgnVCM1000000b205a0aRCRD&vgnextchannel=3edd31d3b28fe410VgnVCM1000000b205a0aRCRD |
| 3 | Soulsight | Consultancy and Strategic Design (SME) | Leonor Ruiz Posada & Santiago Fernández | https://soulsight.es/?lang=en |

| | | | | |
|---|---|---|---|---|
| 4 | Directorate of Green Spaces and Biodiversity. Ecology, Urban Planning, Infrastructures and Mobility. Municipality of Barcelona. | Municipality | Marga Parés | https://ajuntament.barcelona.cat/ecologiaurbana |
| 5 | Directorate of Conservation. Urban Ecology. Municipality of Barcelona. | Municipality | Gabino Carballo | |
| 6 | Anthesis Lavola | Sustainability consultants (Big Firm) | N/A | https://www.lavola.com/ |
| 7 | Barcelona Regional – Urban Development Agency | Public Agency for strategic planning, urbanism and infrastructure development | Marc Montlleó | https://www.bcnregional.com/ca/ |
| 8 | Zaragoza Vivienda. Urban rehabilitations, built environment and urbanisation - Municipality of Zaragoza | Municipal Agency | Eduardo Dallo | https://www.zaragozavivienda.es/#gsc.tab=0 |
| 9 | CEA -Municipality of Vitoria | Municipality | Blanca Marañón | https://www.vitoria-gasteiz.org/we001/was/we001Action.do?idioma=es&accion=cea&accionWe001=ficha |
| 10 | Tecnalia | Research and Innovation - Technological development (Big Firm) | Gemma García | https://www.tecnalia.com/en/ |

| | | | | |
|---|---|---|---|---|
| 11 | Bioo | Research and development – Technological Development and Education | Pablo Vidarte | https://www.biootech.com/ |
| 12 | Ecodes | Foundation & Advisory body – Ecology and Development | Sergio García Pérez | https://ecodes.org/ |
| 13 | Creando Redes | Natural capital restoration & environmental consulting | Ana Méndez | https://creandoredes.es/ |
| 14 | Naturalea | Soil engineering and landscape; Executive solutions and consulting | Albert Sorolla & Salut Ribera | http://www.naturalea.eu/en/home/ |
| 15 | Eco@csa & UPM (Universidad Politécnica de Madrid) | Dissemination and innovation on natural capital and biodiversity | Carmen Avilés & David Álvarez | https://ecoacsa.com/ |
| 16 | Elii | Architecture and Design Studio (3 freelancers working as an SME) | NA | http://elii.es/en/projects2/ |
| 17 | Paisaje Transversal | Integrated Urban Planification & Participatory processes | NA | https://paisajetransversal.com/ |

*Extended list of interviewees, including interviewee number, name of the organisation, name of the interviewee and their corresponding websites.*

**Some interviewees preferred to stay anonymous, for which only the name of their organisation is in the table.*

## *Annex 1– Public Procurement Law 9/2017*

To better understand how the public procurement law (Ley 9/2017) can become problematic for specialised SMEs willing to get involved in public works, the following information was gathered in between information shared by Int. (2), (5) and (13) as well as an exhaustive analysis of the Spanish public procurement law, legally known as Law 9/2017 of November 8th which transpose EU Directives 2014/23/EU and 2014/24/EU of February 2014 to the Spanish legal system.

There are three types of public procurement according to the project's volume:

- Up to €15,000, it is a directly assigned contract or *minor*. A firm speaks to the municipality, or vice versa and both agree on collaborating straight away.
- From €15,000 to €60,000, three firms are pre-selected and the public administration publishes certain technical and administrative specifications that must be met. Whoever scores higher in these, e.g. technical or economic scoring, gets selected. Here is where Int. (13) explained how firms able to reduce their costs more dramatically (usually bigger firms) tend to get these since the economic aspect currently holds the heavier score.
- Above €60,000, the contract is made public and all type of companies are allowed to participate.

The law states that public administrations can only offer a minor contract to individual SMEs, of the value of €15,000, but Int. (13) explained how most times they are asked to carry out projects worth €30-40,000. What happens, is that because both parties want to work together, but the law does not allow to pay them more, in the end the public administration gets used to paying unjust salaries. And this problem is now systemic, and Int. (13) showed concern for incoherencies like the fact that the PA accepts that the construction of a shopping mall will take hundreds of thousands of euros, whilst it assumes that it is possible to have a consistent green infrastructure plan for €15,000. Int. (13) pointed this is wrong as a green plan design demands highly qualified work during a year or more. Thus, by demanding more NBS without fixing this issue, a market is being generated which does not value qualified technical work, and currently, many professionals are realising remarkable works for outrageous salaries, a statement also supported from a municipality technician like Int. (5). Moreover, Int. (2) explained that a few years before, the municipality of Madrid had unsustainable and delayed payment periods, which drowned many SMEs in need of solvency.