

Nature-Based Solutions Education Network (NBS EduWORLD)

Deliverable D2.1 State of the Art Report

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Abstract	<p>This report aims to provide an overview and detailed analysis of the state of the art in nature-based solutions (NBS) education across the European region and at different education levels. Based on desk research and interviews, it highlights the gaps and opportunities in NBS education. It finds that NBS is a great practical tool and opportunity for teaching learning for sustainability and sustainability competences, but that NBS often is not included in the Learning for Sustainability (LfS) agenda explicitly and particularly at the level of vocational education and training, and in coastal and rural communities. The current State of the Art report highlights good practice examples across Europe that primarily focus on urban regeneration and green space management, and not a larger diversity of NBS.</p>
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Table 1 Table of abbreviations

C-VET	Continuous Vocational Education and Training
CEDEFOP	European Centre for the Development of Vocational Training
CO ₂	Carbon dioxide
COVID-19	Coronavirus disease 2019
CPD	Continuous Professional Development
EC	European Commission
ECEC	Early Childhood Education and Care
EEA	European Education Area
EGD	European Green Deal
EHA	European Higher Education Area
EHEA	European Higher Education Area
ERA	European Research Area
ESD	Education for Sustainable Development
ETF	European Training Foundation
EU	European Union
GHG	Greenhouse gas emissions
GreenComp	Green Competence framework by JRC
HE	Higher education
HEIs	Higher education institutions
I-VET	Initial Vocational Education and Training
IBSE	Inquiry-Based Science Education
ICT	Internet Communication Technologies
IT	Internet Technology
ITE	Initial Teacher Education
JRC	Joint Research Centre
LfS	Learning for environmental sustainability
NA	Not Applicable
NBS	Nature-Based Solutions
NGO	Non-Governmental Organisation
PhD	Doctor of Philosophy
PAC	Professional Action Competences
RSP	Rounder Sense of Purpose
SDG	Sustainable Development Goals
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics
UN	United Nations
UNA	Urban Nature Atlas
UNECE	United Nations Economic Commission for Europe
VET	Vocational Education and Training
WP	Work Package
WSA	Whole-School Approaches

1. Introduction

Box 1 Definition of Nature-Based Solutions

Definition of Nature-Based Solutions

Nature-based solutions (NBS) are: “innovations inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. They bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. Nature-based solutions must benefit biodiversity and support the delivery of a range of ecosystem services.”

Source: European Commission

Driven by policy, environmental and economic imperatives, NBS education is increasingly emerging across disciplinary boundaries, knowledge silos, and skill sets to deliver integrated solutions to address the causes and consequences of climate change through education. Solutions that can be delivered at a low cost, compared to conventional infrastructure (Price 2021), broaden the scale of benefits for people and nature (Kapos et al. 2019), and, from an education perspective, provide common ground to learners on the benefits of NBS to address global wicked problems and how sustainability as a competence (Bianchi, Pisiotis, & Cabrera Giraldez 2022) can be delivered through NBS.

The Nature-Based Solutions Education Network (NBS EduWORLD) aims to nurture an NBS literate, inclusive and sustainable society by building synergies between NBS professionals and education providers across sectors and formal and non-formal and ensuring free and easy access to high-quality NBS knowledge resources. Through this work, communities should become more prepared, cohesive, and participatory in engaging with nature and using the benefits of nature to solve local and global challenges and improve public health and wellbeing. Other more specific and related objectives are to:

- Support integrated STEM teaching and Inquiry-Based Science Education (IBSE) by exploring real-world applications of NBS, feeding into the broader EU STEM education strategy;
- Explore and implement new dissemination and mobilisation strategies to suit broader lifelong learning on NBS through 21st-century technologies and transversal skill development;
- Explore synergies between NBS and the emerging field of learning for environmental sustainability (LfS).

To contribute to achieving the overarching and specific objectives of the NBS EduWORLD, there is a need to stand on the shoulder of giants, meaning: to learn about challenges, achievements and lessons learnt from those who first implemented NBS and NBS education projects across Europe and pioneering NBS teachers, academics, and other education personnel. Therefore, this report summarises the state of play of NBS education in Europe and

critically reviews the initiatives already in place and the lessons one can learn from them. The main aim of the research is to identify gaps, barriers, and opportunities in mainstreaming NBS in education from the perspective of the edu-community.

The authors of this report, leaders of work package (WP2), hope that this report will be a foundational asset for all consortium members. Hopefully, it can help work package leaders finetune their approaches and implement their project tasks in a better and more coherent way building upon the lessons learnt. This report, deliverable 2.1. (D2.1), is the first out of three deliverables from WP 2 and an outcome of T2.1.

2. Policy context

This chapter introduces the policy context of NBS in education projects in Europe to contextualise the upcoming discussion on the state of the art of NBS in education in the wider policy discussions and to clarify why the report itself is needed.

At the **EU policy level**, at least eight documents are crucial for contextualising this report:

- **Urban Agenda for the EU (2016)** (European Commission n.d.) provides sets of integrated and coordinated approaches among the EU Member States to deal with the problems modern cities are facing by setting up partnership among EU Commission, EU organizations and Member States' governments. Even though its implementation and mainstreaming are limited at city level, the agenda recognizes the importance of integration of NBS as tools for sustainable development and recovery of EU cities;
- **EU Bioeconomy Strategy (2018)** (European Commission 2020a) has a recognized contribution in the achievement of European Green Deal Objectives, as well as other EU level circular economy and clean energy innovation strategies. The strategy defines five main goals to achieve: ensure food security, use natural resources in a sustainable manner, reduce dependence on non-renewable energy sources, limit climate change and adapt to it, strengthen EU competitiveness.
- **The European Green Deal (2019)** (European Commission 2021) sets out the direction for the EU on just and green transitions aiming for no net emissions of GHG emissions by 2050, economic growth decoupled from resource use and no person and place left behind;
- **The EU's biodiversity strategy (2020)** (European Commission 2023a) is a long-term plan to protect nature and reverse the degradation of ecosystems, putting the EU's biodiversity on a path to recovery by 2030;
- **Post-2020 Global Diversity Framework** (UNCTAD n.d.) adopted under the United Nations Convention on Biological Diversity after covid-19 crisis. The convention guides actions to preserve and protect environment as well as the essential ecosystem services to people to ensure that countries fulfil the vision of 'living in harmony with nature' by 2050;
- **The EU's adaptation strategy to climate change (2021)** (European Commission n.d.) sets out a path for how the EU can adapt to climate change and become resilient by 2050 focusing on smarter, swifter and more systemic climate adaptation measures;
- **The EU Forest Strategy (2021)** (European Commission 2023b) provides a vision and sets of specific actions tailored to advance the quality and quantity of EU forests; strengthen measures towards their protection, restoration and resilience. The strategy

- aims to prepare preconditions for forests to continue delivery their socio-economic functions as well as ensure existence of vibrant rural areas with thriving population;
- **The Council recommendation on learning for the green transition and sustainable development (2022)** (European Council 2022) highlights the crucial role of education and training systems in working towards the goals of the European Green Deal;
- **The European sustainability competence framework (2022)** (Bianchi, Pisiotis, & Cabrera Giraldez 2022) (known as GreenComp) advances a definition of sustainability as a competence around *embodying* sustainability values, *embracing* complexity in sustainability, *envisioning* sustainable futures, and *acting for* sustainability.

In addition, there are few EU level policy documents that emphasize the crucial role of education and training in engaging citizens in environmentally sustainable actions and empowering them by skills and knowledge that is essential for green transition:

- **EU Youth Strategy (2018)** (European Union n.d.) is focused on three main areas ‘connect, engage and empower’ young people across the EU Member States. Among many other goals, the Goal 10 stresses the need of building a society where each and every young person is ‘environmentally active, educated and able to make difference in their everyday lives’;
- **EU Skills Agenda (2020)** (European Commission n.d.) is a five-year work plan to support individuals and businesses to strengthen their sustainable competitiveness and help them in the process of rapid shift towards a climate neutral Europe. The agenda supports the development of green skills by integrating environmental and climate considerations into general education, higher education, vocational education and training;
- **Youth4Climate’s Educational Toolkit** (Connect4climate n.d.) published by the EU commission is designed to support engagement of young people in shaping green transition in just and inclusive manner. The toolkit sets various principles and methods how to achieve successful participation of youth in those processes;
- **Digital Education Action Plan (2020)** (European Commission n.d.) is a renewed EU policy initiative which sets common vision of high-quality, accessible and inclusive education across the Member States for 2021 – 2027. The main focus of the plan is to support green and digital transition in education and training;
- **Council Resolution on the European Education Area (2021)** (European Union 2021) is a strategic framework for education and training for 2021 – 2030 to structure collaboration between EU and Member States to achieve their collective vision in education and training. The resolution emphasizes the need of reshaping of education and training systems in order to achieve the changes that are essential for green transition as well as empower learners with relevant competencies to live, work and act towards sustainable development;
- **Zero Pollution Action Plan (2021)** (European Commission 2023c) sets an action plan for achieving key deliverable of the EU green deal. Importantly, the action plan anticipates multiple communication activities among partner organizations, including educational institutions to promote actions towards zero pollution involving general public, standers and vulnerable groups. This includes tailored EU training modules for workers in various care sectors (i.e., healthcare, social care etc.) to improve their knowledge and capacity to deal with environmental risks;
- **The Council recommendation on learning for the green transition and sustainable development (2022)** (European Commission 2022) highlights the crucial role of

education and training systems in working towards the goals of the European Green Deal and LfS for all;

- **Upcoming European Strategy for Universities** (European Commission n.d.) is anticipated to promote effective and deep transnational cooperation among the Member States' educational institutions to work towards the twin digital and green transitions and build sustainable future environment.

Furthermore, on May 19, 2021 with the UNESCO-led **Berlin Declaration for Sustainable Development** (UNESCO n.d.) more than 80 ministers and 2,800 education and environment stakeholders (including stakeholders from the EU Member States, as well as globally) committed to take specific actions to incorporate environmental and climate actions in core education curriculums no later than 2025.

As a backdrop to this review, the European Commission has published numerous reports focusing on NBS (**Figure 1**). Each report provides an overview of different EU-funded projects, conducted as part of the European Commission's Valorisation of NBS Projects Initiative. The reports produce two very useful outputs: 1) they highlight new approaches available to support the development and management of NBS; and 2) they provide policy recommendations for further NBS development. NBS support biodiversity, sustainable development, disaster prevention, help counter climate change, and are an important part of the EU's green strategy.

Figure 1 Examples of expert reports on NBS funded by the EU on NBS



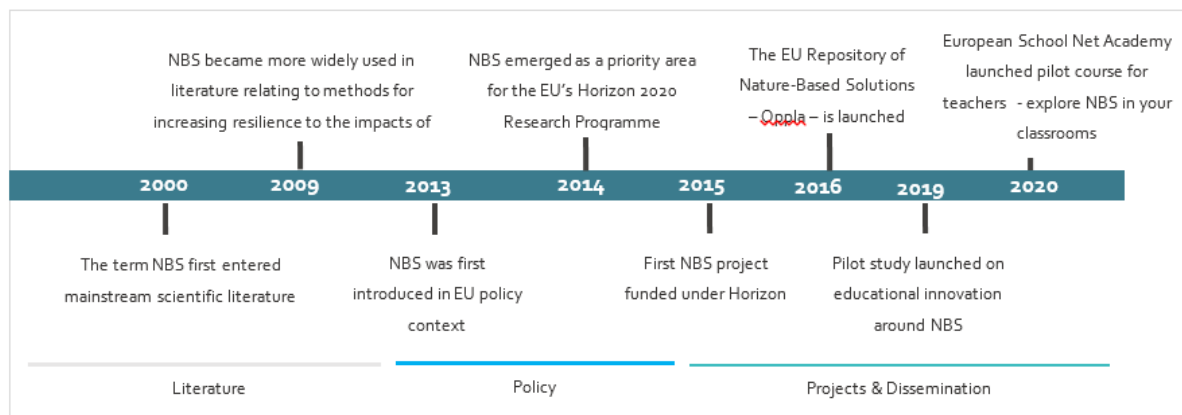
Source: Created by PPMI

In the expert reports, NBS has been highlighted as crucial in contributing to all of these strategies, in particular to biodiversity restoration, climate change mitigation and adaptation, and just and green economic transitions. Thus, the Horizon 2020 (H2020) funding programme provided considerable funding for NBS research and innovation (R&I). The relevant strands of the H2020 programme include projects with a total budget of €282m (EC, 2020). Moreover, there are plenty of funding mechanisms to foster integration of NBS in policy creating process. For example, EU funded Urban Innovative Actions aims to provide urban areas throughout Europe resources to test new solutions to address urban challenges in a sustainable manner. The total budget allocated for the initiative during 2014 – 2020 amounted to €372m (Urban Innovative Actions n.d.). The total budget allocated for the initiative during 2014 – 2020 amounted to €372m (Urban Innovative Actions n.d.).

In 2015, the H2020 Expert Group on NBS pointed out the need for awareness within the broader public on the usefulness and importance of NBS. It stated that one should 'consider the importance of education simultaneously to innovation - key to long-term change and

impact' (EC, 2015). There is a need to shorten the time to bridge recent innovations to actual education materials and resources so that environmental sustainability and biodiversity can be mainstreamed into learning and teaching activities. Recent report by the Directorate General for Education on learning for the green transition and sustainable development highlighted the need of acceleration of actions for introducing changes in education and training to empower and engage broader public for the green transition especially considering the urgency of climate and biodiversity crisis (Directorate-General for Research and Innovation 2022). Due to the extensive research funded by the EU on NBS, there is strong scientific evidence base available for teachers, academics, and other education personnel to rely on in preparing educational materials. In the case of NBS, one option is outlined more than others – to build on the results of recent and ongoing R&I projects and participatory initiatives in more than 70 cities in Europe (Naturvation, n.d.). Accordingly, since 2019, the trend of having NBS R&I projects focusing on linking NBS, education and dissemination of project findings from NBS R&I projects started (**Figure 2**).

Figure 2 Historic development of NBS in the EU policy context



Source: Created by PPMI

The rationale in the research and policy reports is that education plays an essential role in promoting environmental sustainability by raising awareness and instilling the key competences needed for changing personal behaviours and empowering people to act for positive change. Through learning about and creating NBS, students can develop the 12 sustainability competences (clustered into four competence areas: embracing complexity in sustainability, embodying sustainability values, envisioning sustainable features, acting for sustainability) highlighted by (Bianchi, Pisiotis, & Cabrera Giraldez 2022) such as problem framing, systems thinking, promoting nature and collective action. In fact, some evidence suggests that education for sustainable development that actively makes use of nature, e.g., climate change education in nature-based museums, is particularly effective in shaping nature-pro behaviours and habits (Swim et al., 2017) which are competences related to *acting for sustainability*.

Ensuring that all learners acquire the knowledge and skills needed to promote sustainable development, is one of the targets under SDG 4 (Target 4.7) and aligns with EU's policy vision on education and sustainability. Learning about NBS can provide the Member States with tools and discourses to implement the Council Recommendation on learning for the green transition and sustainable development and, in the long run, through the competence and capacity development of communities, help achieve the ambitious goals of the European Green Deal. The relevant literature also advocates that successful implementation of the European Green

Deal is impossible to achieve without a thorough reforms of the educational systems across the Member States. To achieve this objective, it is essential to develop 'tailored educational curricula' which will contain major skills and competences that are crucial to support a green economy (Martos, 2022).

Regardless of the increasing importance placed on NBS at the EU policy level, the earlier review of education policy in Member States during the 2019 pilot study found that no education policy documents at the Member States level mention NBS and there is a lack of awareness among policymakers and educators and accessible educational materials for teachers and learners. More recent report by the Directorate General for Education (Directorate-General for Research and Innovation 2022) also stresses out that there is no significant improvement in this regard – despite the growing public and policy attention on NBS, the EU education and training policy documents are still characterized with the lack of systematic approaches regarding learning environmental sustainability. Recent review of the national curriculum and policy documents (such as Education Sector Plans and National Curriculum Framework) performed by UNESCO revealed that in EU Member States (i.e., Malta, Czech Republic and Italy) 'the environment' and 'sustainability' is broadly presented in education policy documents; however, the presence of 'biodiversity' and 'climate change' is significantly limited (UNESCO 2021a).

The educational potential of NBS remains largely unexplored because innovative programmes and resources around NBS are currently missing from formal and informal education programmes for children and families. The consequence is that only students lucky to have highly motivated teachers who have learned about NBS, often through EU-led projects, have the chance to learn about NBS. NBS needs to be mainstreamed more widely in order for awareness about NBS to grow, and for NBS projects and innovations to also be taken up at a wider scale and be impactful and accessible to all.

Policy developments related to NBS have been ongoing on both European and national level. In line with the Green Deal, the European Commission has recently published a European competence framework to help develop and assess knowledge, skills and attitudes on climate change and sustainable development. This competence framework should serve as a reference tool for the development and assessment of competences on environmental sustainability. Moreover, in June 2022, the European Commission proposed a Council Recommendation on encouraging cooperation in LfS, including biodiversity learning and teaching (European Commission n.d.). The document provided key recommendations to the Member States in order to stimulate learning towards green transition: (i) Define learning for the green transition and sustainable development as one of the core priorities in education and training policy documents; (ii) Provide green transition and environmental sustainability learning opportunities in formal and non-formal educational settings; (iii) Ensure provision of relevant digital tools and resources to support teaching and learning skills and competences for green transition and sustainable development; (iv) Disseminate evidence-based and easily accessible information regarding climate, biodiversity and environmental crisis as well as regarding the main drivers of these crisis; (v) Support teachers and educators in their professional development related to the environment and sustainable development.

Moreover, earlier document from 2020 – communication on achieving the European Education Area by 2025 (European Commission 2020b) – highlights the role and importance of

communication among the Member States to address the current challenge of incorporation green and digital transitions in the EU education policy.

At the national policy level, Member States are responsible themselves for designing an institutional, policy, regulatory and financially enabling environment that will facilitate the take up of NBS. Since Member States' approaches and progress may vary, we provide a scan of documents and current policy provisions for NBS across the EU-27 in the following section. The purpose of the review is to understand to what extent NBS are already included in public policy, including education policy. The table in the Annexe presents an overview of existing policy documents relating to NBS across EU-27 Member States.

While mapping general NBS policy developments, no national policy documents linking NBS and education were found. It can also be observed that very few policy documents refer to NBS directly (e.g., France and Poland). Although it is an established concept across the EU, green-blue infrastructure is mentioned far more frequently than NBS (EEA n.d.) in national policy documents, i.e., plans, strategies and legal acts. This is also attested in a study by (Mendes et al. 2020). Using discourse analysis, the authors find that while the EU quickly incorporated the concept of NBS, it is still shadowed by other environmental concepts (e.g., ecosystem services and green-blue infrastructure). Earlier study, supported by the NATURVATION project, also highlighted that policy documents of EU Member States lack the explicit incorporation of NBS in terminology. Instead, the terms such as 'green (and blue) infrastructure', 'ecosystem-based management/approach' and 'sustainable management' are more commonly used (Davis, Mederake, & Knoblauch 2018):

'While multiple Member States' policy instruments explicitly acknowledge NBS-related concepts. they rarely contain quantitative and measurable targets relating to NBS deployment and quality... [Member States'] policy frameworks also largely neglect urban areas when considering NBS and - when included - focus heavily on maintaining and restoring existing green and blue areas as opposed to deploying NBS to create new green and blue spaces.' - (Davis, Mederake, & Knoblauch 2018).

References to NBS range from countries simply stating that they recognise the importance of these approaches as part of climate change adaptation, to the explicit reference of using NBS for addressing specific hazards. In terms of the former, Poland's policy documents fall well in line by recognising the importance of NBS. The 'Polish National Strategy for Adaptation to Climate Change (SPA 2020)' aims to address coastal hazards and flooding using non-grey infrastructure. It outlines NBS simply as a valuable approach that will become increasingly important due to intensifying climate change. In terms of the latter, the case of Portugal can be used. One of the aims of the policy document 'Biodiversity in the City of Lisbon: A strategy for 2020' is to 'implement nature-based solutions against natural disaster risks, such as floods'. The document denotes NBS as a solution to a specific hazard – floods. Despite this example, few countries make references to concrete implementation measures.

Therefore, in the overview in the Annexe (**Table 5**) most policy documents revolve around green space development in cities – green roofs, green walls and green corridors – as well as water body restoration – natural floodplain construction/expansion next to rivers and seas, river basin restoration, and water filtering. In these policy documents, the 'greening' of infrastructure is found to be a useful mechanism in climate change mitigation, dealing with weather anomalies and maintaining/preserving biodiversity. Green spaces can help address heat island issues, sewage congestions, and serve as vital recreational spots for the urban

population. Meanwhile, floodplain development, river basin restoration and water filtering are perceived as preventative measures against seasonal occurrences and extreme weather conditions. While these are not always framed as NBS, they are good examples of NBS if they sufficiently protect biodiversity⁷.

Three countries – Bulgaria, Finland and Lithuania – have been found to not have any existing policy documents that would cover either NBS or green infrastructure development. However, there exist standalone documents and public statements from the government in all three nations acknowledging the importance and potential value of NBS/green infrastructure in comparison to grey infrastructure. This means that NBS awareness is present to a certain extent within the countries but is yet to materialise into policy documents. This is interesting because some of the literature on policy implementation suggests that unclear policy goals tend to hinder successful policy implementation (McConnell 2014). In the case of NBS, the lack of clear and explicit formulation in some of the Member States' policy documents can obstruct successful policy implementation.

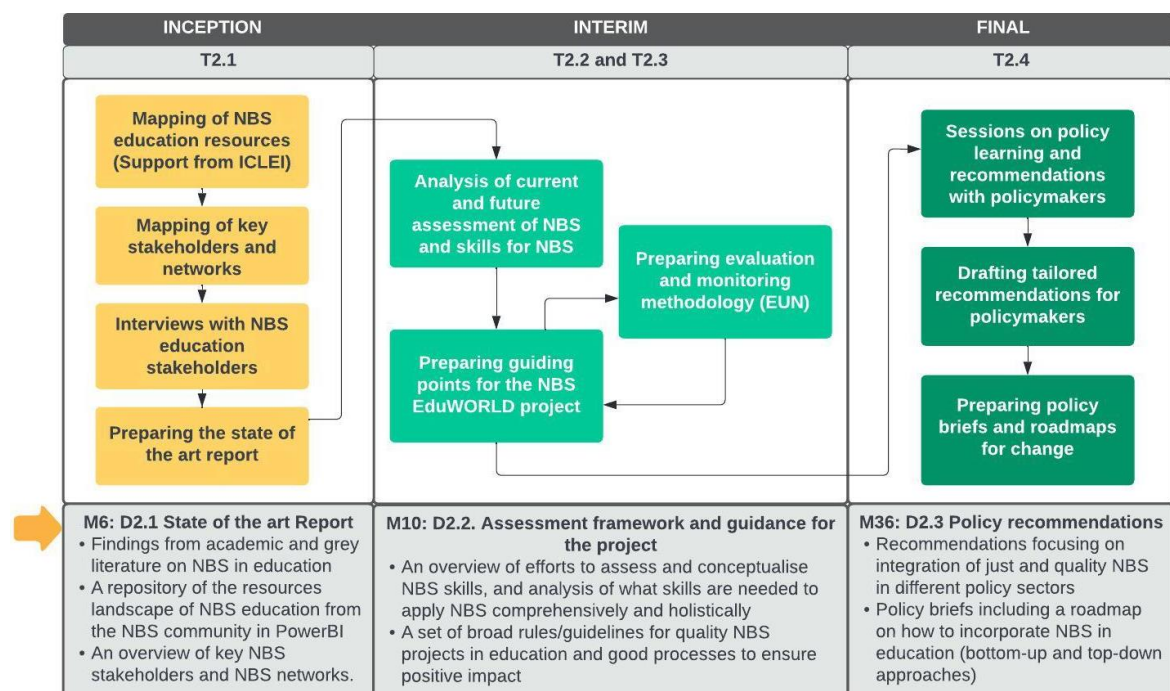
Therefore, it can be concluded that while Member States generally do not include NBS in their education policy documents, some lag even further behind by not having general policy documents on NBS in place. These findings provide a puzzling picture regarding future policy developments of NBS and its integration into education, especially in countries where NBS is at its early conceptual policy stages. While the link between NBS and green infrastructure⁹ means that NBS is not entirely disregarded by Member State policy makers, lack of concrete data on NBS in education policies is worrying and will be further discussed in Integration of NBS areas and materials into education and its challenges.

3. Methodology

3.1. Research design

This report builds on two key sources of qualitative evidence: desk research and analysis of academic and grey resources on NBS education initiatives and in-depth interviews with education stakeholders. This report consolidates and triangulates the findings from these sources to highlight the latest trends and developments in NBS education. The visual below shows where D2.1. is situated in the wider work of work package 2 and in relation to Task 2.1 (T2.1). T2.1. takes place in the inception period of WP2 and the task concerns the 'defining the status quo' based on three strands of parallel work, of which the second sees considerable support from ICLEI:

- Identification of gaps, barriers, and opportunities in mainstreaming NBS in education from the perspective of the education community:
- The mapping of the resources landscape of NBS education from the NBS community:
- The mapping of networks and education stakeholders working in the field of NBS education.

Figure 3 Methodological overview of research tasks in work package 2


Source: Compiled by PPMI

The purpose of the desk research and mapping of initiatives is to document existing projects, tools, capacity-building materials, cases and platforms in NBS education (ICLEI), the coverage of NBS in education policy, the evidence on the effectiveness of NBS in education and the challenges and opportunities with the implementation. The desk research and mapping are used to further shape the direction of the interview questionnaires, and the framework for the study, emphasizing gaps in the current knowledge on the topic of the study and highlighting areas for further research and action. Key outcomes of the desk research and mapping task is the repository of resources on NBS education and an inventory of stakeholders operating in the NBS education landscape.

The desk research and mapping task, conducted by PPMI and ICLEI, focuses on both academic and grey literature (e.g., policy papers) covering all education levels and, to the extent possible, formal, non-formal and informal education. The research covers trusted knowledge engines such as Web of Science, Science Direct, Scopus and Google Scholar. A key resource for the desk research is the NBS platforms and online repositories (e.g., [Oppla's case studies](#), [Urban Nature Atlas \(UNA\)'s resources and examples](#), NetworkNature's [knowledge hub](#) and [case study finder](#) and [Scientix](#)). Regarding the Network of Networks on NBS - an overview of key stakeholders, PPMI is reaching out to NBS, broader environmental and education networks to inform about the social media accounts and activities of the NBS EduWORLD, and include them in a broader network of networks who support and are interested in the outcomes of the NBS EduWORLD. The outcome of T2.1, a repository of educational resources, and the Network of Networks on NBS will be available on the project webpage, as well as accessible under the following [link](#). With the support of project partners, the repository of resources, and the inventory of stakeholders confirmed to support the CSA, will be updated on a regular basis to account for the newest resources and to expand to other European languages, connected communities, as well as to coastal and rural contexts.

The purpose of the interviews was to disclose the opinions and perceptions of key stakeholders that are not obtained through desk research and to facilitate a better interpretation of the information gathered through the literature review. Interviews were conducted with educators and experts to understand challenges, opportunities, and achievements of NBS education projects in formal and non-formal education and with disadvantaged groups and conceptualise the NBS skills and assessment of them in practice. The in-depth interviews provide a chance to network and further build the 'Network of Networks on NBS' – the overview of key stakeholders and their contributions to the field. Thus, as a result of the interviews, the WP2 researchers further developed the repository of resources and the inventory of stakeholders. One can find the preliminary inventory uploaded to the shared folder and titled "D2.1. Draft inventory of NBS stakeholders".

WP2 researchers scheduled and conducted 10 interviews with experts (e.g., project coordinators and lecturers) working on NBS education and 5 interviews with teachers implementing the NBS learning scenarios from the 2019 pilot study. The expert interviews tried to cover different education levels and also pay particular attention to levels and areas where there is a gap in information attained through desk research (especially vocational education and training, informal education and initiatives focusing on social inclusion). **Table 2** shows an overview of the area and focus of the expert interviewees.

Table 2 List overview of stakeholders interviewed

NBS education	Education form	Education level	Date of interview
NBS exemplar programme with focus on eco-garden kindergartens demonstrators	Non-formal	Early childhood education and care	15 February 2023
Educational platform on NBS	Non-formal	Primary and secondary education	26 January 2023
Research project on how much organic farming is integrated into "traditional" farming training in Germany	Formal	Vocational education and training	25 January 2023
A course on organic farming techniques	Formal	Vocational education and training	10 February 2023
Online course on teaching NBS	Formal	Continuous teacher training	19 January 2023
Training course on water management	Non-formal	Adult learning	19 January 2023
Project on mainstreaming natural sciences	In-formal	Adult learning	27 January 2023

NBS education	Education form	Education level	Date of interview
Course for youth water professionals	Non-formal	Adult learning	19 February 2023
Youth NBS initiative	Non-formal	Adult learning	10 February 2023
Park with a learning platform	Formal and informal	Primary and secondary education and adult learning	14 February 2023
Learning scenario on NBS	Formal	Secondary education	20 February 2023
Learning scenario on NBS	Formal	Secondary education	21 February 2023
Learning scenario on NBS	Formal	Secondary education	21 February 2023
Learning scenario on NBS	Formal	Secondary education	22 February 2023
Learning scenario on NBS	Formal	Secondary education	23 February 2023

Source: Compiled by PPMI

The teachers were the same as those interviewed for the 2019 pilot study in which teachers were a part of a co-created effort to create learning scenarios on NBS and test them in their classrooms. This allows the WP2 researchers to integrate a longitudinal perspective into the study design. The teachers were asked similar questions to understand how the situation has changed between 2019 and now, as well as additional questions related to the current study and its needs.

In order to ensure that the interviews are coherent thematically and methodologically, the WP2 researchers prepared and discussed the processes to achieve a common and targeted approach. WP2 researchers developed tailored semi-structured interview questionnaires for the different types of interviewees. The interview data analysis followed coherent approach to coding, synthesis and analysis among the team members.

The table below provides more details of what the research focus on by operationalising the research questions guiding the work of WP2 containing an overview of:

- The project outcomes and impact pathways the answers to the questions will help to address;
- The informational sources and how they will help answer the research questions;
- Within which deliverable one can find the synthesis of the answers to the research questions.

Table 3 Research questions for work package 2

Research question	Link to project impact	Method
Related deliverable: D2.1 'State of the Art report'		
Is the concept of NBS included in policy documents and strategies at the EU and national level? In what areas of policy is NBS included?	Pathway 5: Mainstreaming NBS education in policies across sector	Desk research
What networks in NBS education have been operating in the EU in the last 10 years? From which parts of Europe do the networks originate? Are disadvantaged groups represented?	Pathway 1-4, but in particular Pathway 3: Increase understanding of value and benefits of NBS education for rural, coastal and urban communities and pathway 4: Building and maintaining communities around NBS education	Desk research, interviews
What are the key NBS included in education in the last 10 years? In what types of education and learning communities are they implemented? What NBS challenges are covered (e.g., green space management, health and wellbeing)?	Pathway 1-4, but in particular Pathway 1: Mainstreaming NBS in formal/informal education across different educational levels and Pathway 3: Increase understanding of value and benefits of NBS education for rural, coastal and urban communities	Desk research, interviews
Who are the participants in NBS education projects? Have the education projects reached disadvantaged groups? What were the factors ensuring that NBS education projects achieved inclusion? What can NBS in education do for disadvantaged groups?	Pathway 1-4, but in particular Pathway 1: Mainstreaming NBS in formal/informal education across different educational levels and Pathway 4: Building and maintaining communities around NBS education	Desk research, interviews
What is the evidence of the success of NBS education activities in influencing values, knowledge and skills on NBS? What is the evidence of these instilling broader sustainability competences?	Pathway 1-4, but in particular Pathway 1: Mainstreaming NBS in formal/informal education across different educational levels and Pathway 3: Increase understanding of value and benefits of NBS education for rural, coastal and urban communities	Desk research, interviews

Research question	Link to project impact	Method
What are the challenges and achievements in implementing NBS in education projects in different areas of the EU and across learning communities? What are specific challenges in formal, non-formal and informal education? How and why do these challenges and achievements vary across learning communities and education levels?	Pathway 1-4, but in particular Pathway 1: Mainstreaming NBS in formal/informal education across different educational levels and Pathway 3: Increase understanding of value and benefits of NBS education for rural, coastal and urban communities	Desk research, interviews
Related deliverable: D2.2 'Assessment framework and guidance for the project'		
How has NBS competences been assessed in the last 10 years? How have learners' achievements been recognised, and if not, what are the reasons the learning is not being recognised and assessed? Is the recognition of qualifications cross-institutional?	Pathway 1-4, but in particular useful for Pathway 2: Driving nature-based rural, urban and coastal economies by building educational stepping stones	Desk research, interviews
How can the NBS EduWORLD work packages be implemented to reach more people and ensure high-quality take-up of its outputs and outcomes? How can the EduWORLD project be tailored for different groups and NBS learning communities?	Pathway 1-4, but in particular useful for Pathway 2: Driving nature-based rural, urban and coastal economies by building educational stepping stones	Desk research, interviews
Related deliverable: D2.3 'Policy recommendations'		
How can policymakers across sectors, at different geographical levels and in different types of communities (rural, coastal and urban communities) improve their strategies and actions to support the NBS edu-community effectively?	Pathway 5: Mainstreaming NBS education in policies across sector	Desk research Policy learning sessions (workshops) Interviews

Source: Compiled by PPMI

3.2. Analytical framework

The 2030 Agenda for Sustainable Development and the European Green Deal (EGD) reflect the urgency to embed the principles of the green transition and sustainable development into competence development and all levels of education. NBS has been highlighted as crucial in contributing to all the main policy strategies related to the EGD, in particular to biodiversity restoration, climate change mitigation and adaptation, and socially just and green economic transitions. Learners should be empowered to act in complex situations in a sustainable manner, which may require them to strike out new directions, participate in socio-political processes and attain sustainability competences. While NBS can be such a new direction that strengthen nature and participatory inclusive problem-solving, leading to long-term solutions for society and climate – if done right – engaging in NBS can be great way for students to acquire tangible skills for the green transition and sustainability mindsets.

In order to increase the take-up and know-how around NBS across communities, holistic implementation is needed. Action is needed both vertically (from individual to institutional and systemic changes) and horizontally – all the stakeholders acting in synergy for the promotion of NBS at the organisational level. This report therefore considers both system and organisational level approaches and practices and interlinkages between them. The system level can be understood as related to the development of long-term political visions at national, regional and local levels, as well as changes to formal education (e.g., curricula, teacher education, assessment and recognition, among others). This is primarily reflected in the policy context to the report.

The organisational level relates more to the actions taken at educational institutions by school leaders, board members and individual teachers, regarding their own effort to strengthen Whole-School Approaches (WSA) around NBS, engaging with and innovating in content and methodology, improving facilities and cooperating with NBS experts and the broader NBS edu-community. Thus, the organisational level relates more to non-formal education, as both education and expert institutions can design and provide their own learning on NBS both in physical and virtual spaces. Institution-level and non-formal practices are an important dimension of the education on NBS. So are families and friends and the community outside immediate learning communities which play a key role in in-formal learning around NBS. Hence, WSA around NBS refers to a holistic, systemic, co-creative and reflexive effort by all stakeholders involved in education to meaningfully engage students in complex NBS challenges. Holistic highlights the attempt to explore and address sustainability issues from multiple perspectives in an integrated and relational way. Systemic refers to considering key aspects of the education system simultaneously (formal, non-formal and informal education, curriculum, pedagogy and learning, professional development, school-community relationships, school practices, ethos, vision and leadership). Finally, co-creative refers to the inclusion of multiple voices and multiple stakeholders in the development of the approach within a given context (Mathie & Wals 2022).

A critical outcome of learning NBS is in-depth understanding and appreciation of NBS accompanied by practical skills around the implementation of various types of NBS to tackle different NBS challenges. Given the risk of greenwashing around NBS, it is crucial to pay attention to NBS being integrated into the learning environment, learning content and pedagogy in a comprehensive manner. It is crucial that the innovations are inspired and

supported by nature and provide social and economic benefits in addition to environmental, and thus not being superficially implemented or, eventually, abandoned due to lack of support. The EU has already supported a variety of projects and research that have increased the knowledge-based on what high-quality NBS entail and how it can be supported to address different types of challenges. The mainstreaming of these resources through the creation of engaging education is one way that the EduWORLD project can help ensure *comprehensive* learning around NBS.

In this context, NBS education can be understood as an important part of education for the green transition and sustainable development that is also in line with the overall EU Green Deal Policy objectives. In order for NBS to be mainstreamed more broadly so that its positive effect on nature and communities can be strengthened, NBS education should be applied holistically and comprehensively through key supporting pillars of education:

- **Policy and visions around NBS:** The visions and applicability of NBS can be recognised and integrated in key long-term education strategies shaping the education delivery system, as well as other policy areas. Integrated policymaking can be crucial to strengthen NBS education and providing ecosystem benefits across different fields and to different stakeholders. A strong policy vision around NBS can be strengthened through **financial mechanisms**, for example by ensuring that ambitious for teacher education on NBS is followed up by financing to run CPD course, or financial incentives for teachers and schools to get involved.
- **Assessment:** Clear competence frameworks and learning objectives on NBS should be created along with assessment systems mirroring these frameworks. This way one will ensure that NBS is taken seriously and taught, given that assessment often gives clear direction for what topics should be prioritised and taught. To this end, it is crucial to create strategies and programs along with evidence-based knowledge and policy recommendations for promoting and integrating the key features of sustainability citizenship through NBS.
- **Learning content:** Critical issues around NBS, such as the different NBS challenges, need to be integrated into curricula, competence frameworks and education material for all education levels in appropriate classes and, to the extent possible, in interdisciplinary ways.
- **Pedagogy:** Engaging pedagogy can be very advantageous to strengthen the effectiveness of learning and making sure learners also acquire action competences around NBS. Examples are interactive, learner-centred teaching and learning settings and designing action-oriented, transformative pedagogy, which supports self-directed learning, participation and collaboration, problem-orientation, inter- and transdisciplinary and the linking of formal and informal learning to the development of competences around NBS.
- **Learning environment:** Positive learning environments are crucial for strengthening the effectiveness of learning. The focus can be on the relational aspects and ensuring overall wellbeing and positive learning cultures of the education institution, but also the physical aspects. In terms of NBS, the latter is indeed one of the key ingredients and

using NBS actively in the learning environment can be a great way to demonstrate the meaning of NBS (e.g., school garden for food production and classroom plants to increase air quality). It will be important that NBS demonstrators are not just passively there but used actively in the teaching and learning around NBS.

The supporting pillars of education form the capacities of the education system delivery and are impacted by external drivers and challenges, as well as by the underlying motivations and capacities of key actors (e.g., teachers, school management leaders, policy makers). These factors need to come together to strengthen NBS education. This theory of change guided and informed the study's data collection and analysis.

4. Main findings

4.1. NBS in early childhood education and care

4.1.1. Overview of the scope and availability of NBS education in ECEC

The review shows that NBS education offers at the ECEC level are primarily available in urban areas and constitute examples of green space management. Urban gardens targeting children at the age level of ECEC are limited in the scope of types of NBS and NBS challenges they address, and which forms of communities benefit from them. Finally, as this section show, their educational components are often underdeveloped and thus the extent to which learning is ensured often depends on the usage and initiative of individual education personnel and guardians of children.

The WP2 researchers screened for learning resources for children aged 0-6, related to any of the NBS challenges, in [Scientix](#). Out of 53 resources, although many related to the teaching of food technology and climate change, or to pedagogy related to either of the two topics, only 1 mentioned NBS or NBS related methods explicitly. The other learning scenarios reflected on the NBS challenges and what the key issues are (e.g., unsustainable, unhealthy lifestyles and excessive CO2 emissions) but not on NBS as solutions on the positive benefits of nature and where thus not considered as NBS education activities. Thus, the best example regards the NBS learning scenarios related to the second phase of the Integrating Nature-Based Solutions in Education project led by EUN and funded by the European Commission Directorate-General for Research and Innovation ([Box 2](#)). The Scientix resources related to NBS are available in many EU languages and being used by teachers across the European region, including in non-Member States (e.g., United Kingdom and Turkey).

Box 2 A learning scenario on reforestation for children aged 5**A learning scenario on reforestation for children aged 5**

Every year there are forest fires in Portugal that destroy flora and fauna. In a school close to a forest named Parque Porta do Mezio, one of the five gateways to the Peneda Gerês National Park, there are the beautiful and immense mountains and valleys of Soajo and Peneda - named a World Biosphere Reserve by UNESCO. In this context, the learning scenario's work plan is to raise children's awareness of the richness of this natural park (its fauna, its biodiversity and all the opportunities it offers) and to learn how they can contribute to its preservation through NBS. To properly understand this reality, students visit two different zones: a natural and conserved forest area and a burnt zone. Thanks to this experience of direct and contrasting experience, students are sensitised and motivated to protect nature. The learning scenario also encourages collaboration between the school, the national park, the municipality, and the parents, in the teaching. The lessons are relevant to subjects such as biology, botany, earth science, ecology, forestry, geography, geology and mathematics. The learning scenario was one of the winners of the first Teachers' Competition "Nature Based Solutions in Education".

Source: (Carvalho 2020)

Next, the WP2 researchers screened the [NetworkNature](#) and [Oppla case study finders](#) using the keywords 'kindergarten', 'education' and 'learning'. This resulted in only 4 search results focusing on NBS initiative at the ECEC level. Two of these results regarded the same initiative in Poland, thus in total there were three ECEC-targeted NBS. These three were distributed in the following countries: Armenia, Poland and Switzerland and were all examples of green space management and urban regeneration (urban gardens) although they also aimed to tackle various other NBS challenges.

In the example of Yerevan, Armenia, H2020 funded the creation of a green wall for a kindergarten as a part of the Connecting Nature project (Oppla n.d). The project page in Oppla provide details as to how the green wall may ensure sustainable environmental conditions, including better air quality and increasing accessibility to green open spaces, wellbeing and social interactions. Further, it is argued that *'The care of the plant species (Virginia creeper (parthenocissus quiquefolia), Amur grape (vitis amurensis), monkshood vine (ampelopsis aconitifolia)) used for the green wall creation may serve as an excellent platform to teach kindergarten children to love and preserve the environment.'* Yet, education is not described as one of the NBS benefits and given that the educational effort is not further described, this NBS initiative had a weak educational profile. Similarly, the example from the Aargau canon, Switzerland, regarded spiritual forests and forest kindergartens provides no information about how education is provided and linked with NBS (Oppla 2019a).

Among the Oppla and NetworkNature examples, the example from Poznan, Poland, has the strongest educational value. The focus of increasing NBS in the city starting through a collaboration with eco- and social gardens at kindergartens (Oppla 2020a). The effort was an outcome of the Connecting Nature project and led by the Project Coordination and Urban

Regeneration Office of Poznań City Hall. Within already existing gardens, an attempt was made to strengthen accessibility and climate change adaptation targets.

Box 3 Poznań NBS kindergartens**Poznań NBS kindergartens**

Each year, the City Hall provided kindergartens with professional help of landscape architects designing the playground in a natural way, and offered workshops for teachers on how to use such a space for children. The goal was to increase the number of green spaces in the city by utilising already existing spaces, in this case, kindergartens. Another goal was to have influence on children, to increase their ecological awareness and knowledge about environmental processes occurring in the environment through contact with nature which is essential for their development. Education class scenarios were developed for teachers to ensure the educational value of the urban gardens and actualising the natural playgrounds as spaces of learning. In parallel to the technical delivery of the natural playgrounds, a series of information activities promoting the idea of natural playgrounds were organised. This included a seminar on "Natural playgrounds in pre-school gardens" at the Poznan International Fair as part of a two-day conference "Education for public space". The workshops included activities in which the directors and teachers at nursery schools tried their hand at designing their own kindergarten natural playgrounds, under the supervision of an expert. These events were designed to build awareness of, and demand for, nature-based approaches to play spaces at kindergartens and schools, both at an academic and political level.

Source: (Oppla 2020a)

While also in this case, the NBS were described more technically, this case study also featured more details on the approach to education. Education class scenarios were prepared to be used by teachers in conducting ecological education classes with the use of eco-demonstrators installed in preschool gardens. These NBS gardens for children have been successfully upscaled since the start of Connecting Nature. There are now 46 pre-schools with eco-demonstrators.

The gardens were described as 'natural playgrounds' for children: *'A natural playground is more like a garden to play in than a typical playground. Instead of traditional playing facilities like a swing or a slide, playing facilities might use plants like the Willow, or have a maze made of tall grass. There are elements like hills, natural paths, objects made from natural materials like wood and stone. Artificial safety surfaces are replaced with natural water absorbing surfaces made from sand or gravel. Plants provide a nice microclimate, shade or natural isolation from the traffic noise and pollution. The children can observe how plants grow and sometimes even consume fruit from trees or bushes.'* (Interview with early childhood education and care expert, 15.01.2023)

Furthermore, the [Urban Nature Atlas \(UNA\)](#) featured 7 original ECEC NBS education initiatives. These examples were from Armenia, Bulgaria, Czechia, Germany (2), Poland and Romania and tackled primarily green space management together with health and well-being and social justice and social cohesion benefits. The sources in UNA further revealed the same trend, NBS education initiatives at ECEC are primarily examples of urban gardens or tree planting measures with weak descriptions of their educational aspects. The exception was the Green Play City implemented by the NGO 'Wissenschaftsladen' in Bonn. In this initiative, education was one of the main aims of the project rather than, as in the other initiatives, an additional benefit or outcome of the NBS.

Box 4 Environmental education project in the Green Play City**Environmental education project in the Green Play City, Germany**

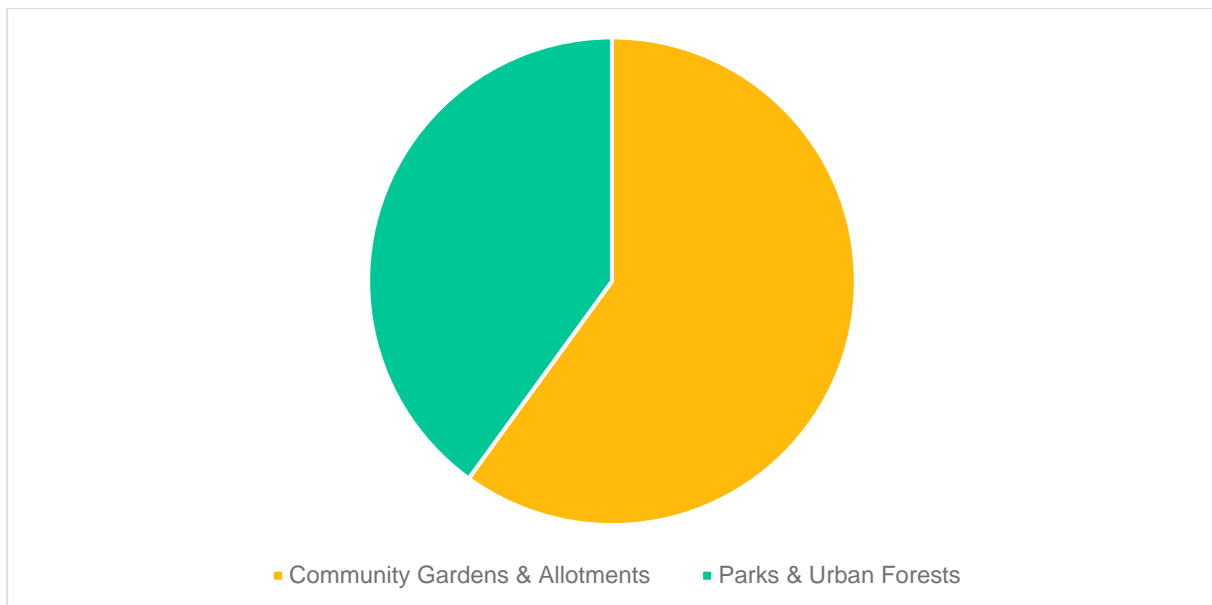
Project objectives were to intensify participatory aspects & use of the green play town by local actors, such as schools, kindergartens or associations for environmental education; collaborate with educational institutions long-term and ensure they integrate the area into their educational curriculum and activities; foster and facilitate the sustained integration of environmental and biodiversity aspects into official education curricula; use a participatory approach to develop tailored educational measures that combine the topics culture, biodiversity & nature and render the green play town a more lively open-air classroom; create a sense of ownership for the area and its elements, strengthening and expanding the network of volunteers to secure maintenance of the territory in the long run; create financial security for the project "Green Play City" and thereby securing its continuation. Key activities implemented were to gather ideas for a sustained outdoor learning space, and extend activities that spark interest in nature-themes, inspire ownership and autonomous maintenance of elements of the area in close exchange with the stakeholders (i.e. schools, kindergartens, associations, scouts etc.), the definition of possible measures based on stakeholders' needs and their pilot implementation; improve ties with participating stakeholders and making measures more concrete and compromising between stakeholders; publication of a country-wide study and analysis of targeted activities, potentials and barriers of smaller institutions for environmental education; events portfolio and networks to attract more volunteers.

Source: (Urban Nature Atlas 2021a)

The European Commission refers to different forms of NBS actions as “some involve using and enhancing existing natural solutions to challenges, while others are exploring more novel solutions” (European Commission 2015). The findings from this education level showed that NBS used are primarily the former, developing existing and established natural solutions, which can be considered less sophisticated NBS technically (Sowińska-Świerkosz, Michalik-Śnieżek, & Bieske-Matejak 2020).

Figure 4 shows that the initiatives either are examples of Community Gardens & Allotments or Parks & Urban Forests.

Figure 4 Form of NBS among NBS ECEC initiatives



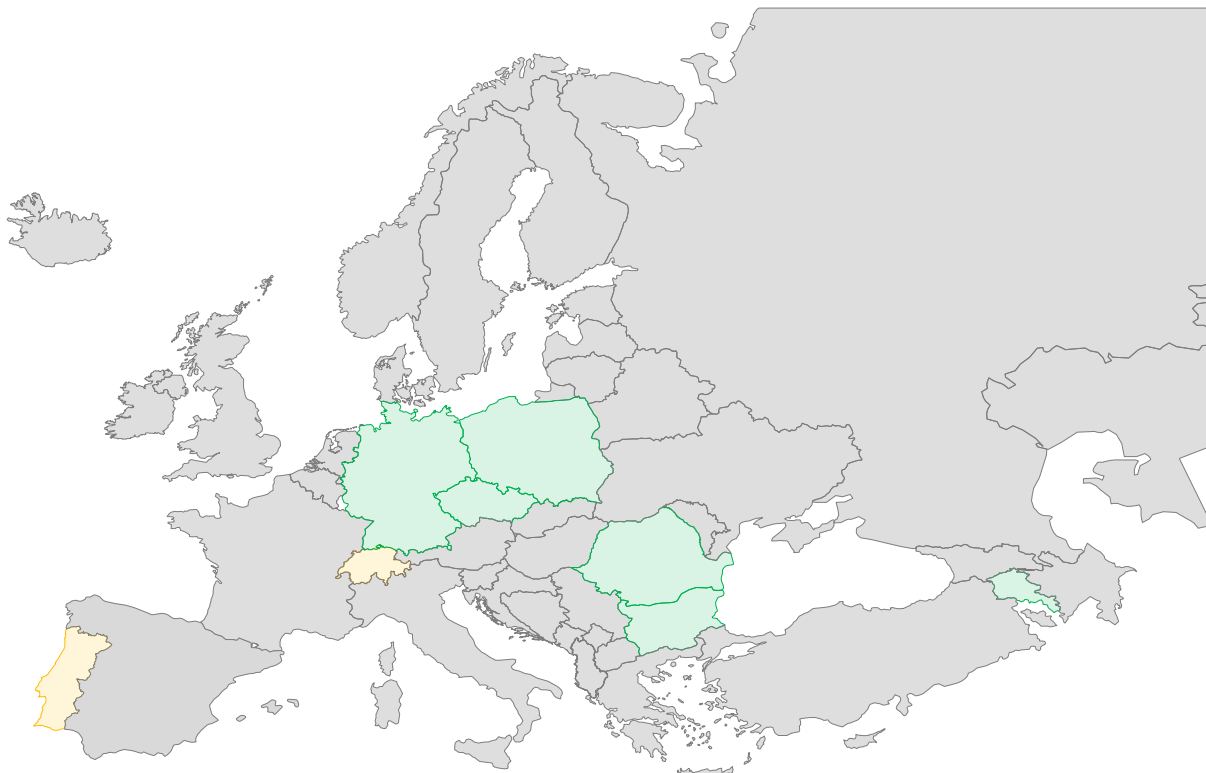
Source: Compiled by PPMI based on repository

While the online resources do not provide information of disadvantaged groups being targeted, research into allotment gardens or community gardens, a form of NBS, have found that they indeed may solve urgent economic and social problems such as the provision of food to the poorest (Sowińska-Świerkosz, Michalik-Śnieżek, & Bieske-Matejak 2020). By claiming the initiatives contribute to social and economic NBS benefits, solving the ‘social justice and social cohesion’ NBS challenge, there is an implicit underlying assumption that they target people from disadvantaged areas and can lead to their empowerment. There is research into community gardens showing that collaboration and teamwork in gardens foster social capital by facilitating bonding, bridging and linking of ties and connectivity among participants (Firth, Maye, & Pearson 2011). Social capital has again been linked to social cohesion, democracy, economic well-being and sustainability (Forrest & Kearns 2016).

Considering social justice, and whether disadvantaged people benefit, is trickier. Research finds that urban community gardens have been used primarily by privileged people (Glover 2004) or a small group of highly motivated individuals (Veen 2015). Overall, NBS education activities’ ability to reach those from disadvantaged areas depends largely on their location and proximity to deprived areas (Milbourne 2012) and whether children with poorer socio-economic backgrounds participate in ECEC (Flisi & Blasko 2019). Thus, it needs to be investigated further who benefits from these activities and can draw the most from them in terms of their potential educational value.

The visual below provides an overview of the location of all the ECEC level NBS education initiatives discovered are located. The colour orange indicates the target community as rural; the colour green indicates the target community as urban. No coastal community initiative was identified. Apart from the Portuguese learning scenario and the case of the Swiss forest kindergarten, the NBS education initiatives identified, so far, targeted urban, rather than coastal and rural communities. Thus, it must be concluded that it looks like children at ECEC in urban communities are benefitting the most from NBS education initiatives, while children in ECEC in coastal areas benefit the least.

Figure 5. Map of ECEC level NBS education initiatives in the European region



Source: Compiled by PPMI based on the repository. Green colour indicates urban communities being targeted, orange indicates rural communities targeted and blue indicates coastal communities targeted

This review has found that the types of NBS and challenges tackled through NBS at the ECEC level is limited and that there is also a lack of information regarding what the education provided entails and who it targets. Through additional desk research and interviews, it was difficult to answer the research questions regarding the socio-economic background of the participants in the NBS initiatives at ECEC, and how many reached disadvantaged groups. This is because most initiatives do not gather this form of information. Further, none of the initiatives at ECEC in NBS made use of digitalisation and thus this section does not further reflect on this area and type of NBS education, as there were no such examples.

4.1.2. Challenges and barriers in implementing NBS education in ECEC

The analysis found that there are particularly two challenges that stand out with regards to the implementation of NBS education in ECEC; 1) the lack of involvement of education professionals in developing ECEC NBS initiatives and 2) the lack of diversity in the type of NBS implemented and the NBS challenges addressed.

The lack of involvement of education professionals in developing ECEC NBS initiatives

Generally, in the descriptions of these NBS initiatives in the online repositories, emphasis is put on the form of NBS at work, with very weak description of the type of education. Searching in general for garden on Oppla results in 39 initiatives, and a large scale of these mention education or the possibility for and 'educational value'. However, the further description is often lacking, and it appears that in terms of NBS learning paths and educational value primarily refers to informational boards and organised tours. As these efforts are not implemented with

the help of professional education personnel, their pedagogical value, especially for younger children, is questionable. The education value of these initiatives thus depends on whether education personnel use them for this purpose or not. Education personnel in ECEC may not be aware of NBS and thus not teach NBS through the NBS available at the kindergartens. This situation is also likely given that NBS is rarely a part of official curriculum and thus educators are not encouraged to teach NBS explicitly (Interview with early childhood education and care expert, 15.01.2023).

The lack of diversity in the type of NBS implemented and the NBS challenges addressed.

Recognition of the global nature of climate change and the need to implement actions at appropriate scales, has been supported by the increasing inclusiveness of NBS within society through implementation at local, landscape, watershed and basin (or transnational) scales, with the necessary support of environmental, economic, and educational policies. Particularly in relation to biodiversity and the inherent benefits as described by (Dasgupta 2021). However, a barrier with current education offers at ECEC level is that they lack the ability to link the issues of green space management to the other wider NBS benefits or going beyond “green” NBS to also foster on “blue” NBS on NBS for coastal communities. The current initiatives are quite uniform and not more novel NBS. This could mean that children do not learn comprehensively about NBS, and that they may also not learn about all the different challenges that NBS can help address. Learning very complicated concepts about NBS may not be needed at this stage either, but children should be lead towards the most suitable learning path to further develop competences and skills for a more advanced understanding and application of various NBS at later stages.

Lack of competences on NBS among professional fields

Given that NBS require specialised knowledge about biodiversity, plants and species, educators who want to teach it in a hands-on manner are seeking expert advice. This is particularly needed at the initial project phases, when there may be scepticism within communities towards introducing NBS in kindergartens (Interview with early childhood education and care expert, 15.01.2023). An interviewee who had worked with this process, emphasised that there were teachers, parents and headmasters who were curious about hazardous situations occurring from introducing NBS since they were not used with it. In order to assure the community and implement NBS in the most successful way, it may be needed to invite companies responsible for certification of green elements and infrastructure, or landscape architects to advice on best integration of NBS in the existing structures. However, our analysis shows that one key barrier is the lack of competences on NBS among professionals, and the scarcity of good contractors who can work on NBS (Interview with early childhood education and care expert, 15.01.2023). In one example, contractors working on NBS were only available in a big European city, and thus additional funding was needed to have the NBS experts travel to the smaller town. Given the costs of this procedure, coupled with the costs of maintaining the NBS, it is also understandable that there seem to be less NBS education initiatives targeting rural and coastal, often less economically strong, areas.

4.1.3. Evidence of the success and achievements of NBS education in ECEC

The analysis found that there are particularly two success factors that stand out with regards to the implementation of NBS education in ECEC; 1) the benefits of play and outdoor education for children's development of sustainability competences and 2) that urban gardens can be great spaces for strengthening intergenerational relationships and learning.

The benefits of play and outdoor education for children's development of sustainability competence

Previous research has found that nature and garden experiences and the chances for play and sensuous perceptions can lead to the permanent retention of knowledge and awaken children's lifelong interest in nature (Hake 2017). It is not for no reason that researchers note that "children are playing learning individuals" (Samuelsson & Park 2017). Compared to school-aged children, the approach to education for early childhood learners should be less about achievements and more about free discovery on each child's own terms (Siraj-Blatchford, Mogharreban, & Park 2016). Personal perceptions, attitudes, and connections with nature are the key goals at this stage. Play is a constitutive part of learning during early childhood years is often discussed in research, since playing can contribute to development of cognitive functions, as well as communicative and social skills, necessary for child's future sustainability mindset (Bascope, Perasso, & Reiss 2019).

This requires social organisation of learning spaces and consistent, deliberate and systematic learning activities. Accommodating children's knowledge process requires creativity, play, and attention to reality, meaning that play and creativity have to have space in ECEC pedagogy, not as something separate from learning, but as a dimension of the teaching and learning process (Samuelsson & Park 2017). Samuelsson and Park claim that: *"To create meaning, children have to relate new knowledge both to prior experiences and with their immediate communication with teachers and peers. Children see, hear, and reflect on what they experience in their everyday lives, and educators then have to meet children in their ideas, support them, and challenge their ideas to develop sustainable ways of learning as a lifelong process"*(Samuelsson & Park 2017). Thus, the role of educator in children's learning process is essential.

Similarly, it is important to highlight that outdoor education in early childhood education does not refer to any outdoor activity, but those activities that deliberately aim at triggering long-lasting bonding between child and environment, as place (culturally signified local environment) and/or as "nature". Among those pedagogical experiences, some are framed as play, as outdoor exploration, or inquiry, and as participation in community life. Research shows the single most important influence in promoting environmental awareness and concern is identified as childhood experience "outdoors" (Siraj-Blatchford, Mogharreban, & Park 2016). Particularly interesting examples are the possible interconnections between NBS and play such as highlighted in the box example above with the examples of 'natural playgrounds' that integrate both NBS concepts and values and real NBS (Interview with early childhood education and care expert, 15.01.2023).

Urban gardens can be great spaces for strengthening intergenerational relationships and learning

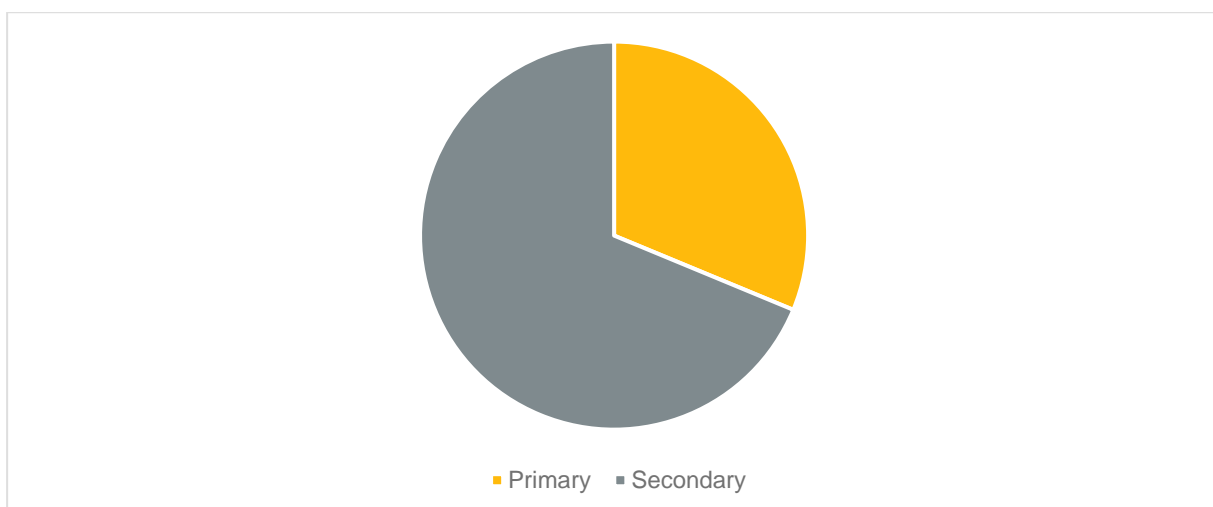
Intergenerational learning has recently become a firm agenda of gardeners, policy makers and researchers. Intergenerational learning involves members of different ages and generation co-participating in sustained learning activities (Hake 2017). Urban gardens and especially kindergartens and school gardens, can function as service-based learning spaces particularly well suited for intergenerational learning (Williams & Brown 2012). The idea is that young people can learn to grow for example food with the help and support of the older generation in the community, which can also positively influence their healthy eating habits. Although there may not be official education programmes in relation to NBS, informal transmission of what children learn in formal education, practice, or informal learning from older people and the community, may flourish. One notable risk with this approach is that older people involved in these initiatives may join to enhance their own ‘wellness’, ‘social capital’ and ‘feel-good community involvement’ rather than in order to change behaviours and be a role model to the children (Hermann et al. 2005). Thus, there may be some limits to the effectiveness of this approach and the informal learning taking place. Furthermore, it is unlikely that the participants will learn about NBS more broadly and more novel forms of NBS unless the untrained older people know about NBS are motivated to share and teach.

4.2. NBS in schools (primary and secondary education)

4.2.1. Overview of the scope and availability of NBS education at schools

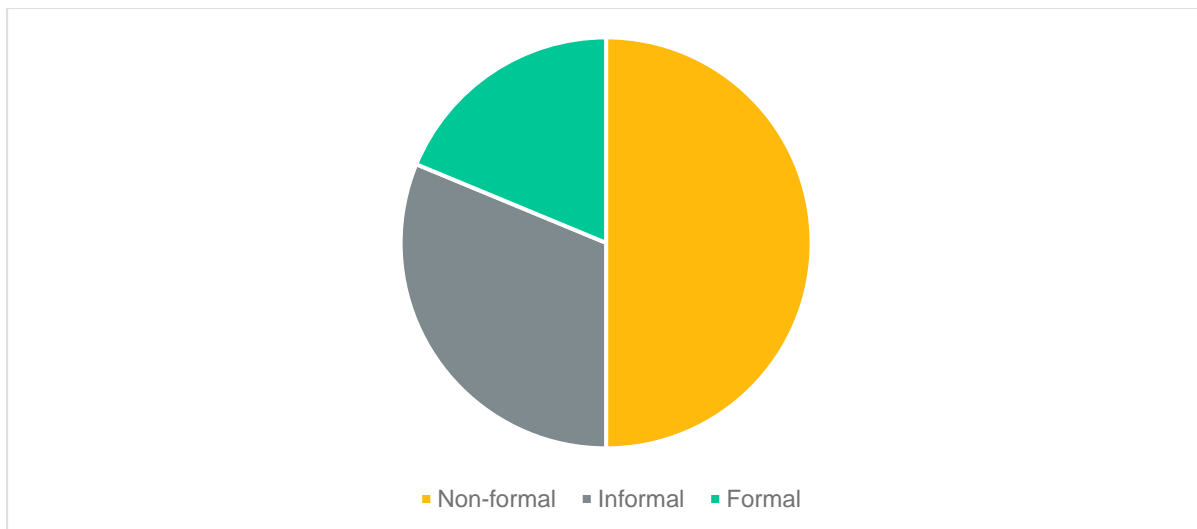
The review of the online NBS platforms, [Oppla](#) and [UNA](#), resulted in 48 relevant NBS education projects for primary and secondary education. They were spread within 13 countries in the European region, with no examples from Scandinavia and the Baltics. Most of the examples are embedded in an urban context which requires green space management. Vulnerable groups are occasionally included, especially when the target group involves adults too. Besides, there were slightly more initiatives discovered in secondary than primary education, and the majority where in non-formal as opposed to formal and informal education.

Figure 6 Distribution of NBS school initiatives among primary and secondary education levels



Source: Compiled by PPMI based on the repository

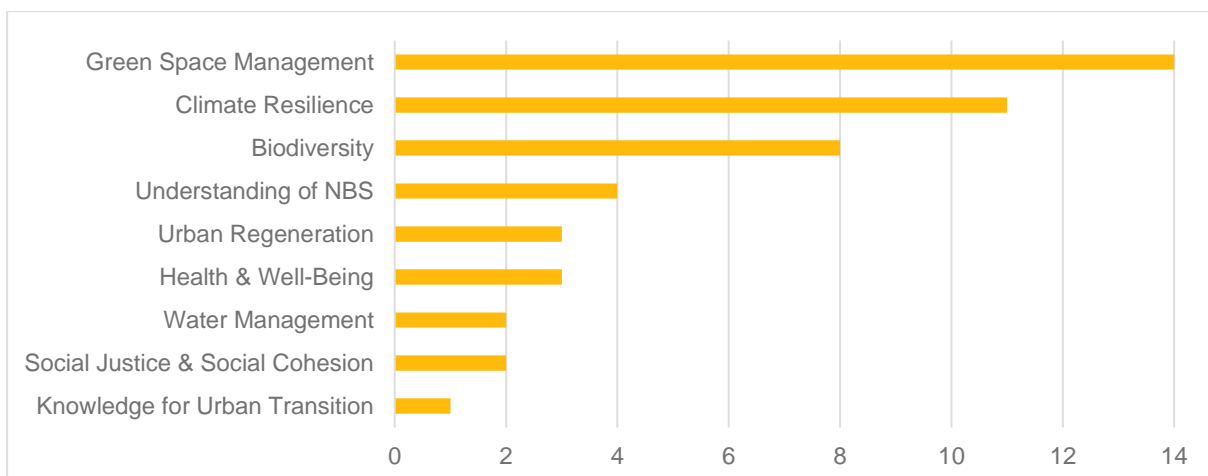
Figure 7 Form of education among NBS school initiatives



Source: Compiled by PPMI based on the repository

The initiatives display a diversity of NBS education projects. The learners are usually exposed to open green spaces, located in or outside schools with which they should be engaged as either part of study requirements or additional education opportunities. Habitat enhancement, such as developing footpaths and planting native trees, and management of invasive species were carried out to support the educational activities. Other projects include visits to farms, parks, or water reserves to provide practical experience to students. Thus, the NBS education initiatives focus primarily on the following NBS challenges: green space management, climate resilience and biodiversity enhancement.

Figure 8 Main NBS challenges addressed in the NBS school initiatives



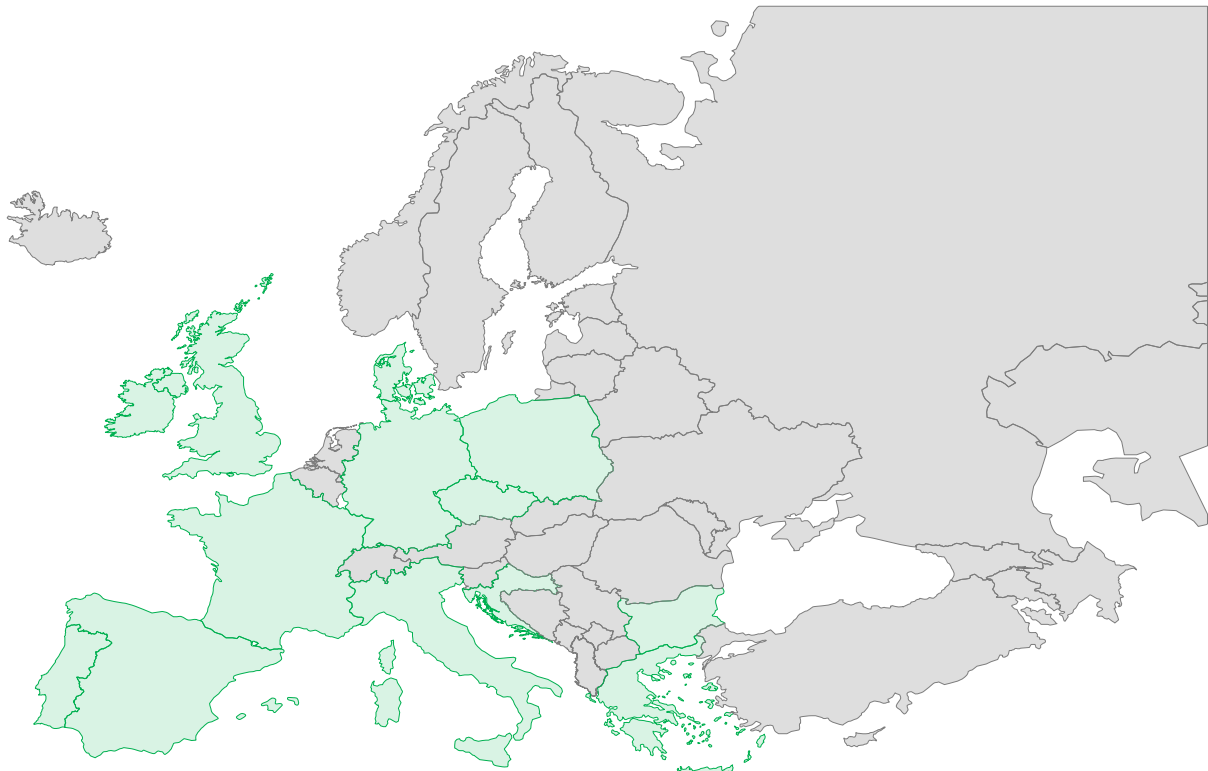
Source: Compiled by PPMI based on the repository

The mapping of NBS education activities in schools shows that there are some that explicitly target various groups facing disadvantage. For examples, NBS learning activities in Spain, France, Croatia and the United Kingdom have targeted children with disabilities and an initiative in Bulgaria have targeted refugee children. Besides, an urban inter-generational NBS education initiative in Greece targeted elderly and children from migrant and/or low-income background or with disabilities. While there are some examples of initiatives that address social

justice issues, the majority do not, or are not clear about how the NBS education initiative tackled and contributes to social justice and social cohesion.

Furthermore, these initiatives are all in urban areas, which could suggest that children from disadvantaged backgrounds in rural and coastal are underrepresented in NBS education activities (See map). Of all the 48 initiatives studied, only three were in coastal areas and one in rural areas – the remainder were in urban areas. **Figure 9** visualises this trend.

Figure 9. Map of school level NBS education initiatives in the European region



Source: Compiled by PPMI based on the repository. Green colour indicates urban communities being mainly targeted. There were no countries where coastal and rural areas were more targeted than urban.

Although most of the examples involve non-formal education, there are cases of curricula and assessment adjustments as well. Due to the methods used through desk research, the research team cannot get an equally comprehensive overview of what is taught in formal education given that a curricula review is not a part of the scope of the study. Previous research has found that education, similarly for both primary and secondary education, see most entry points for LfS within natural scientific subjects such as Natural Sciences and Geography, and, to some extent, Citizenship Education (Tasipoulou et al. 2021). It can be assumed that the same is the case for topics related to NBS.

Overall, there is a high potential for integrating the interaction with nature and green infrastructure in curricula or extra-curricular activities in formal education, regardless of the initiatives being developed by non-formal education institutions or NGOs. Interviews with the pilot teachers in the study on educational innovations around NBS by PPMI and EUN, find that it is feasible to integrate NBS also in formal education and by way of cross-curricular approaches. The learning scenarios by pilot teachers in the Integrating Nature-Based Solutions in Education project, available online and accessible for teachers across the region,

are a good example of this. So is the example of the learning scenarios and materials provided developed by Clearing house. Yet, it hinges on the availability of learning materials for teachers and students, and teachers having a prior interest in NBS and support from their surroundings to teach project-based learning (Interviews with secondary education teachers, February, 2023).

Box 5 NBS and hardy plants for a sustainable city**NBS AND HARDY PLANTS FOR A SUSTAINABLE CITY**

NBS Challenge: Biodiversity enhancement; Natural and climate hazards; Green space management

Description: The purpose of this learning scenario is to discover and name a variety of hardy plants (plants that can survive adverse growing conditions) which can act as NBS, helping to transition towards greener cities by having an impact on urban heat, oxygen production and citizens' wellbeing. These plants can be planted in various spots of the city to make the city sustainable. Although this learning scenario uses a suburb of Athens as an example, it can be implemented in other cities and areas. Students will visit a green area (in this case, Nea Filadelfeia Park of Athens, a park covering 480 hectares and containing a wide variety of flora) to search and take photographs of various plants. The plants in the park are adapted to the city microclimate, but students must seek the plants with less maintenance needs. The photographs will be uploaded to PI@ntNet, a citizen science project for automatic plant identification through photographs based on machine learning. This will allow students to discover which plants are hardy, according to a Greek hardiness zone map; that is, a map with geographic areas defined to encompass a certain range of climatic conditions relevant to plant growth and survival. A Padlet with the hardy plants that students have detected will be created and communicated to the local municipality.

Source: Oppla (n.d.)

The research team also screened for learning resources for children aged 6-18, with the keyword “nature” in the [Scientix](#) resource repository. The majority of the 131 results that were relevant, related to the project on integrating NBS in education. The types of resources were diverse covering learning scenarios on NBS, conceptual drawings, career sheets, videos and podcasts with NBS professionals to inspire students to start NBS careers. The NBS learning scenarios stemming from the pilot, however, reflect explicitly on NBS and on various of the NBS challenges. **Box 6** gives an example of a learning scenario where NBS is taught through innovative ICT to also foster digital competences.

Box 6 Lungs of the world: Make trees and forests part of your teaching**Lungs of the world: Make trees and forests part of your teaching**

NBS Challenge: Green space management; biodiversity enhancement; knowledge building for sustainable urban transformation; climate resilience

Description: The importance of forests and the benefits of single trees in the cities are still too vaguely understood by the urban inhabitants, students and teachers alike. The Clearing house project regards learning materials around ecosystem services of trees. The materials aim to lower the threshold to make trees and forests part of teaching, across subject lines. It is of utmost important to help the students recognize the importance of trees in the immediate living sphere, and the materials invite one to teach students about urban trees and forests in a manner that allows them the easy integration and application of the learnt material, and finally, inspires students to notice, value and protect the urban trees and forests now and in the future for the health of our planet. The learning scenarios and descriptions are available in Italian, Catalan, Chinese, Dutch and English.

Source: (ClearingHouse n.d.)

In the other relevant learning scenarios or resources in the Scientix resource repository, nature and ecosystem services were promoted to address climate change (Moore n.d.) (Hastings n.d.) and health (Suárez 2019), but the term of NBS was not used explicitly. Rather, terms such as ecosystem services, nature promotion and protection were used instead.

This review has found that in the NBS education activities at this education level, the focus is more strongly on the NBS challenge of green space management targeting urban communities. Overall, there seem to be many good examples of concrete educational guidance for teachers on NBS at this education level compared with the ECEC level, even if the trend regarding the focus in terms of NBS challenges is the same.

4.2.2. Challenges and barriers in implementing NBS education at schools

There are two key challenges observed among the analysed cases and through analysis of interview data, relating primarily to the overall project sustainability and the unclear focus on education – the latter resonating with the findings at the ECEC level.

Limited project sustainability

The first challenge refers to the limited duration of the NBS projects due to a lack of financial sustainability. This reflects in offering short-term educational opportunities only. For example, a non-formal urban education offer from the United Kingdom, although well-designed on paper, encountered unforeseen problems on site, including a contingency in the budget (Oppla 2021a). Some of the other projects did not necessarily have financial issues, but the project funding was completed, thus the education opportunity stopped. Similarly, an agriculture cooperative outside of Athens that was very active on social media, hasn't been active since 2018 (Urban Nature Atlas 2021b). Furthermore, a formal urban education offer from Bulgaria was active during its lifetime, but the events surrounding the pilot educational garden ceased

by 2013-2014 (Urban Nature Atlas 2022). Lastly, some of the projects, such as a non-formal urban project in Portugal, were not intended to be an occurring educational opportunity (Urban Nature Atlas 2021c). In 2017, the project had 2 weeks of educational sessions at elementary schools in Sintra county as well as tree planting. There is no recollection of subsequent educational events, or their quality of implementation. This identified challenge is consistent with the literature about the finding that finances and project-based approach to education are key barriers to developing and sustaining an NBS project along with its educational offer (Coles & Tyllianakis 2019).

This situation was reported as challenging also for the teachers who are teaching NBS, because it results in the resources from NBS projects not being available for a long time. A teacher in secondary education explained that many of the links from the first time they taught the learning scenario on NBS, were no longer available because project websites had been removed (interview with teacher in secondary education 2, 21 February, 2023). As projects often last a limited number of years, their associated websites get shut down as well as all their resources and heritage of the knowledge gained from the project.

Lacking focus on education

The other emerging challenge is the lack of maximising the educational outcome of an NBS project. In some cases, the education offered is a minor side-lined goal. In other cases, the project is all about establishing the green infrastructure, which is underused for educational purposes, or it is assumed that the green infrastructure will contribute to educational outcomes on its own. For example, several projects include building a green roof (Oppla 2020b), creating orchards (Urban Nature Atlas 2021d), or regenerating a biotope (Urban Nature Atlas 2021e) which are accessible to school children, but there is no evidence of how these NBS projects contributed to the education about the particular NBS. One of the underlining issues could be too broad of a target group which can undermine the learning offered to the intended target groups. For instance, two non-formal urban education offer from Spain and Germany have been intended for both the general public and school children (Urban Nature Atlas 2021d) (Urban Nature Atlas 2021e). While there may be educational programme intended for school children as a side possibility, the main intention is for the green infrastructure to offer recreation for a number of diverse audiences, including children, adults, and vulnerable groups. Finally, one project, a non-formal urban education offer from the United Kingdom, recognises that a challenge can be to integrate the NBS project in the classroom because schools have already a busy schedule (Oppla 2021a). This conclusion is in line with the observations in the literature that education opportunities from NBS projects are not always clear, or at least are not streamlined (Coles & Tyllianakis 2019) as well as interviews with teachers at this education level.

External challenges facing teachers

There are several external factors that act as barriers of successful NBS education at primary and secondary school levels. One key factor that acts as a barrier for teachers at secondary education in teaching NBS, is the element of finding time in a packed schedule. This relates to the challenge of teacher shortages, which is an issue in several Member States. An interviewee stated: *“Sometimes it is also hard to convince other colleagues to dedicate certain hours to climate change, even if the respondent offers to give them the ready scenario”* (Interview with

a secondary education teacher 3, 22 February, 2023). Thus, teachers request more time, at least an hour once a month or a week per yet, that can be devoted to NBS (Interview with a secondary education teacher 4, 22 February, 2023).

Another external factor acting as a barrier for teachers over the last years was COVID-19, as indicated by the following teacher who was teaching students NBS and focusing on soil management: *“It was more challenging during covid. We didn’t have any kind of soils at home. The problem was not the internet connection or the digital skills for the kids. The problem was the measurements, the data, the practical aspects because there’s a lot of hands on activities. Some of them I did at home myself, some of the soils I mixed to show them, and they would take notes of the results”* (Interview with a secondary education teacher 5, 22 February, 2023). While this challenge is less relevant currently across Europe, potential reversal to school closures due to COVID-19 or new pandemics, is a potential threat that crystallises the importance of developing suitable blended learning and ICT for teaching NBS – as well as the relevance of NBS itself to deal with health and well-being, pandemic and nature-related challenges, and social and economic resilience.

Socially disadvantaged children

Many of the observed NBS education projects focus on co-addressing societal challenges and foster social inclusion. However, in practice, including disadvantaged groups can be a challenge. According to an interviewed expert, when the school organises a visit to the park with bicycles, students of more humble background usually report sick that day because they don’t have bicycles to join the visit (Interview with adult and primary/secondary education expert 4, 14.02.2023). This requires further thinking on how to include socially disadvantaged groups, as well as to remove any Member States of stigma they might experience, as they report to be sick to cover the real reason for not attending a visit to the NBS education-related park. However, it should be noted that public parks in general, if the learning event is organised correctly without reliance on learners’ acquiring personal tools, could be a very good instrument for inclusion through NBS education.

4.2.3. Evidence of the success and achievements of NBS education at schools

Other than the mentioned drawbacks, the majority of identified NBS projects have evidence of multiple achievements of activities advancing NBS education. These relate to the innovative governance structures, financial models, inclusion of vulnerable groups, involvement of teachers, examples of NBS formal education, and examples of outdoor education. Interview data will further expand and/or validate these success factors.

Governance and sustainability: collaboration of private and public actors

To develop an NBS project and subsequently explore its educational purpose, many stakeholders need to be involved. There were examples of active involvement of schools, school children, and teachers, but also public and private stakeholders. Some projects centre around the active involvement of school children, such as a suburban formal initiative in the United Kingdom, as it has engaged thousands of children before its 10th anniversary (Urban Nature Atlas 2021f). The involvement of non-governmental actors is relevant, especially for a non-formal urban initiative in France (Urban Nature Atlas 2021g). Many projects depend on volunteers, such as the examples from the United Kingdom (Urban Nature Atlas 2021h) and

Croatia (Urban Nature Atlas 2021i). Furthermore, the involvement of public institutions is essential. In Portuguese project regarding green infrastructure, the local government donated trees and organised educational programmes (Urban Nature Atlas 2021c). For a French NBS initiative targeting children with disability, the prominent role of the Deputy Mayor to co-lead a project was noted (Urban Nature Atlas 2021j). This relevance of cross-sectoral cooperation for NBS education activities has been also highlighted in the literature as important for successful implementation of LfS (UNESCO 2019).

Supportive use of digital tools

The introduction of digital tools in schools depends on the national context and school regulations. In some schools, such as in France where terror attacks have happened, there is a very strict policy regarding the use of digital resources. Students have to leave their phones behind before entering a classroom, and cannot go out in the school yard (Interview with primary/secondary education expert 1, 26.01.2023). This makes the integration of digital tools more difficult in certain contexts and requires adaption from school to school. The situation shapes how NBS education will be implemented. Thus, one cannot expect that mainstreaming of NBS education in schools can happen in the same way in different schools in different parts of Europe, as it depends on the practices around the usage of digital technologies for learning. That being said, being able to use ICT for strengthening teaching around NBS is crucial and very much appreciated by teachers (Interviews with secondary teachers, February, 2023). Especially, the need for good digital infrastructure was highlighted as key to reducing the negative impact of the COVID-19 pandemic.

Financial models: a combination of private and public funds

Similar to the previous point, a combination of private and public funds was found to be a relevant ingredient to the success of NBS projects and their education activities. In some projects, public financing was crucial, such as for two projects from France (Oppla 2020b; Urban Nature Atlas 2021k) and one from Czechia (Urban Nature Atlas 2021l). The city budget funded an urban NBS education project in France and involved the participation of local environmental NGOs (Urban Nature Atlas 2021k). In some cases, the school was the initiator and applied for public funds, such as an urban non-formal initiative in Poland (Urban Nature Atlas 2021m). On the other hand, a non-formal German initiative was led by NGOs and attracted both public funds and corporate investments (Urban Nature Atlas 2021n). Similarly, an urban non-formal education project in Bulgaria was led by students and teachers while the key funding came from an environmental NGO (Urban Nature Atlas 2021o). Lastly, some projects are a combination of grants and public support. A non-formal education project in Czechia was funded by the Czech Ministry of Education, the City of Brno, the Austrian government, and EU funds (Urban Nature Atlas 2021l). The literature has also found that an NBS project requires multi-level stakeholder involvement to ensure its sustainability (Directorate-General for Research and Innovation 2015).

Social inclusion and addressing societal challenges

NBS has an important role to address societal as well as environmental challenges. Some of the projects specifically addressed the needs of vulnerable groups. In the United Kingdom, a sensory garden enable people with disabilities to experience nature (Urban Nature Atlas 2023), while in Croatia, a project engages the participation of people with disabilities in activities and

programmes of the City Garden for therapeutic gardening and education (Oppla 2020c). Furthermore, a project in Bulgaria included the active participation of Syrian refugees in the communal bio-garden (Urban Nature Atlas 2021p). The underlying ingredient of these projects intending to address the needs of vulnerable populations is that they have been led by citizens. In Bulgaria, the communal garden was created by a group of citizens and the local residents take care of the garden. In some projects, citizens can contribute to legislation change through NBS. In an urban non-formal initiative in Spain, citizens acted to keep a public and open green space against proposed legislation that would destroy it (Urban Nature Atlas 2021q). This shows that NBS education has an inclusive educational purpose and outreach potential (Directorate-General for Research and Innovation 2015) – although these examples are primarily examples of non-formal educational settings.

Outdoor education

One of the concerns of the modern educational setting is the unhealthy habits of learning in a confined space like a classroom for long hours. The distinctive contribution of NBS education is the integration of outdoor education. Many projects illustrated the positive impact of outdoor learning spaces. Some are integrated into the schools, such as project which is a wildlife-friendly area as the outdoor play space in a primary school (Urban Nature Atlas 2021h). In other cases, outdoor education takes place during school trips. In an urban initiative in France, the students could visit a farm with organic vegetables (Urban Nature Atlas 2021r), while in a non-formal urban initiative on NBS in Germany, they could taste bee products (Urban Nature Atlas 2021s). The literature singles out outdoor education as a positive and immersive way to learn about nature comprehensively not bound by grey infrastructure and materials (Nicol 2014). Besides, a non-formal urban initiative in Spain especially notes the impact of outdoor learning spaces on students with behavioural difficulties (Urban Nature Atlas 2021t).

Facilitating the role of teachers

The NBS projects also address the relevance of teachers and their contribution to utilising green infrastructures for formal educational purposes. In a United Kingdom non-formal suburban initiative, it's been noted that involving the school staff ensures the school will feel a sense of ownership and pride towards their NBS project (Oppla 2021a). An urban and coastal formal NBS initiative in Spain motivated pupils to enter the world of urban horticulture, creating synergies with other lectures, and has been well received by teachers and parents (Urban Nature Atlas 2021u). This is consistent with the literature emphasising the role of teachers and other school stakeholders in shaping children's education (Nature-Based Solutions Facilitation Team 2019). We confirm this finding with an interviewee who explored NBS in schools in France, Denmark and Croatia to find out that to which extent NBS gets embedded in formal education depends on the teacher (Interview with primary/secondary education expert 1, 26.01.2023). Younger teachers tend to be more interested to innovate their teachings and introduce NBS (Interview with primary/secondary education expert 1, 26.01.2023). This is also consistent with the findings of the global UNESCO study on the role of teachers in teaching ESD (UNESCO 2021b).

Integration in formal education

The key success of several NBS projects involves their educational offer of formal education. This has been observed across a few projects which successfully translate the learning about

green infrastructure into a curriculum or a required learning material. In the Irish example, which is a school-based business run by students, the initiative resulted in integrating the knowledge into a curriculum (Urban Nature Atlas 2021v). Moreover, projects from the United Kingdom have also been incorporated into the classroom. In one particular case, each school incorporated the different stages of the trout lifecycle into their classroom learning as an approach to teacher NBS for water management (Urban Nature Atlas 2021f). In another Irish example, the initiative also resulted in learning material for teachers (Urban Nature Atlas 2021w). As a result of the FitzSimons Wood Biodiversity Education Programme, a detailed handbook for schoolteachers was produced with guidance on how to lead school activities where students investigate local wildlife. In a few projects, formal education can be witnessed by placing students at the centre of the programme development which has been integrated in official subject evaluation. The Saltersgate Junior School in the United Kingdom co-created an eco-friendly 'living wall' and they are using it as an educational area for studying different types of plants and insects as a result of an NBS education initiative (Urban Nature Atlas 2021x). Furthermore, in an initiative in a formal urban setting in France, students were active co-creators of maintaining a sustainable building including vegetable gardens using them to develop projects on biodiversity (Oppla 2020d). This highlights the potential of green buildings and other green infrastructures to be used for formal educational purposes – although this occurs less frequently than the integration of NBS in non-formal education. Therefore, the educational spill-over effect starts with the support for green building (Directorate-General for Research and Innovation 2022).

The interviewed teachers who have taught NBS through their learning scenarios, emphasised that the lack of NBS in the curriculum is not a complete hindrance but still an obstacle to teaching NBS (Interviews with secondary teachers, February, 2023). While the teachers have been creative in finding ways to teach NBS (e.g., through project week), it would be more easy if NBS was clearly identifiable in the official curriculum. This could enable NBS to be taught more frequently and by all teachers – not just the ones who are highly motivated and supported by their school environment. One such positive story and example is that recently the teachers from the European School Network have been working on the development of new syllabus for sixth and seventh graders- Sustainability and Active Citizenship. One of the topics of the course refers to the innovation and technology of NBS to solve the bioclimatic crisis. The syllabus has not been validated yet, but it is expected to be done by the end of March 2023 as schools are getting ready for September 2023. The course will be taught in 27 different schools around the EU Member States, which means that approximately 20,000 students will be able to elect this course and those students will have an opportunity to learn about NBS.

School children as green ambassadors

By being exposed to NBS education, but nature in general, children can facilitate the education of their parents as well. In some cases, parents have limited knowledge about nature and are afraid of bees, therefore, are not willing to allow their children to be involved in outdoor education in green spaces (Interview with adult and primary/secondary education expert 4, 14.02.2023). Children can help challenge these perceptions of their parents and help address the issue of adults being 'detached' from nature (Interview with adult and primary/secondary education expert 4, 14.02.2023). This can be an example of intergenerational learning about NBS.

4.3. NBS in vocational education and training

4.3.1. Overview of the scope and availability of NBS in VET

While WP2 researchers recognise that VET should be distinguished between initial and continuous, the desk research and interviews did not find any valuable information on continuous VET and thus this section focuses primarily on initial VET. This is another of the key gaps discovered during this study – there is very little information available on both initial and especially continuous VET.

Although there are several thematic areas in VET where education on NBS could be potentially included, **desk research could not identify any concrete training offers that include NBS at the VET level.** Possible VET courses, into which NBS elements could be integrated, are mainly situated in the agricultural sector and in the building sector. In these sectors, some companies in Europe have started applying NBS and are now looking for qualified workers who are knowledgeable of NBS. However, while there is an increasing number of available short-term trainings for workers who have concluded their basic training and are already working in the sector (see section on adult learning), the curricula of basic VET courses have not yet been revised. For instance, the curriculum for VET training to become farmers has not been updated for more than 20 years in many German regions (John & Beringer 2019).

Box 7. Description of a learning scenario to integrate NBS in technical classes

Description of a learning scenario to integrate nbs in technical classes

NBS Challenges: Biodiversity enhancement; green infrastructure; knowledge building for sustainable urban transformation

Description: The purpose of this learning scenario is to introduce students, especially those at technical and vocational high schools, to NBS, using the concept of green infrastructure applied to a practical project. To begin with, the teacher presents NBS and their benefits and discusses them with students, with an eye to local issues. After laying the foundations of NBS and related challenges, students' approach (urban) problems and how to address them through green infrastructures, i.e. infrastructures integrating nature. Followingly, the teachers propose a challenge that students must solve practically by modelling a solution involving green infrastructures. Students divide into groups and work on their project, considering design, planning, NBS, financing and civic engagement through co-creation. Finally, students present what they created to their classmates, as if they were public and private stakeholders, trying to gain support and funding. Through this scenario, students can reflect on the increased social, economic, and environmental value of infrastructures that include NBS. They also develop a sense of how to get a project funded, and they practise pitching a project to relevant stakeholders. Thus, students not only expand on their knowledge and vocabulary, but they also acquire communication skills by addressing real-life problems. Most prominently, they understand the relevance of combining STEM with NBS and the feasibility of including sustainability in their future projects and plans.

Source: (Jabłoński 2020)

In the **agricultural sector**, a specialisation on organic farming could be enriched by NBS aspects, as topics such as rotational grazing, crop rotation and the use of organic fertilisers are common to both organic farming and an NBS approach. For instance, the VET curriculum for Agroecology in the autonomous community of Valencia in Spain includes topics such as traditional systems of using and saving of water for irrigation, biocenosis, use of organic and mineral fertilizers, organic vegetable production, biofumigation as well as ethical commitment to the values of conservation and defence of the environmental and cultural heritage (Department of Education, Training and Employment 2012).

In the **building sector**, vocational skills are mainly needed for the construction of green roofs and green facades. Professional profiles that could include NBS aspects are roofers and civil engineering technicians. According to the chairman of the VET committee for gardening and landscaping in Germany, the curriculum for VET training to become landscape gardeners from 1996 is currently being revised to include aspects such as climate, biodiversity, water and sustainability. According to him, no development of a new VET training course is needed but the existing training prepares young professionals well to carry out works for the greening of facades and roofs (Bundesverband GebäudeGrün e.V. 2021).

There is a limited offer of non-formal VET education, and those found through desk research, also are combined with educational activities for other target groups as well. In **Box 8**, an example from Germany shows that vocational trainings for extracurricular education is offered in a project that also targets adults and children too. However, there are different education packages for each group.

Box 8. Wilderness experience garden Münster

Wilderness experience garden Münster

NBS Challenges: Green space, habitats and biodiversity; Social justice, cohesion and equity; Health and well-being

The wilderness experience garden and laboratory was founded by two pedagogues. It's a place for nature experience and exploration for children and adults. Guests are encouraged to engage with nature scientifically, via play, arts or manually. Vocational trainings for extracurricular education providers are also offered. The focus is on creating a community and close the gap between man and nature. The organizers offer different experience packages for children, school classes and adults alike.

Source: (Urban Nature Atlas 2021n) Source: (Urban Nature Atlas 2021n)

4.3.2. Challenges and barriers in implementing NBS in VET

The main barrier to implementing NBS education activities in VET is that **NBS is not yet very present at VET level**. Curricula of disciplines that could include NBS aspects have not yet been updated, and there does not seem to be a lively debate about whether to include NBS. A reason could be that **the discourse on NBS and professional training is mostly situated at the level of adult learning** and focuses on introducing upskilling training offers for workers

who have already received basic training in the field, or who are interested in learning more about it.

Furthermore, **the use of NBS as an alternative or addition to grey infrastructure has not yet been mainstreamed and is often confronted with concerns from various stakeholders**. For instance, a study on barriers to the implementation of Blue-Green Infrastructure in a city in the United Kingdom found that the vast majority (89%) of interviewed stakeholders involved in city planning displayed a “reluctance to support novel/new approaches to flood and water management and change practices, typically from traditional hard-engineering grey solutions towards more sustainable Blue-Green strategies” (O'Donnell, Lamond, & Thorne 2017).

In addition, a study on the uptake of new concepts in urban greening in Poland came to the conclusion that **concepts such as NBS and green-blue infrastructure feature prominently in many strategies but that local administrations have little knowledge of concrete implementation of these concepts** (Baravikova 2020). These difficulties with implementing NBS can be seen as a reason why there is currently only limited demand for NBS-related skills, and thus the update of VET curricula is not yet seen as a priority.

The competences frameworks, although known, are not a crucial reference point for educators, neither in VET nor in other forms of education, according to multiple interviewees. They are considered a buzzword, and many other relevant aspects need to be considered and embedded in the competences (Interview with VET expert 1, 10.02.2023). This impression is also found in the youth informal education initiative, NBS Youth initiative, which has the following key message: *“NbS is a new term for an old idea that has been understood and practiced for millennia. The term “NbS” is vulnerable to greenwashing that could promote monoculture plantations, the commodification of nature, land grabbing, and other impacts on human rights”* (NBS Youth Position 2021). This does not mean that competences are not important, but there seems to be an inflation of catchy words and phrases that reframe the same aspirations of greater integration of nature and society in a mutually supportive way.

Similar to adult education, and non-formal education, NBS VET education does not necessarily focus on providing proof or assessment of the knowledge gained about NBS. According to the VET expert, it is not common, or a goal, to issue certificates as proof that the education about NBS took place (Interview with VET expert 1, 10.02.2023). There is also no intention to assess the education about NBS. The impression is that such assessment is not necessary.

The role of teachers to foster NBS education is important in VET as well as in primary and secondary education, however a barrier can be the lack of mandatory requirements about teaching NBS. An interviewee elaborates: *“And we've found that it's often the teacher's choice to [include] organic farming in the classroom. And the teachers are partly guided by the demands of the students and it is still the case that the students or some students have great reservations...that is enough an obstacle that there are no clear mandatory requirements to address organic farming.”* (Interview with VET expert 2, 25.01.2023).

The lack of finances can be an obstacle to mainstreaming NBS in VET. According to one interviewee, finances, or the lack thereof, is the biggest challenge (Interview with VET expert 1, 10.02.2023). The same interviewee explains that sometimes funding gets cut by the local or federal government. Having a lack of adequate equipment, even a car, can also adversely impact their work.

4.3.3. Evidence of the success and achievements of NBS in VET

There seem to be almost no scientific literature or reports in English on the inclusion of NBS topics into the learning offer at VET level, and, thus, **no concrete evidence can be given at this stage**. Yet, as the two examples above have shown, it is likely that VET courses in several countries and sectors do already include NBS aspects, without explicitly labelling them as NBS and without communicating about these programmes in English. Therefore, to identify best practices and evidence of success, more in-depth research on a national level in local languages is needed.

There is a focus on biodiversity among VET education offer. There can be cohesion with teaching organic farming, along with interest in circular economy, protection against erosion, and similar challenges (Interview with VET expert 1, 10.02.2023; Interview with VET expert 2, 25.01.2023). However, one of the interviewees does not that their goal of mainstreaming organic farming has not been achieved, but still many introduced it making part of the 'eco-class'. (Interview with VET expert 1, 10.02.2023). According to the same interviewee, biodiversity is a huge topic related to agriculture and crop production.

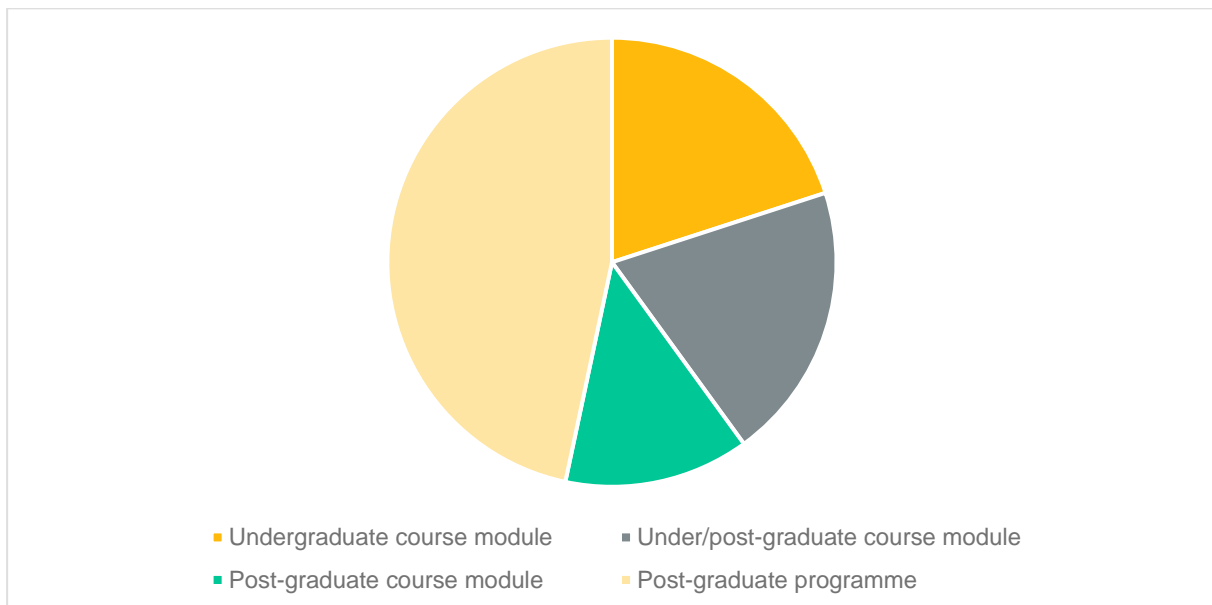
There is evidence that NBS in VET can be a good example of diversity in students along with high graduation rate. According to an interviewee, they have often persons with special needs school background, and a higher share of female students (Interview with VET expert 1, 10.02.2023). They are not only proud of this diversity, but also because they have a high graduation rate compared to other agriculture classes (Interview with VET expert 1, 10.02.2023). This example can be contrasted to the example mentioned in the section on primary and secondary education where socially disadvantaged children face greater challenges to be involved in NBS education projects. This VET example of inclusion shows that greater social cohesion can yield better societal outcomes, also in relation to mainstreaming NBS education.

4.4. NBS in higher education

4.4.1. Overview of the scope and availability of NBS in higher education

The focus on sustainability in higher education institutions (HEIs) has been an outgrowth of the Millenniums Development Goals and the more recent UN Sustainable Development Goals which have fostered labelling of research, education and training programmes within the identified 17 SDGs structure (Vasconcelos & Calheiros 2022). The adoption of the globally agreed definition of NBS by the UN Environment Assembly has likewise encouraged greater international collaboration, placing a stronger emphasis on implementation of NBS to tackle societal challenges. Finally, although there remains some confusion on what constitutes a solution and how they should be designed, implemented, financed and assessed, NBS have gained traction in business and policy owing to favourable EU policy on green investment. Given the current transition to a green economy, skills around NBS can be expected to increase in demand among employers, and higher education policies and curricula have evolved as a key element to prepare students for this changing labour market (Leal Filho et al. 2018a).(Leal Filho et al. 2018a)(Leal Filho et al. 2018a). All of these developments impact the broad range of education offers available at the higher education level today, to be further explored in this section.

Figure 10. Formal higher education NBS offers by type of programme

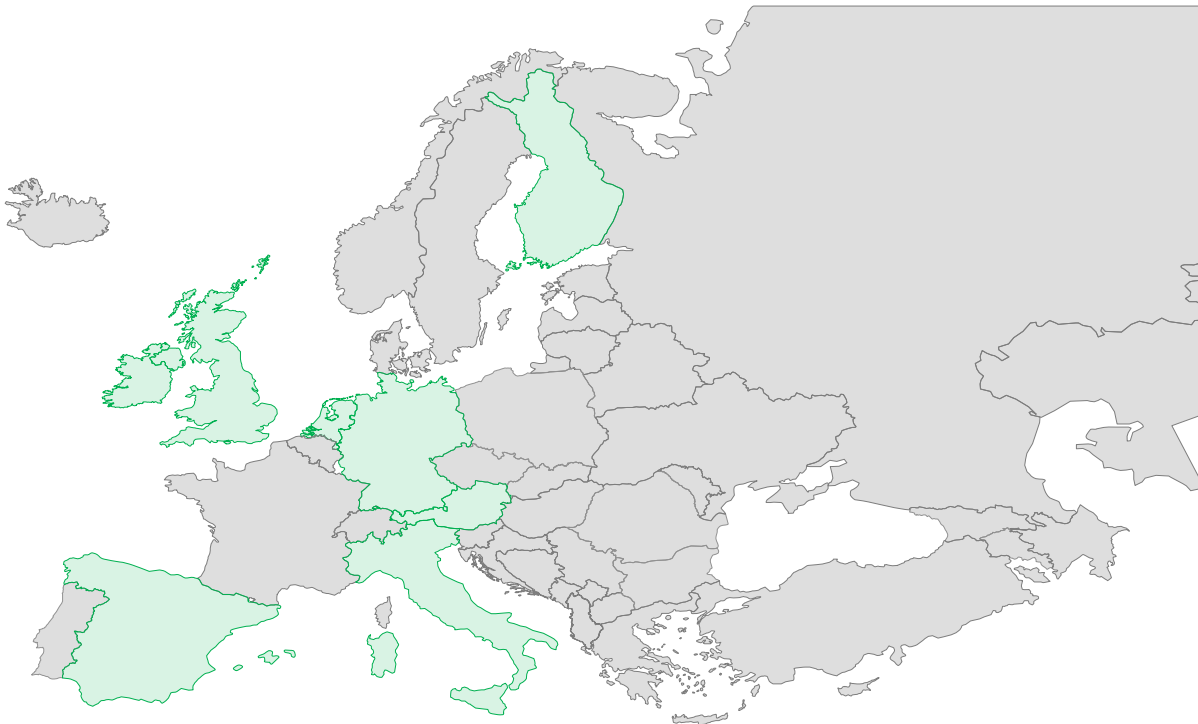


Source: Compiled by PPMI based on the repository

The primary focus of this section is formal education, i.e., study programmes or courses offered to HEI students. Research on under- and post-graduate programmes and course modules relating to NBS in Europe resulted in 15 relevant examples. It should be noted that, overall, cases of NBS education in HE are somewhat difficult to circumscribe, as HE programmes in sustainable development and urban planning inherently include instruction on NBS, even if not making direct reference to the term in course or programme descriptions. Cases of NBS specification, whether in syllabi of study programmes or in specific taught course descriptions, are still rare, indicating HE is lagging behind the terminology employed within the EU institutional landscape. All examples included here make direct reference to NBS in their descriptions.

Of these 15 cases, all offered programmes or courses are relatively recent, dating no more than several years in teaching. Most are offered in the United Kingdom and Spain, with the rest of examples coming from Austria, Finland, Germany, Italy, Ireland, and the Netherlands as reflected in the map below. Majority of the examples (13) come from urban settings, four of which are urban coastal settings. One identified example is in a coastal rural area, and one was conducted online. It should be noted that the setting of the studies does not necessarily determine the focus of NBS teaching, and neither does it necessarily mean the students come from the local area.

Figure 11. Geographical distribution of NBS education in HEI



Source: Compiled by PPMI based on the repository

Box 9 Practice-based NBS university course module

Practice and place based NBS course module at the University of Helsinki

The Nature-Based Solutions course is offered to students of master's Programme in Environmental Change and Global Sustainability at the University of Helsinki. It aims to instruct students on the policy relevance of nature-based solutions and their role in addressing important challenges in urban areas. Students are provided with instruction on how to critically assess and utilise methods for planning, implementation, and evaluation of NBS. They later use this knowledge to address a challenge of a city within Finland (or abroad) using the NBS approach. The course module also requires students to explore themes of social inclusion, environmental justice, human well-being, environmental governance and/or ecosystem resilience.

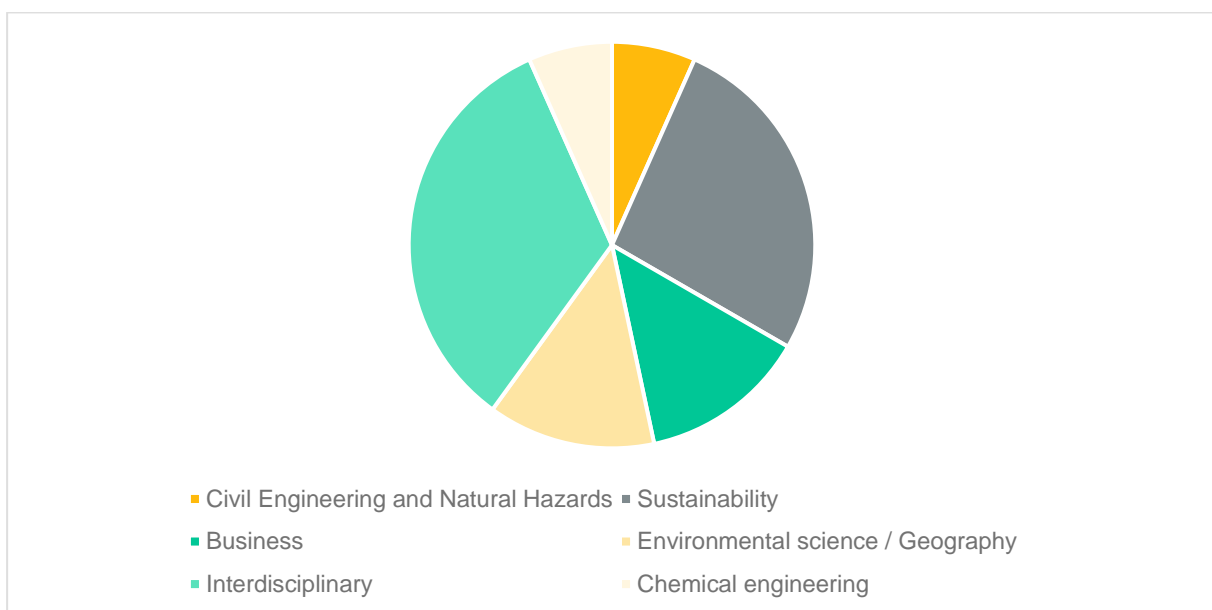
Source: ("Nature-based Solutions, University of Helsinki")

A distinction in approach to teaching can also be made between programmes or courses that focus on a general instruction of what is NBS (7 examples) and others that are more focused on a certain topic (e.g., urban design, water management, or ecosystems restoration) (8 examples). Although the setting for HEIs is primarily urban, several universities offer outings and cooperative projects in nearby rural or coastal areas. Moreover, courses and programmes diverge based on their focus on theory versus praxis, with the latter type offering a more engaged and place-based experience to students in developing their own NBS to social or

ecological problem. An example of a practice-based course module is presented in box 9 above.

Whereas a greater part of NBS teaching takes place within under- and post-graduate programmes falling under sustainability, geography, or environmental science departments, a third of the examples can be categorized as inter/trans-disciplinary approaches (Figure 6). The latter are usually either separate departments that focus on inter-disciplinarity (e.g., Warwick University School for Cross-faculty Studies) or are examples of course modules and study programmes run by several different departments and/or taught by professors of different disciplines, along with a mix of public institution, NGO or business representatives.

Figure 12. Course module and study programme distribution by department/field of study offering it.



Source: Compiled by PPMI based on the repository

The online NBS platforms, [Oppla](#) and [UNA](#), were also used to search for non-formal NBS education projects carried out in and by HEIs. Nevertheless, this resulted in only 3 relevant cases relating to on campus NBS initiatives that engage the broader HEI community or events relating to NBS. Examples of non-formal education in HEI includes urban community gardens on site of the institution (e.g., University of Education in Karlsruhe, University of Murcia), which are open for student involvement and focus not only on creating green spaces, but also education in maintenance and management of urban nature, and further knowledge creation to replicate the learnt skills in the broader community extending past the HEI in question. Another example comes in the form of an NBS competition for students globally, presented in greater detail in the box below.

BOX 10. The nature-based solutions challenge

The nature-based solutions challenge

In the Nature Based Solutions Challenge, organized by Wageningen University in the Netherlands in 2022, student teams from around the world worked on a nature-based solution in their own local context, addressing climate change mitigation, climate change adaptation and biodiversity restoration, as well as societal and economic impacts. Eight teams from Brazil, Congo, Indonesia, Nepal, Sri Lanka the Netherlands and Uganda were selected by the jury to implement their Nature-based Solutions project. Each team was provided mentoring from experts in the field and funding (2500 euro), to work on their projects from May until September 2022. The winning team from Sri Lanka had been working on the rehabilitation of coral reefs in the Kayaker Coral Cove by building in situ coral nurseries, creating awareness within schools in the area about nature based solutions specific to coastal areas. To ensure the continuity and success of this event, the University established an additional budget of € 10.000 for the teams to further develop their projects.

Source: ("Nature Based Solutions Challenge" 2022)

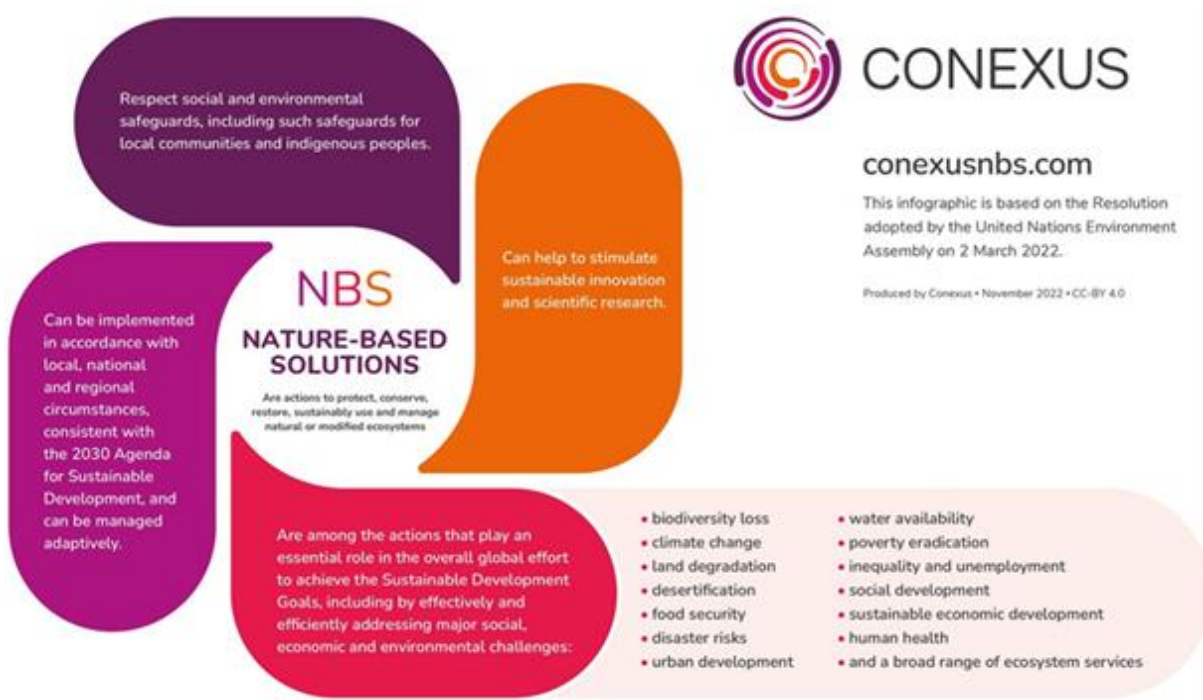
Finally, there are also cases of cooperation around themes of NBS among researchers and academics and/or HE institutions, which may extend to partnerships with policymakers, communities and activists, fostering interchange of knowledge and synergies between different stakeholders. This is exemplified by the international HEI knowledge sharing network Conexus, which relies on conceptual frameworks centred on NBS (see Figure 13 and 14). Conexus connects partners across Europe and Latin America with the aim to inform and foster changes in urban policy.

Figure 13. Conexus conceptual framework



Source: (Conexus 2020)

Figure 14. Conexus definitions of NBS



Source: (Conexus 2020)

There are also several NBS focused projects and research group, usually consisting of professors and PhD students (e.g., University of Helsinki, Norwegian University of Science and Technology). It should be noted that in these cases opportunities for direct education may sometimes be limited, as the primary goal of such cooperative work is knowledge creation.

4.4.2. Challenges and barriers in implementing NBS in higher education

NBS courses are challenging to deliver within the education sphere as relevant and detailed, with taught on-ground examples not always readily available, although this is changing rapidly within the 5 years as NBS project suite delivers expected research and demonstration outcomes. Due to their constituent components and scale, NBS often require time to realise the adaptive, mitigative or resilient co-benefits, are very context specific making their effectiveness difficult to quantify (in either monetary or non-monetary returns) (Kapos et al. 2019), and their benefit-cost ratios may be variable over time to accrue benefits. Therefore, creating and delivering education that caters to specific contexts, situations, knowledge requirements and success metrics with a range of nuanced examples, is often difficult and requires not only careful consideration, but transformative cross-disciplinary education.

Lack of transdisciplinarity

The increasing understanding of NBS, their value and importance to the environment and sustainable development has fermented a change in terminology and discourse used to describe actions, education, and the training arena, quantifying NBS in terms of knowledge exchange and target audiences. Being multifunctional, working at multiple scales and varying over time, NBS are often complex, which presents issues associated with ownership (land rights, etc.), administrative capacity, consistent policy and regulatory compliance, making the designing, implementation and measuring of the effectiveness and impacts of NBS difficult

(Kapos et al. 2019; Price 2021). In turn, delivering education and training in NBS is even more complicated, as they need to be studied from a variety of disciplines. Higher education textbooks and courses across disciplines have been developed as field focussed materials addressing environmental education, with inconsistent inclusion of life and earth sciences (Colonge, Molina-Navarro, & Alfaro 2022). For NBS education to be effective, it has to integrate both earth and social science approaches. As such, there is a need to redesign and integrate these fields to provide a broader understanding of nature, our role in it, and to steer those about to enter the world of work towards care for the environment (Alva 2022).

A strong understanding of ecosystem performance interrelationships and justice dimensions that engages a variety of stakeholders requires a comprehensive integrated knowledge set, which calls for developing higher education platforms that cross disciplines and employ fundamental transitions in the way subjects are taught (Nesshöver et al. 2017; van der Jagt et al. 2021). This includes transformations in education institutions, rethinking and promoting the need for cross-collaborative approaches, redesigning of disciplines, and appreciating the epistemology and multicultural vision of sustainability (Leal Filho et al. 2018b). To date, this has not been accomplished consistently across HE institutions in the EU: as Figure 12 shows, only about a third of NBS education in HE cases employ an inter/trans-disciplinary approach.

Proliferation of terminology

Similarly, the recent changes in the discourse to focus on “green transition and sustainable development” raises concerns that returning to the use of the term sustainable development and accompanying it with an emphasis on the ‘green transition’ has created a dichotomy of terms, policies, functions, and investment strategies which have often masked the success of NBS education programmes. In effect, labelling NBS as sustainable development education makes it difficult to distinguish between the success of NBS initiatives both inside and outside educational institutions. The re-introduction of these terms is a recent evolution which is, however, in line with the development of overall EU policy, where the green transition is becoming a more commonly used term in overall energy, economy and environmental policy documents and strategies (e.g., European Green Deal) (Mulvik, Siarova, & Coles 2023).

Difficulty in quantifying NBS effectiveness

Finally, it is an unrealistic expectation that NBS is a panacea, thus, it should not be expected that every NBS is cost effective, easy to install, or delivers immediate benefits in the short-term; NBS also come with an additional requirement to accept uncertainty in relation to perceived success or performance (Nesshöver et al. 2017). Acting otherwise would be bordering greenwashing at worst, and inefficient and superficial usage of NBS at best. This is a considerable risk for HEI which often compete for awards and reputation, and is a business that is increasingly results and performance driven based on quantitative rather than qualitative indicators (Vidal & Ferreira 2020). This trend towards easily quantifiable outcomes of education, may make NBS an unappealing subject to teach due to its complexity and the unpredictability of success that carrying out NBS projects as part of the learning process entails.

4.4.3. Evidence of the success and achievements of NBS in higher education

Within the EU, higher education has achieved greater prominence in the policy arena in the 21st century, largely because of the Bologna Process (Brooks 2018). Given HE's policy standing across the EU, while it is still not considered a 'classical' single market domain, there have been considerable efforts to advance integration across the Union (Cino Pagliarello 2022). HE is therefore considered an important driver for achieving a range of economic, social and political goals of policymakers across Europe (Brooks 2018). Despite the inconsistency in implementation and lack of convergence around common values in the construction of a single market for education, the effort to utilise HE in this unification process is loosely categorised as The European Higher Education Area (EHEA) and the European Research Area (ERA), both of which fall under the competence of Member States (Cino Pagliarello 2022). The aim of the EHEA and ERA is to enhance and promote a system of easily readable and comparable degrees, promote European citizens employability and the international competitiveness of the European higher education system.

As a result of these actions and policy decisions, greater opportunities exist for increasing student and postgraduate mobility, academic recognition, whilst still maintaining relative autonomy of the educational institutions within the EEA and the European University Institute network. Thereby, this facilitates the adoption and development of NBS (or green) competencies, subject modules and degree options within the sustainability context across the continent. Using HE as a pillar to increase awareness of NBS also provides a backdrop for moderating global expectations, to better recognise connections within and between our societies and ecosystem functionality that is ostensibly linked to NBS and, by extension, sustainable development. Using NBS to address sustainability challenges has foreshadowed the need to reform scientific expertise at university level, with HEIs incorporating and institutionalising sustainable development through some pathways for success:

- the adoption of new and NBS-explicit communication patterns;
- developing new ways of knowledge production and decision-making;
- engaging with different actors from outside academia in the research and education delivery processes (Tejedor, Segalàs, & Rosas-Casals 2018).

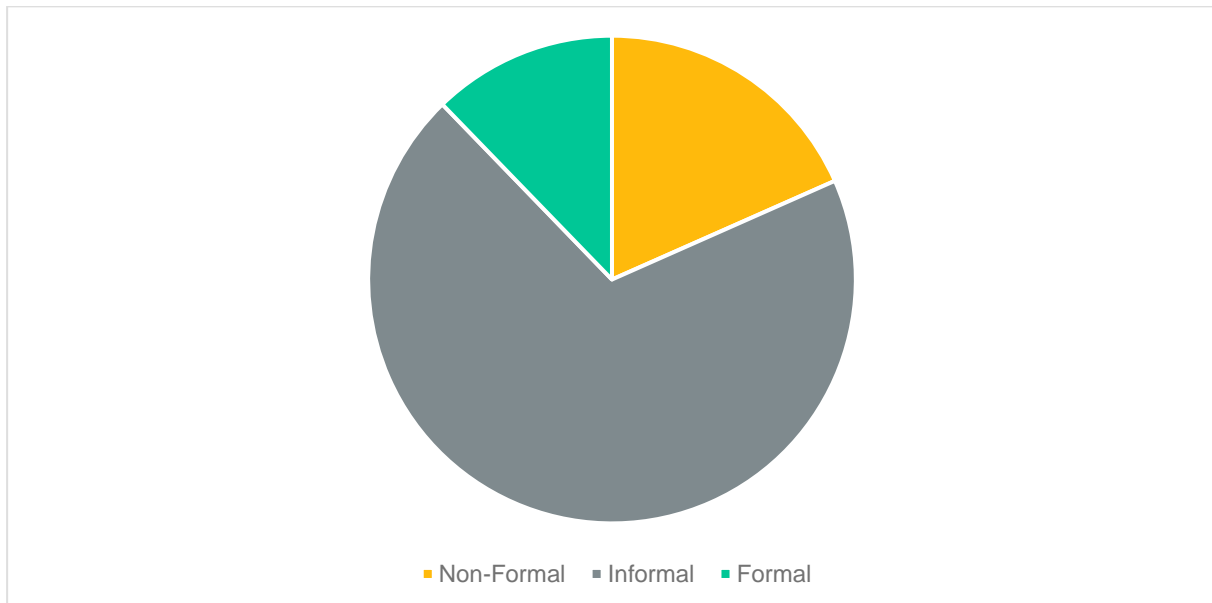
4.5. NBS in adult learning

Adult learning refers to a range of formal and informal learning activities, both general and vocational, undertaken by adults, after leaving initial education and training (European Commission). In the context of this study, it is understood separately from C-VET which is more focused on work-based learning and learning specifically tailored for specific professions.

4.5.1. Overview of the scope and availability of NBS in adult learning

The databases explored for NBS projects with relevance to adult education resulted in 49 relevant projects across several European countries. This section sees several of the same trends as the prior chapters, with a strong focus on green space management and biodiversity in urban areas. The only way it stands out from the previously discussed education levels, is in there being much more good examples of informal education initiatives, which this section aims to understand more in-depth.

Figure 15 Form of education among NBS adult learning offers



Source: Compiled by PPMI based on the repository

The learning offers are located in 13 European countries, ranging from Western Europe, Eastern Europe, Northern Europe, and Southern Europe. Most projects have been in Germany, followed by France where we can observe a lively and developed active citizenship that often aims to address the needs of society. In this regard, we can mention at least three projects in Germany initiated to integrate migrants into German society through NBS projects. For instance, the **Green Spaces in Leipzig's East Quarter** project (Urban Nature Atlas 2021y) aimed to expand and improve the green spaces in the community through the development of parks, communal use of vacant plots, the establishment of new urban forests, the setting up of new communal gardens, and the planning of a green corridor for cyclists and pedestrians. Querbeet was set up in 2012 by a small group of gardening enthusiasts who shared a philosophy of cooperation and democratic self-governance in a shared rather than private space, but this also involves active engagement with social issues such as community politics.

We can observe that almost all of the projects have a non-formal or in-formal education profile. This ties to the concept of active citizenship rather than the formal delivery of education for adults. Multiple examples witness that the contribution of citizens is the key component of the sustainability of the projects along with demands for green infrastructure and solutions to societal problems. An example is shown of active citizenship's contribution to NBS sustainability in **Box 11**.

Box 11 Heempark, genk – a community-driven nature & sustainability park, Belgium**HEEMPARK, GENK – A COMMUNITY-DRIVEN NATURE & SUSTAINABILITY PARK, BELGIUM**

NBS Challenges: Climate resilience, air quality, water management, participatory planning, public health, social cohesion

Description: Local citizens were consulted on the park development and expressed a desire to retain the natural character of the site rather than convert to 'formal' park greenspace. A collaborative city citizens model for 'Heempark' was developed. The model represented a small-scale model of the former agricultural landscape with a focus on environmental sustainability and conserving native flora and fauna. The site has demonstration gardens, small farm animals, beehives, hayfields, ponds, nature areas and a children's playground. Heempark has about 90 members and approximately 35 active volunteers. It has been successfully existing since 1987.

Source: (Oppla n.d.)

The projects target various adults, but there is often a consideration for various vulnerable groups. Depending on the country's context and local population needs, various NBS projects include different vulnerable groups. There were projects involving migrants (Germany), persons with illness or disability (Germany, Belgium, Spain, Norway), the elderly (Spain, Finland, the United Kingdom), vulnerable women (Spain), unemployed persons (Germany), or low-income people (Belgium). The intention is to either strengthen the community by integrating persons of different backgrounds or improve the health and wellbeing of the ill, disabled or elderly. In **Box 12** we show a good practice example of addressing health needs with an NBS project (Urban Nature Atlas 2021z).

Box 12 Addressing health needs: great-granny's garden in Oslo, Norway**ADDRESSING HEALTH NEEDS: GREAT-GRANNY'S GARDEN IN OSLO, NORWAY**

Challenge: Habitat and biodiversity conservation, improving mental health

Description: The project is a cooperation between The University's Botanical Garden and Oslo's Resource Centre for Dementia and Psychiatric Care of the Elderly. The Great-Granny's Garden is an important element in the Botanical Garden, aiming to preserve Norway's horticultural heritage and prevent traditional fauna from disappearing while encouraging sustainable use in future horticulture. The Garden also act as a sensory garden for people with dementia. It also accommodates wheelchair users.

Source: (Urban Nature Atlas 2021z)

Urban examples prevail because the urban context can be the furthest from nature requiring special attention. This is especially relevant for cities affected by air pollution. Incorporating an NBS project will address both environmental and urban challenges as well as offer education for adults through engagement with nature. In **Box 13**, we illustrate how the city of Brno is addressing air pollution and offering NBS adult education.

Box 13 Addressing urban air pollution through NBS – open garden in Brno, Czechia

ADDRESSING URBAN AIR POLLUTION THROUGH NBS – OPEN GARDEN IN BRNO, CZECHIA

Challenge: Climate change adaptation, air pollution flood protection, sustainable consumption

Description: Situated in park Spilberk, the garden features a building with a green roof and a garden with various plots. The building is designed to be carbon neutral and reuses rainwater for toilet flushing and for watering the garden plots. The garden is used for horticultural purposes and environmental education, as well as animal and beekeeping. The complex improves the local micro-climate through cooling and humidification and promotes biodiversity.

Source: (Urban Nature Atlas 2021aa)

The NBS education projects for adults targeted locals, specific vulnerable groups, or a combination of actors. This is the case because most of the identified projects are community projects serving the social and environmental needs of the local population. Initiated either by public institutions or non-governmental actors, the identified projects are around setting up open green spaces, opening parks, or creating community gardens. The locals, including vulnerable groups, are an important part of the community citizenship and activism surrounding local solutions to climate actions. The integration of vulnerable groups is relevant and their socialisation. Social cohesion and integration are as important as addressing environmental challenges.

The education effort is less tangible because the overall intention is to provide relaxation or sport. Almost all projects take place in a natural environment involving hiking trails, orchards, or green roofs. Some highlights of the projects involved providing a publicly accessible space for recreation and offering educational facilities for local residents. An information education is one of the most common forms found regarding adulting education. For example, the education offer includes occasional workshops for children and adults. That does not mean that education is side-lined, but that the educational offer is bottom-up and co-created with the local participants, rather than being a formal educational setup. Often, the education offer can be extracted from the close engagement with green spaces. For example, this involves co-creating community spaces, such as community gardens, or farms. In **Box 14**, we highlight a project combining educational and environmental goals through active participation.

Box 14 Combining educational and environmental goals through active participation – open gardens in Gdynia, Poland**COMBINING EDUCATIONAL AND ENVIRONMENTAL GOALS THROUGH ACTIVE PARTICIPATION – OPEN GARDENS IN GDYNIA, POLAND**

Challenge: Maintenance and management of urban nature, Knowledge creation and awareness raising, inclusive governance

Description: This pilot project to create social gardens in Gdynia was developed by a cooperative of the local government, NGO sector and businesses. The local government employees were the primary caregivers of the garden. The project expanded towards other locations and now includes children and intergenerational community building. The inhabitants of Gdynia can grow tomatoes, strawberries and other plants in public community gardens.

Source: (Urban Nature Atlas 2021ab)

The review of the NBS adult education cases has shown that there are multiple examples of erecting green infrastructure, especially in an urban setting to primarily address climate change along with societal problems. The educational offer, although not explicit and rarely formal, is embedded in the development of the community's needs for local environmental solutions and inclusive governance – especially needed in urban areas and 'concrete jungles'.

4.5.2. Challenges and barriers in implementing NBS in adult learning

Based on the desk research and overview of 49 projects, literature review and interview data, the key barriers to implementing NBS education activities are related to the limited project sustainability and the lacking educational focus of the NBS projects.

Limited project sustainability

Many of the NBS projects have stumbled upon a lack of funds to guarantee their continuation. During an informal urban initiative in Germany (Oppla 2022), the coordinators noted that there were no sufficient funds to guarantee sustainable financing of the life cycle costs for the upkeep of green infrastructure. Similarly, an initiative in Hungary (Urban Nature Atlas 2021ac) that intended to include the water sports project in the area, was cancelled due to criticism from citizens. In another case, even a financially promising project can flop. An urban education initiative in France (Urban Nature Atlas 2021ad) was supposed to be 100% self-sufficient, but it was ended due to financial difficulties, filing for bankruptcy in 2018. Another Hungarian initiative (Urban Nature Atlas 2021ae) was disrupted because the company that owns the land wanted to start construction on it. Finally, some projects, such as a non-formal urban initiative with local stakeholders in Croatia (Oppla 2021b), included educational activities of limited duration, such as several workshops in the project timespan. Linked to the issue of financial sustainability, one of the interviewees explained that lack of human capacities can be a challenge. This is because the initiative was performed by volunteers who had daily jobs or were in education, therefore had to make additional efforts to allocate time to their NBS work (Interview with adult education expert 3, 10.02.2023). This indicates that governance structure, but also the financial model can be a challenge (European Commission 2020c; Think Nature 2019).

Lacking focus on education

Adult education in the NBS context does not have a clear educational outcome in mind, but the purpose is to offer socialisation or relaxation. For example, a community garden in Romania (Urban Nature Atlas 2021af), a park with NBS in Spain (Urban Nature Atlas 2021ag), and a green corridor and promenade in Germany (Urban Nature Atlas 2021ah), or a wetland in France (Urban Nature Atlas 2021ai), firstly aim to offer leisure or sports activities. In some cases, there is an educational trail offered, such as in a green space management initiative in Poland (Urban Nature Atlas 2021aj) and in Hungary (Urban Nature Atlas 2021ac). Only in a limited number of projects we can observe the offer of organised educational events such as project in a non-formal urban initiative in Czechia (Urban Nature Atlas 2021aa) on sustainable horticulture education, beekeeping and animal care education, sustainable cooking, or project an informal initiative targeting the elderly people in the United Kingdom (Urban Nature Atlas 2021ak) on learning skills about semi-natural habitats and orchards. The literature also points out that not all NBS projects have clearly defined educational goals (Coles & Tyllianakis 2019).

Lack of knowledge assessment

Assessing the knowledge about NBS in adult education settings is not of high priority. According to the interviewees about adult education, rarely is the knowledge gained on NBS assessed. The elaboration is that the goals of the initiatives were to bring nature closer to citizens (Interview with adult and primary/secondary education expert 4, 14.02.2023); gather the input of young people about NBS (Interview with adult education expert 3, 10.02.2023); or focus on sharing the knowledge through feedback sessions (Interview with an adult education expert 2, 19.02.2023). Only one of the interviewees, who is involved in informal adult education, is keen on getting a certification and thus, some form of acknowledgment of informal learning (Interview with an adult education expert 1, 27.01.2023). In the other interviews, it is not the case that assessment is not relevant, however, the approach to learning and education is based on the intrinsic motivation of the learners and addressing their needs, rather than testing the knowledge about NBS in a formal manner.

Diverse options for integrating digital skills

In some initiatives, the integration of digital skills has been crucial for the project to take place, however in some not only digital tools are not integrated, they are also not seen favourably. Digital tools can be useful to collect data and gather input from the target group (Interview with adult education expert 3, 10.02.2023). In other cases, they can be a useful collaborative tool, especially in times of COVID-19 (Interview with an adult education expert 2, 19.02.2023). One interviewee considered that 'people are distant from nature' and that they have little understanding of it, and spending time in nature, without exposure to screens, can make one appreciate nature a lot more (Interview with adult and primary/secondary education expert 4, 14.02.2023). On this topic of integrating digital resources in NBS education, it depends on the nature of the initiative. The interviewee who was not favourable of digital tools runs a project situated in a park with a lot of biodiversity which is educational material on their own. In the other contexts, the focus was on education about NBS rather than maintaining a green infrastructure of green space. One reason for not including digital resources is that the team does not have such equipment and the educators do not have the required skills (Interview with adult and primary/secondary education expert 4, 14.02.2023).

Explicit acknowledgment of NBS

Many of the interviewed stakeholders are engaged in NBS education, however, do not usually refer to 'NBS' as a notion/term, and some even report having no theoretical expertise on NBS. The rationale is that NBS is a new 'name' for something we already know about – nature. On the other hand, the interdisciplinarity and the intersectionality NBS offers can attract various professions. One interviewee, a social worker, claims she has no theoretical expertise on NBS, and that what their project does is close the gap between men and nature (Interview with adult and primary/secondary education expert 4, 14.02.2023). Another interviewee emphasised that she has a generic educational background, and also they do necessarily align themselves with NBS definitions, but their role is rather to bring the voice of the youth into the discussions about NBS (Interview with adult education expert 3, 10.02.2023).

4.5.3. Evidence of the success and achievements of NBS in adult learning

There are **several strengths identified** among the analysed NBS projects and their educational potential. The examples of innovative governance structure, financial collaboration, the focus on inclusion and citizenship, and key examples of formal adult education and the use of digital skills are worth mentioning. Interview data will further expand and/or validate the findings.

Governance and sustainability: collaboration of private and public actors

Successful implementation of NBS education activities highlights the exemplary role of various involved stakeholders. We can observe the leading role of public bodies, such as a city that supports a cooperative in Belgium (Oppla 2021c) or involves local residents as in Finland (Oppla 2021d). The involvement of non-governmental actors is very important. An informal urban education initiative in Germany (Urban Nature Atlas 2021a) is led by an NGO and local citizens, while a coastal and urban informal initiative in Spain (Urban Nature Atlas 2021a) is supported by a social equality foundation which developed the project in a socially mindful way to address the needs of pensioners. Sometimes, a company can lead a project as has been the case in a French coastal city initiative (Oppla 2019b). Complex environmental projects require a broad set of expert bodies, such as environmental agencies, funding bodies, natural heritage institutions, and similar, as shown through a United Kingdom example (Urban Nature Atlas 2021a). This draws the attention to the productive outcomes of a participatory government, a new model unique for NBS projects (Frantzeskaki 2019).

Financial models: a combination of private and public funds

NBS projects with the ambition to tackle environmental and social issues require sustainable financial support. The listed projects showcase examples of municipal co-funding along with citizens' contribution (France, coastal-urban, non-formal (Oppla 2019b)), a combination of public and private support (Hungary, suburban, informal (Oppla 2019c)), and the involvement of citizens and NGOs (France, urban, non-formal (Urban Nature Atlas 2021a) and Germany, urban, informal (Urban Nature Atlas 2021a)). A key contribution is often given through volunteering. Due to the interest of citizens in green space management project in Poland (Urban Nature Atlas 2021a), the community garden is blooming. These examples highlight the relevance of participation and various financial incentive to support NBS (EKLIPSE n.d.; UNESCO 2019).

Exemplary cases of formal and digital education

In the list of 32 case studies of adult education, only one of formal education, and only one involving digital education could be observed. A formal education initiative from an urban area in Spain (Urban Nature Atlas 2021aq) focused on women and offered training courses on green roofs. The aim was to support women in accessing professional opportunities and enhancing green employment. It was supported by the Ministry of Health, Social Services and Equality. The other example incorporated the use of digital skills. This project from a coastal city in Finland (Oppla 2021d) was about developing a nature trail using digital IT solutions. Along the trail there are ten short poems presented on information boards describing the surrounding nature and suggesting activities. The project was developed with disabled and elderly people in mind so that wheelchairs can access the trail. A web portal was created as well as a mobile application. These unique cases for adult education could be used as a basis to push further the impact of NBS education activities in a way that's inclusive, productive, and incorporates other relevant skills, such as life-long learning and digital education.

Social inclusion and addressing societal challenges

Another relevant feature of NBS adult education projects is the particular focus on involving or addressing the needs of various vulnerable groups. In the example from Norway (Urban Nature Atlas 2021z), a botanical garden aimed at improving the well-being of people suffering from dementia, while a coastal city initiative in Spain (Urban Nature Atlas 2021am) is an orchard for retired people and people with disabilities. In a few projects, addressing the educational and socialisation needs of refugees was considered. For example, in a coastal city project in Germany (Urban Nature Atlas 2021ar), a sustainable residential district includes educational offers to help the integration of refugees into German society. Furthermore, in Germany, a community garden (Urban Nature Atlas 2021y) and registered refugee aid association that aims to bring residents and refugees together. Besides, some of the projects targeted unemployment as a relevant social vulnerability among adults. For example, an informal initiative in Germany (Urban Nature Atlas 2021as) included a charitable society for inclusive employment to involve disadvantaged groups as well as promote urban subsistence and sustainable solutions in food production. Another urban and German initiative (Urban Nature Atlas 2021at) provided employment and qualification for long-term unemployed people. The examples are in line with the findings that NBS education is relevant to identify societal needs and challenges (Directorate-General for Research and Innovation 2015).

Citizens as key stakeholders

In many of these projects, the prominent and leading role of citizens was identified. This is embedded in the understanding of active citizenship fostering inclusivity and innovative governance models. In the adult education projects, citizen involvement can be seen as part of a cooperative or as a volunteer, as in an informal initiative in a peri-urban coastal area in Belgium (Oppla 2021c). In another initiative in Belgium (Oppla n.d.), in a suburban area, a collaborative city citizen model was developed. On many occasions, residents are allowed the project to continue as in two informal initiatives from cities in Germany (Urban Nature Atlas 2021ap, 2021y). On several occasions, the local population took over an initiative that was initially neglected by institutors. For example, a non-formal project in Croatia (Urban Nature Atlas 2021au) was not supported by the government initially, and therefore, citizens jointly

cleaned an illegal waste disposal site and the bushes and shrubs to initiate a communal garden. In an informal initiative targeting senior citizens in Germany (Urban Nature Atlas 2021av), a new governance model based on citizens' involvement, a plenary, which manages the garden, has been set up. All new ideas have to be approved by the plenary. The literature also talks about the crucial role of citizens which are able to identify citizens' needs and act within their networks (*Cities, Nature and Innovation* 2020).

Including the views and needs of the youth in decisions about NBS

The NBS education should not be only seen as a top-down education process delivered by teachers or experts to 'unaware or unexperienced' receivers of education. One of the interviewees, engaged in informal youth education, stresses the relevance of including the voice of youth in decisions about NBS (Interview with adult education expert 3, 10.02.2023). In this regard, the initiative pays attention to gender and geographical representation of the youth and establishing an intergenerational dialogue (Interview with adult education expert 3, 10.02.2023). Interestingly, the target group of the initiative is decision-makers on NBS which are to be informed about the position of the youth (Interview with adult education expert 3, 10.02.2023). What this youth initiative brings is a fresh and critical perspective on things which might be neglected by more established NGOs (Interview with adult education expert 3, 10.02.2023).

4.6. NBS in teacher education (initial and continuous)

4.6.1. Overview of the scope and availability of NBS in teacher education

Sustainability competence frameworks for educators exist both at the conceptual level in academia and at organisations that teach topics related to sustainability. However, there are no clear competence frameworks for teachers on nature-based solutions and only some which mention NBS competences implicitly, for example, 'promoting nature competency' (GreenComp). Several sustainability competences may still be relevant to teaching NBS due to their relevance for NBS implementation (e.g., participatory processes, good dialogue, innovation, and ability to take initiatives).

There have been numerous efforts to define specific competences for sustainability in academia (Waltner, Rieß, & Mischo 2019) (Barth et al. 2007) (Vare et al. 2019). To assist in understanding, consistency and integration of sustainability, the Joint Research Centre has published a new European competence framework (GreenComp) on sustainability for lifelong learning for all ages providing a framework that can be used in education and training programmes in formal, non-formal and informal settings and for learners of any age (Bianchi, Pisiotis, & Cabrera Giraldez 2022). It identifies the competences for sustainability across four competence areas (values, embracing complexity, envisioning, and acting). The framework (Bianchi, Pisiotis, & Cabrera Giraldez 2022). It identifies the competences for sustainability across four competence areas (values, embracing complexity, envisioning, and acting). The framework considered the principles of the green transition and sustainable development into competence development and all levels of education with a focus on acquiring sustainability competence. It should act as an enabler for '*children, young people and adults to understand challenges related to climate change and the environment, reflect on their behaviours, and engage in action for a sustainable future*', and encourages ITE (Initial Teacher Education) and

CPD (Continuous Professional Development) providers to refer to it when preparing teachers and educators to teach such sustainability competences (Bianchi, Pisiotis, & Cabrera Giraldez 2022).

Figure 16. Sustainability competences (GreenComp)



Source: Prepared by PPMI based on (Bianchi, Pisiotis, & Cabrera Giraldez 2022)**Source:** Prepared by PPMI based on (Bianchi, Pisiotis, & Cabrera Giraldez 2022)

Researchers sometimes differentiate between competences for sustainability in schools and higher education institutions (Lozano 2019), as well as sustainability competences for teachers (Bürgener & Barth 2018). While these do target different groups, the suggested competences share much common ground with general education for sustainable development (ESD) competences. Teachers' competences often focus more on the different aspects of interpersonal competences (participation, attentiveness, empathy, engagement) (Vare et al. 2019). Since the question concerns competences that are specific to teachers and given that sustainability competences for other learners should be discussed elsewhere, the mapping has primarily focused on competence frameworks targeting teachers. **Table 4** summarises the findings of desk research and tries to reflect on how the competences link to NBS. Given the importance of the GreenComp, and the UN frameworks, they are also included in the analysis.

Table 4. Competences for teachers related to NBS

Competences	Link to NBS	Level/ Application
Global or regional competence frameworks		
The JRC sustainability competence framework covers 4 clusters: embodying sustainability values (valuing sustainability, supporting fairness, promoting nature); embracing complexity in sustainability (systems-thinking, critical thinking, problem framing); envisioning sustainable futures (futures literacy, adaptability, exploratory thinking); acting for sustainability (political and collective	<p>Linkage through the points on envisioning change – NBS is about solutions to challenges that threaten sustainability.</p> <p>Linkage through the point on promoting nature in the embodying sustainability values cluster which regards "To acknowledge that humans are part of nature; and to respect the needs and rights of other species and of nature itself in order to restore and regenerate</p>	Can be applied to both ITE and CPD. No information on application in practice for developing programmes was found so far.

Competences	Link to NBS	Level/ Application
agency, individual initiative) (Bianchi, Pisiotis, & Cabrera Giraldez 2022)	healthy and resilient ecosystems.”(Bianchi, Pisiotis, & Cabrera Giraldez 2022)	
ESD competences for educators in: 3 clusters: holistic approach (integrative thinking, inclusivity, dealing with complexities), envisioning change (learning from the past, inspiring engagement in the present; exploring alternative futures), achieving transformation (transformation of what it means to be an educator, transformation of pedagogy, transformation of the education system as a whole) (UNECE 2012)	Linkage through the points on envisioning change – NBS is about solutions to challenges that threaten sustainability. Linkage through the emphasis on social, economic and environmental dimensions of issues – NBS also need to bring about different forms of benefits and tackling also social and economic issues.	Can be applied to both ITE and CPD. No info on the scale of the application in practice, but it one of the most well-known and first frameworks and thus has been tested widely globally (for example, see (Winter, Cotton, & Warwick 2016).
The teachers’ professional action competence in education for sustainable development: It has three core components: self-efficacy regarding education for sustainable development, perceived pedagogical content knowledge of education for sustainable development and willingness to implement education for sustainable development. The instrument is based on the concept of action competence, considers ESD principles such as pluralism, holism and action-oriented and builds on existing frameworks for measuring self-efficacy, pedagogical content knowledge and motivation for ESD (Isac et al. 2021)	There is a link between the self-efficacy, especially the ability to develop students’ ability to weigh different solutions to sustainability issues, the need to reconsider and decide which NBS suit best for certain types of challenges and problems, and teaching concrete skills on how to implement solutions in practice.	Can be applied to both ITE and CPD. So far, it is not known if it is used to guide the development of education programmes, but a questionnaire to assess teachers according to the framework has been tested by the researchers in Belgium.
Rounder Sense of Purpose (RSP) began as a three-year EU-funded project that set out to develop a practical ESD accreditation model for educator. 12 competences from the project emerged. They regarded: systems, futures, participation, attentiveness, transdisciplinarity, empathy, engagement, innovation, action, criticality, responsibility and decisiveness (Vare et al. 2019).	There is a link between the participation in decision making competence and the participatory efforts around NBS. Innovation in teaching methods emphasising living laboratories is relevant as this is a common approach to NBS. Also, RSP has linked each competence to the SDGs which helps to show how each competence is relevant to address various NBS challenges as they are also very much linked to the SDGs.	Can be applied to both ITE and CPD. It has been tested in various countries and a follow up initiative aimed to implement it in CPD education programme for university staff. The results show that all 12 RSP competences are indeed relevant for higher education teaching, but the potential for developing them into a staff training programme is limited (Scherak & Rieckmann 2020).

Competences	Link to NBS	Level/ Application
A competence framework for professionals in ESD based on the approach of complexity. It is structured around 6 categories of complexity on ESD: connections, dialogue, creativity, innovation, critical thinking and uncertainty (source). The framework operates with the 4 domains of learning to know, learning to live together, learning to be and learning to do (Garcia, Junyent, & Fonolleda 2017).	Potentially stronger links around the competency of connections (social, economic and environmental), dialogue (participatory co-created NBS) and innovation, though there are no explicit reference to NBS.	It is advised to include in ITE, which so far is not the case. However, several teaching guidelines are making headways towards teaching professional competences in ESD from the perspective of complexity in general (e.g., Learning Camp of the Cistercian Monasteries).
National level competence frameworks		
A model of ESD-specific professional action competence of teachers in kindergarten and primary schools. It distinguishes between broad areas of knowledge and ability and motivation and volition. The former covers the ability to recognize conflicts of goals and interests of agents in a field relevant to ESD, and the knowledge and ability to constructively cope with them, and knowledge of participative processes and process steps (content knowledge). Regarding pedagogical content knowledge, it refers to the ability to choose possible teaching topics and to evaluate the aptitude for ESD, to embrace complexity and confrontation in teaching ESD and develop suitable learning chances. Motivation and volition refer to the support of education as a tool for sustainability, ethical judgments, etc (Bertschy, Künzli, & Lehman 2013)	Linkage through the emphasis on social, economic, cultural and environmental dimensions of issues – NBS also need to bring about different forms of benefits and tackling also social and economic issues. There is also a link between the know-how of participative processes and the aim for participatory efforts around NBS.	A course was designed based on the competency model and tested in Lueneburg in Germany as a part of a research and development project by The Future Centre of Teacher Education (Zukunftszentrum Lehrkräftebildung) network. It was a community of practice initiative, and a form of in-service CPD (Bürgerener & Barth 2018).
The KOM-BINE competency model was developed as a part of a large-scale EU project involving 15 teacher training institutions in eight EU Member States. It covers the dimensions of valuing and feeling, knowing and acting, communicating and reflecting, visioning, planning and organising and networking, across three spheres of action: instruction and teaching, design	The resource does <i>not</i> refer to ways of promoting and recognising nature, or green infrastructure in engineering. However, there's implicit links throughout when reflecting on sustainability, and the encouragement of networking processes can be seen as a link as this is often emphasised in NBS too.	It is applied primarily by the training institutions that developed it across 8 EU Member States and primarily in CPD for educators.

Competences	Link to NBS	Level/ Application
participation of the institution and outreach to society and wider environment (Rauch & Steiner 2013)		
EDINSOST is a project funded by the Spanish R&D+I programme that aims to establish a framework for training of engineering educator graduates. It covers 4 sustainability competences to be developed for inclusion in the ESD curriculum: Critical knowledge contextualisation establishing interrelations with social, economic and environmental, local and/or global problems, sustainable use of resources and prevention of negative impacts on the natural and social environment, participation in community processes that promote sustainability, application of ethical principles related to the values of sustainability in personal and professional behaviour (Sanchez-Carracedo et al. 2018).	The resource does <i>not</i> refer to ways of promoting and recognising nature, or green infrastructure in engineering. However, there's implicit links throughout when reflecting on sustainability, and the encouragement of participatory processes can be seen as a link as this is often emphasised in NBS too.	It has been applied in Spain at several higher education institutions in ITE courses.

Source: Compiled by PPMI

As can be seen in the table, many of the frameworks overlap. With different nuances in terminology used, they all emphasize related knowledge and skills needed to grasp, analyse and act upon sustainability issues. Bearing in mind the complexity of environmental issues spread across different domains, people need to be enabled to think in a systemic way. They also need good analytical skills and critical thinking to be able to assess the current state, past developments, and future trajectories of the environment, as well as identify false information. To visualise a sustainable future and be able to adjust that image in time, anticipatory or future-thinking competence is needed for which the STEAM framework can be particularly helpful. Clearly, sustainability mindset based on normative values, fostering individual as well as community action in an ecological and fair manner is inseparable from this approach. Finally, people need competences to initiate action, take leadership in promoting sustainability, engage, cooperate and effectively communicate with others, as well as enable others to act – it all calls for strong interpersonal competences. This is closely in line with the literature, claiming that most common competences are critical thinking, participation and connection building competence (Corres et al. 2020).

With regards to NBS, there are no explicit linkages or mention of NBS in any of the reviewed sustainability competences. The closest case would be the GreenComp which recognises 'promotion of nature' as a competence. However, the GreenComp is not tailored to educators, though it can be used for developing educator programmes as well. Observed potential points for linkages could go through the emphasis on participation and connectedness in

sustainability, which is also a crucial part of NBS. Another link is that NBS can contribute to innovation, creativity, and critical thinking in sustainability education. Finally, many of these competences have yet to be used for relevant ITE and CPD programmes, and thus it remains known how useful they are in practice. Potentially the link to NBS would be even stronger in the ITE and CPD programmes and practical implementation of the competence framework as NBS is a great tool through which one can foster several of the broad sustainability competences reflected in the table.

4.6.2. Challenges and barriers in integrating NBS in teacher education

It has been stated that although the application of ESD in the university context has a long history, the field of teaching seems to be the most complex when it comes to introducing changes and working on professional competencies in ESD (Blanco-Portela et al. 2020) (Bertschy, Künzli, & Lehman 2013). This section presents identified challenges and barriers related to: 1) the overall fragmented discourse which NBS needs to find its place in; 2) isolated competency dimensions and challenges with achieving the comprehensive and holistic approach; 3) systemic and horizontal issues such as overcrowdedness of curricula and lack of time and financial support for teacher training. These challenges need to be validated and strengthened based on feedback from partners and interview data.

The challenge of fitting NBS within an everchanging discourse on sustainability competences

The first challenge we see is the challenge of fitting NBS within an everchanging discourse on competences for environmental sustainability. As identified in the JRC report, “*The literature on competences for sustainability is characterized by a great deal of terminological ambiguity, resulting in a “sea of labels”* (Bianchi, Pisiotis, & Cabrera Giraldez 2022). Different terms: “competency”, “competence”, “competences”, “competencies”, “skills” are often used interchangeably with differing spelling in the same document. The shift in focus to deliver competencies associated with NBS, and the sustainable development agenda (through the SDGs) has promoted a move away from the terminology around ‘education and training’. This has also been prompted by the move in the EU to focus on lifelong learning as opposed to education, and recently ‘learning for the green transition’ as opposed to ‘learning for environmental sustainability’. The evolution in terminology used for educators and policies has evoked a shift in their use, application and meaning while writing the ongoing discourse concerning ‘sustainability’ its meaning and deployment across institutions (Mulvik, Siarova, & Coles 2023). Within this evolution, NBS becomes another term to compete with other terms, and thus may be deprioritised or difficult to place within the discourse.

The need to build more holistic and transformative competence frameworks and actualising them

Specifically, many of the available studies are focused on isolated competency dimensions (e.g., teachers’ self-efficacy in education for sustainable development and/or their education-for-sustainable-development -related knowledge and skills, often neglecting to address teachers’ willingness and passion for education for sustainable development), and tend to focus preponderately on pre-service teachers (i.e., relatively limited studies focus on in-service teachers’ education for sustainable development competence). Overall, it is challenging to

achieve the interdisciplinary approach often recommended by studies in practice. This may be one of the reasons that many of the more comprehensive and holistic competence frameworks above, are difficult to use for developing concrete and relevant educational programmes. Furthermore, there is little information available about how to turn broad sustainability competences into tangible programmes. The example below is a good example of how turn the broad competences into relevant ideas for teachers of various disciplines, but it also relies on the overall framework feeding into the already existing structure of disciplines and gives no guidance on how to achieve interdisciplinarity in practice.

Box 15 REAL Teaching – teaching for sustainability, Oslo University, Norway**REAL Teaching – teaching for sustainability, Oslo University, Norway**

The approach of the course was to use the eight sustainability competences by UNESCO (not targeting teachers) and show how they can be linked to ongoing courses at the university, across disciplines. In one of the workshops, – “What are we already doing? Sustainability in our teaching”, initial teacher students and in-service teachers worked with their own subjects and used the framework for sustainability competences to identify what they already do in teaching and how to communicate better around sustainability competences to the students. The participants left the workshop having completed the sentence: “In my course we work with sustainability through...”. In another workshop - “Science fiction as a reflection tool in teaching”, university librarians emphasized the use of science fiction to train anticipatory competence. Films and books can form a unique opportunity to discuss what is possible and what is not possible in the future. The institution attempted a participatory approach to learning, involving libraries and students themselves in the discussion, also with the usage of various tools of media and ICT. The institution attempted a participatory approach to learning, involving libraries and students themselves in the discussion, also with the usage of various tools of media and ICT.

Source: (University of Oslo 2022)

Relevant and ongoing systemic and horizontal challenges for improving teacher education

Finally, there are several systemic and horizontal challenges that may also limit the effectiveness of integrating NBS education activities into ITE and CPD for teachers across the European region. For instance, it is a challenge to attract teachers to attend as funding and time constraints are of significance. Across Europe, teachers often work afterhours, lack finances for resources, and NBS is not an official part of the curricula (Interview with teacher education expert, 19 January, 2023). For this reason, some countries (e.g., Italy) are making CPD mandatory for teachers. In high-income countries, the success of sustainability education was variously linked to policy uptake by government, teacher training and enthusiasm, presence and availability of resources, and participation in initiatives like the UN Decade of Education for Sustainable Development, and the same issues can be expected to matter for

including NBS in ITE/CPD. In many national contexts, under-resourcing of public education, and therefore access to basic schooling, are ongoing challenges that are used to deprioritize topics related to sustainability and teacher education. Innovating in this regard is crucial and could strengthen NBS across the education levels. It could potentially also make the teaching profession more attractive for younger students and help tackle teacher shortages.

4.6.3. Evidence of the effectiveness of existing teacher education programmes

The importance of linking competence frameworks to pedagogical approaches and guidelines

There has been considerable progress in the incorporation of sustainable development into higher education institutions' curricula. This has included research on competences for sustainable development and pedagogical approaches used; however, there has been limited research on the connection between how pedagogical approaches are used and how they may develop sustainability competences. Systemic use of pedagogy is one of the most important success paths for achieving NBS education. The uniqueness of learning on this level is related to the need for combining specific and tailored pedagogies. Nevertheless, some competences significantly associated with transformational education, such as emotion management or future oriented thinking, receive less attention in terms of pedagogical strategies needed to promote them.

The importance of co-learning experiences and professional teaching communities

The relative novelty of NBS as a topic and the practice-based approaches that teaching NBS necessitates, indicates that teacher networks and co-learning opportunities can be especially helpful in developing teacher capacities (see Box 16 below). Regarding education in sustainable development, it has been shown that teachers who participate in a working group or a learning community exhibit higher levels of professional action competences, such as self-efficacy, perceived pedagogical content knowledge and willingness, with co-learning trumping other determinants of competence like teacher experience or level of education (Isac et al. 2021). The positive impact that a learning community can have on teacher motivation to teach NBS was corroborated by a teacher education expert, who claimed that “an NBS network is something that is on demand”, as co-learning helps to build knowledge and skills, as well as providing a network for teachers to rely on and to access still sparse NBS information (Interview with teacher education expert, 19 January, 2023). Belonging to a learning community may also provide teachers with greater access to industry members, tech companies, policymakers, and others who can get involved in the teaching process, bringing the students closer to real life experience (Interview with teacher education expert, 19 January, 2023).

Box 16. MOOC for NBS teacher education**Exploring Nature-Based Solutions in Your Classroom MOOC**

Created and organized by educators and pedagogy experts in the European Schoolnet, a network of 34 European Ministries of Education, this 18-hour free and open to everyone MOOC aims to train teachers how to teach NBS in their classrooms. Created and organized by educators and pedagogy experts in the European Schoolnet, a network of 34 European Ministries of Education, this 18-hour free and open to everyone MOOC aims to train teachers how to teach NBS in their classrooms. It includes ready to use learning scenarios developed by teachers with prior NBS knowledge, which promote critical thinking, collaboration, and project-based learning, and can be easily adapted for a variety of subjects. A noteworthy aspect of the MOOC is that it guides teachers in creating their own learning scenarios. During its initial release, it included a peer-learning opportunity, as

Source: “Exploring Nature-Based Solutions in Your Classroom” MOOC

5. Conclusions

5.1. The current state of affairs: scope, availability, and gaps in NBS education and training offers

This report summarises the state of play of NBS education in Europe, critically reviews the initiatives already in place and the lessons one can learn from them, and considered both system and institutional level approaches, practices, and interlinkages between them. We identified gaps, barriers, and opportunities in mainstreaming NBS in education from the perspective of the edu-community. An analysis of key expert reports on NBS highlights its crucial role in contributing to five EU high level strategies, recommendations and frameworks that deliver biodiversity restoration, climate change mitigation and adaptation, just and green economic transitions.

It is agreed upon that achieving greater impact with NBS requires shortening the time-bridge between recent research innovations and their transition into education materials and resources so that environmental sustainability and biodiversity recovery can be mainstreamed into learning and teaching activities. This review has demonstrated that, driven by appropriate policies, funding, social and environmental imperatives, NBS in education has increasingly become an agent of cross-disciplinary understanding, linking knowledge silos and skillsets to deliver integrated solutions to address the causes and consequences of climate change.

NBS education has been shown to provide common ground for learners and educators through their benefits and adaptive capability in addressing global wicked problems. Global sustainability, as a competence, can be delivered via this transformative pathway. We have concluded that if clear policy goals are not enunciated, successful policy implementation will be curtailed, in turn downsizing the uptake of NBS initiatives across all sectors.

The recent shifts in policy towards promoting and achieving the ambitious goals of the European Green Deal has provided the policy framing and acceleration necessary to utilise the climate resilience potential for NBS. This is being achieved by bringing together professionals and education providers across multiple sectors, in formal and non-formal settings. By ensuring free and easy access to high-quality NBS knowledge resources, communities, businesses, and local governments can be more prepared to engage with nature in a meaningful and cohesive way.

Overview and limitations of the current NBS education landscape in Europe

To date, the educational potential of NBS remains largely unexplored because innovative NBS programmes and resources are currently missing from formal and informal education programmes for children and families. This supports previous findings that no education policy documents at the Member State level specifically mention NBS. There is also a lack of awareness among policymakers and educators regarding accessible educational materials for teachers and learners. We can conclude that while Member States policies generally do not specifically include NBS in their education policy documents, some States lag even further behind by not having general policy documents on NBS in place at all.

Our preliminary analysis based on screening learning resources across all teaching and educational modes suggests that NBS incorporated into education curricula are primarily available in urban areas and generally focus on green space management. In schools, a similar pattern emerges with the majority of NBS examples that are embedded in an urban context focussed on green space management, with vulnerable groups occasionally included, especially if the target group involves adults (i.e., community settings). In the broader context of EU school-level education, initiatives cover a diversity of NBS education projects, but again, NBS education initiatives primarily focus on green space management, climate resilience and biodiversity enhancement. At multiple age levels, the identified limitations are as follows:

- scope of activities that constitute an NBS,
- societal/environmental challenges they address,
- communities and the type of benefit delivered by NBS,
- educational components, which are often underdeveloped with similar outcomes associated with assessment criteria, competencies and cross-disciplinarity and,
- extent to which learning is ensured often depends on the usage, initiative of individual education personnel and community circumstances.

We observed that while there are limited options for the inclusion of NBS in formal vocational education and training (VET), there is a significant range of activities which lend themselves to the introduction of NBS education in this setting. This aside, there is evidence that within the informal or industry level training some programs are emerging. Industry and educational entrepreneurs are developing certified continuous professional development training (CPD), with specific trainings organised by industry bodies in different sub sectors (e.g., green infrastructure, landscape architecture).

Most common challenges and barriers across education levels for NBS EduWORLD to consider

Delivering NBS education from a teacher's perspective often relies on individual knowledge and availability of a competence framework on which to base assessment. Sustainability competence frameworks for educators exist both at the conceptual level in academia and at institutions that teach topics related to sustainability, but there are no clear competence frameworks for teachers on NBS and only some which mention NBS competences implicitly.

While there are differences across education platforms, the suggested competences share much common ground with general education for sustainable development (ESD) competences. Teachers' competences most often address the different aspects of interpersonal competences (participation, attentiveness, empathy, engagement). Key challenges focus on:

- the overall fragmented discourse in which NBS needs to find its place.
- isolated competency dimensions and challenges with achieving the comprehensive and holistic approach.
- systemic and horizontal issues, such as over-crowdedness of curricula and lack of time and financial support for teacher training.

At ECEC level, the findings suggest that in terms of NBS learning paths and their educational value, they primarily refer to informational boards and organised tours that are nominally implemented without the guidance of professional education personnel which may undermine their pedagogical value, especially for younger children. The review has identified two key elements that hinder adoption and delivery of NBS: a lack of involvement of education professionals in developing NBS education initiatives, and limited diversity in the type of NBS implemented and the type of challenges they address. Current initiatives appear to be uniform in approach, suggesting that children do not learn comprehensively about NBS, and may not learn of the different challenges that NBS could address.

A barrier of education offerings at this level is the limited institutional capacity to link the issues of green space management to other wider NBS benefits or going beyond "green" NBS to foster "blue" NBS important for coastal communities. Furthermore, key challenges were observed in NBS project activities that relate to the overall project sustainability, owing to project duration and funding restraints; as well as an unclear focus on continuing education opportunities.

In many cases where NBS sites or demonstrators have been developed or initiated, the educational benefit offered is often a minor side-lined goal. In other cases, after establishing the green infrastructure, the option for education is underutilised or it is expected that the green infrastructure will contribute to education outcomes independently.

Major gaps in NBS education

The majority of the identified NBS education initiatives target urban rather than coastal and rural communities, and there is a pervasive lack of information regarding what the provided education entails and who it targets. There is limited evidence of NBS incorporated directly as

an approach with learning scenarios focussed on NBS challenges and key issues (e.g., unsustainable, unhealthy lifestyles and excessive CO2 emissions), but not on the capabilities of NBS as solutions to deliver the positive benefits of nature. These learning activities were not therefore considered as NBS educational approaches.

Early childhood educational NBS activities focused on either existing or co-created eco-and social gardens as part of an ongoing process to strengthen accessibility and climate change adaptation targets, with gardens identified as natural playgrounds or eco-demonstrators. At school level it was noted that urban gardens or tree planting measures were often associated with weak descriptions of their educational aspects and, therefore, it was difficult to determine the value and direct influence of the educational activity against relevant metrics. While it is recognised that community gardens offer opportunities for collaboration and teamwork that fosters social capital through the facilitation of bonding, bridging and linking of ties and connectivity among participants, the focus on green space alone restricts access to other examples, options and applications of NBS which may offer alternatives for engagement.

While there are some examples of initiatives that address social justice issues at school level, the majority do not, or are not clear about how an NBS education initiative contributes to social justice and social cohesion. Examples evaluated mainly in non-formal settings tended to be in urban areas, which suggests that students from disadvantaged backgrounds in rural and coastal areas are underrepresented in NBS education activities. In formal settings most entry points for NBS education are via environmental sustainability subjects within the natural sciences curriculum, with some spill over into Citizenship Education.

In HEIs, a broad array of courses, materials and delivery methods have been adapted from the delivery on the sustainability agenda aimed to prepare students for the changing labour market, providing a focus on NBS while still maintaining the sustainable development transition pathways. Cases of NBS specification, whether in syllabi of master's programmes or in specific taught course descriptions, are still rare, indicating HE is lagging behind the terminology employed within the EU institutional landscape. Similarly, the recent changes in the discourse to focus on 'green transition and sustainable development' raises concerns that returning to the use of the term sustainable development and accompanying it with emphasis on the 'green transition' has created a dichotomy of terms, policies, functions, and investment strategies which have often masked the success of NBS education programmes.

While NBS is supported by the EU research that articulates NBS principles across multiple disciplines, the focus of Member States is in creating a sustainable knowledge cohort that feeds into future leadership and citizen support groups that are better prepared for societal challenges created by climate change. The importance of linking competence frameworks to pedagogical approaches and guidelines is recognised as one of more important success paths for achieving NBS education. This recognition is supported by the need to incorporate co-learning experiences and professional teaching communities into the development of teachers.

The review noted that NBS education projects for adults generally targeted local communities, specific vulnerable groups, or a combination of actors that can support and deliver the immediate social and environmental needs of these specific groups.

5.2. The current state of the art: positive implementation stories and forward-looking reflections

Good practice examples of NBS education

The adoption of NBS, training and education is at the early stages across the EU, as Member States and business adjust to their everyday use and, therefore, the regulation and assessment of NBS in various settings. The uptake of new concepts such as NBS and green-blue infrastructure feature prominently in many strategies but local administrations have little knowledge of concrete implementation of these concepts. Lacking the encouragement to approve new larger scale projects has affected demand for the skills, and thus training or education necessary for design, implementation, and regulation of NBS, despite strong EU Policy settings that support the advancement of a green economy.

Case studies demonstrated shifts in the approaches to education towards raising awareness of nature within the community. Education class scenarios are being used by teachers in conducting ecological education classes across the EU in various education settings mainly using eco-demonstrator initiatives via EU funded Horizon projects (e.g., Connecting Nature, UNA & EUN) as examples of NBS and their potential. Education activities focussed on providing an understanding and involvement primarily in green space management together with health and well-being and social justice and social cohesion benefits.

Overall, there is great potential for integrating the interaction with nature and green infrastructure in curricula or extra-curricular activities in formal and non-formal education settings. The review findings demonstrated that used NBS examples are primarily focused on existing solutions which can be considered less sophisticated representations. Urban gardens and especially kindergartens and school gardens, can function as service-based learning spaces particularly well suited for intergenerational learning. Even though there may be a lack of official education programmes in relation to NBS, it is recognised that informal transmission of what children learn in formal education, practice, or informal learning from older people and the community, may flourish - although there are inherent risks in this approach.

The learning scenarios by Scientix teachers and Clearing house are good example of the learning scenarios and materials available. The types of resources are diverse, covering learning scenarios on NBS, conceptual drawings, career sheets, videos and podcasts with NBS professionals to inspire students to start NBS careers. Although it is noted that there were few examples of NBS education coupled with ICT methodologies and digital competence development.

Other than the mentioned drawbacks, the majority of evaluated NBS projects and education initiatives provide evidence of multiple achievements and advance NBS education. These relate to the innovative governance structures, financial models, inclusion of vulnerable groups, involvement of teachers, examples of NBS formal education, and examples of outdoor education. There is support for adult education in NBS projects and there are clear examples of innovative governance structure, enhanced digital skills transfer, financial collaboration and a focus on inclusion and citizenship (particularly through volunteering) within communities.

The review found that NBS courses are challenging to deliver within the education sphere as relevant and detailed, with taught on-ground examples not always readily available. This is

changing rapidly within the last 5 years as the EU-funded NBS project suite delivers expected to research and demonstration outcomes. The transition into the education of these findings is supported by EU Education policies that provide greater opportunities for increasing student and postgraduate mobility, and academic recognition, and encourage cross-disciplinarity, whilst still maintaining relative autonomy of the educational institutions.

Across all education platforms and engagement with students it is acknowledged that NBS are multifunctional, work at multiple scales and vary over time making them inherently complex, thereby creating similar issues in designing, delivering and assessing the impacts of NBS within the education and training environment. Additionally, the key barriers to implementing NBS education activities in Adult learning settings (amongst others) is reflected in the longer timeframes from initiation to achieving sustainability and the limited or absent educational focus of NBS projects which often provide socialisation or relaxation rather than clear educational outcomes.

In HEI's there is broad recognition of the need to redesign and integrate multi-disciplinary fields, teaching materials and practice that delivers to the student a broader understanding of nature, our role in it, and to steer those about to enter the world of work towards care for the environment. This will provide a broader platform for understanding of ecosystem performance interrelationships and justice dimensions that requires the engagement of a variety of stakeholders and a comprehensive integrated knowledge set. Further investigation is required to identify who benefits from these activities and how they can draw the most value from them in terms of their potential to deliver an NBS educational benefit.

A summary of key findings:

- NBS needs to be mainstreamed more widely for awareness about NBS to grow, and for NBS projects and innovations to also be taken up at a wider scale and be impactful and accessible to all.
- In mapping general NBS policy developments, no national policy documents linking NBS and education were identified.
- Policy references to NBS range from a) countries simply stating that they recognise the importance of NBS approaches as part of climate change adaptation, b) explicitly referring to the using NBS for addressing specific hazards, or c) do not have any existing national policy documents that would cover neither NBS nor green infrastructure development.
- To increase the take-up and know-how around NBS across communities, holistic implementation and action is needed both vertically (from individual to organisational and systemic changes) and horizontally – all the stakeholders acting in synergy for the promotion of NBS within the organisation.
- Integrated policymaking is crucial to strengthen NBS education and providing ecosystem benefits across different fields and to different stakeholders and is strengthen by supportive financial mechanism (e. g. course funding).

- Clear competence frameworks and learning objectives on NBS should be created along with assessment systems mirroring these frameworks. We think it is important to highlight the lack of evaluation and impact assessment tools for measuring sustainability citizenship (overall and through NBS).
- The creation of strategies and programs along with evidence-based knowledge and policy recommendations for promoting and integrating the key features of sustainability citizenship through NBS is critically important to successful adoption of NBS into the curricula.
- Critical issues around NBS, such as the different NBS challenges, need to be integrated into curricula, competence frameworks and education material for all education levels in appropriate classes and, to the extent possible, in interdisciplinary ways.
- Positive learning environments are crucial for strengthening the effectiveness of learning with both relational and physical aspects incorporated into learning culture, and it has been shown that it is vital to learning that NBS demonstrator projects are not just passive but used actively in the teaching and learning around NBS.
- Majority of educational projects or activities at ECEC, Primary and Secondary levels are focussed on the urban context, in particular green space management in formal and non-formal settings.
- There is high potential for integrating interaction with nature and green infrastructure in the curricula or extra-curricular activities in formal education regardless of the initiatives being developed by non-formal education institutions or NGOs.
- It is necessary to encourage co-operation and knowledge exchange to enable a more effective use of NBS demonstrators as part of an education program, a co-ordinated EU or Member State initiative, or collective education strategy which can pool resources, particularly where remote access can be achieved if physical or funding barriers exist.
- The initiation of a funding pool to support education curricula development for NBS can be highly helpful, with a focus on the existing or planned demonstration sites in which continuation funding for the education materials is provided with extended support of the NBS itself, potentially through multiple levels of government, education institutions and community initiatives.
- NBS education has been shown to be an inclusive educational activity with high outreach potential, particularly in relation to encouraging outdoor activities, citizen science, living labs and community engagement.
- While it is recognised that the industry is moving forward in adopting and developing training and recognised certification processes for NBS, there remains an identified need for more formal vocational education.

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7. Annexe

Table 5 Descriptive mapping of policy developments relating to NBS

MEMBER STATE	NBS POLICY DOCUMENT
Austria	<p>The Austrian Biodiversity Strategy 2020+ (BMLFUW, 2014) includes actions to strengthen biotope connectivity. Austria has specific targets for integrating biodiversity and ecosystem services in spatial planning. Measures include incorporating ecological infrastructure in spatial planning, consideration of functional connectivity and the habitat network when establishing compensating areas, increase of grasslands in urban areas, provision of features that promote biodiversity in newly established green areas, and preservation of un-fragmented areas and migration corridors. The Lower Austrian Nature Protection Concept ('Naturschutzkonzept') published in 2011 divides Lower Austria into several regions based and provides a basis for nature conservation. In 2015, the topic area 'green infrastructure – wildlife corridors – habitat connectivity' was added. The Austrian Strategy for Adaptation to Climate Change published in 2012 covers the importance of green and blue infrastructure and the role it plays in facilitating resilient climatic development. Austria has also integrated renewed Integrated National Energy and Climate Plan for 2021 – 2030 which sets a national objective to reduce emissions by 36 per cent by 2030 and become climate neutral by 2050 at the latest, without the use of nuclear energy. In 2019 the Australian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology together with the Federal Ministry of Finance launched a "Green Finance Agenda" in order to create basis for funding urgently needed climate action measures. The agenda includes proposals for measures as well as set of recommended actions to direct funds for achievement climate targets. The Austrian Development Plan for Por Public Universities (2019 – 2024) indicates that integrating principle of sustainability in university development and university profile is one of the key implementation objectives in order to achieve broader development goals that are set under the strategy.</p>
Belgium	<p>The National Biodiversity Strategy (2013-2020) is a framework document that spells out a range of priority objectives to improve and sustain biodiversity and give political orientation to improve according to these commitments. The operational objectives of the strategy include protecting and restoring biodiversity and associated ecosystem services through protected areas, green infrastructure, mapping and monitoring of ecosystems, their services and values. The Agency for Nature and Forest and the Department for Spatial Planning ('Omgeving') Flanders issued guidelines for the design of local green vision, to support municipalities' green space development in urban areas and take advantage of their multiple benefits. Flanders published a Restoration Prioritisation Framework in 2016 (Prioriteitenkader voor ecosysteemherstel in Vlaanderen), as required under the EU Biodiversity Strategy Target 2 (Action 6a). One of the objectives of the Regional Nature Plan (2016-2020) of the Brussels Capital Region is to consider nature in all plans and projects. The 'Réseau Wallonie Nature' is an initiative of the Walloon administration which aims to strengthen nature conservation efforts in the region, based on an updatable catalogue of voluntary actions to be implemented in the next years, many of them building on existing initiatives. Examples of actions are: encouraging nature on public buildings; restoring riparian habitats; restoring wetland biodiversity; promoting the greening of cemeteries; further implementing the Natura 2000 network in the Walloon Region; creating municipal nature reserves ('réserves naturelles communales'); restoring natural conditions of rivers; raising awareness about environment and nature among inhabitants through the 11 environment education centres. European School National Adaptation Plan covers preventative measures with respect to urban flooding. The plan discusses urban flooding management via use of green and blue infrastructure, e.g., green roofs and improved soil filtration. The National Resilience and Recovery Plan (NRRP) for 2019–2024 supports large federated recovery plans and investment policies in education and training. The plan includes investments to resolve the shortages in inadequate school infrastructure by investing in</p>

	sustainable green infrastructure in educational facilities. Belgium Secondary Education Cross-Curriculum identifies 'inclusion of environment and sustainable development ' as one of the objectives of curriculum. Environmental issues should be covered in an integrated manner together with social and economic aspects of sustainable development.
Bulgaria	No dedicated legislation or policy for green infrastructure or NBS has been found. However, there is a town-hall document ' Strategy for Development of the Green Urban Zones of the Town of Gabrovo 2017-2023 ' touching upon NBS. The strategy is aimed at achieving sustainable development of the green infrastructure in the urban environment. One of the strategic goals is 'building green infrastructure that offers cost-effective and nature-based solutions to many societal challenges, e.g., eco-innovations of different nature, answers to social problems, etc'. Nevertheless, Bulgaria supports the green transition by ambitious plans to cut gas emissions from the power sector by developing a clear framework for phasing-out coal. According to the Bulgarian National Recovery and Resilience Plan (2020) the government intends to invest 4,499m. BGN in supporting circular and low carbon economy, sustainability and biodiversity . In 2021 Bulgaria adopted a new Strategic Framework for the Development of Education, Training and Learning in the Republic of Bulgaria (for 2021 – 2030). The strategy identifies nine priority areas in education and training that have to be developed by 2023. Among those, the development of educational innovation, digital and sustainable development are key.
Croatia	DRAVA LIFE - Integrated River Management (12/2015 – 11/2020) - first inter-sectorial cooperation and integrated management initiative focusing on Croatian rivers. It aims to solve river ecosystem problems, increase pristine, dynamic river habitats (e.g., via reed filters), preserve and create new floodplain waters and improve water level dynamics in Croatia. The Nature Protection Strategy and Action Plan of the Republic of Croatia for 2017 – 2025 lays down long-term objectives and guidelines in order to converse biological, geological and landscape diversity in the country. In 2019 city of Zadar, Croatia, developed a Nature-Based Solutions Strategy , which defines climate projections for the city and estimated impacts of the climate change on various sectors such as biodiversity protection, coastal management and spatial planning. The strategy includes a number of NBS for the purposes of climate change adaptation and mitigation . One of the main education values acknowledged in the National Framework Curriculum as well as under the Strategy of Education, Science and Technology is responsibility , which implies responsible behaviour towards natural environment .
Cyprus	Cyprus has National Action Plans on Climate Change, Desertification and Biodiversity . All three plans include measures for conservation and restoration of habitat function and structure (including greening), in order to reverse biodiversity loss, adapt to climate change, combat desertification and integrate biodiversity into other sectors, policies and strategies. Regarding incorporation of environmental and sustainable development issues in the education policy, Cyprus has implemented Schools Sustainable Environmental Education Policy (SEEP) as an official whole-institution program. The policy is adopted across the country in most of the primary and secondary schools. SEEP aims to ensure that sustainability is an integral part of school planning by engaging students, teachers and school staff in the environment and sustainability through the thematic units outlined in the school curriculum.
Czech Republic	The Territorial System of Ecological Stability of the Landscape (TSES) is included in the Nature and Landscape Protection Act and is one of the main tools for landscape protection. Its main aims are: maintaining and restoring the national natural heritage; reinforcing ecosystem resilience in degraded landscapes via natural means and maintaining intact areas; and delivering favourable impacts in surrounding, degraded parts of the landscape. Strategy on Adaptation to Climate Change in the Czech Republic published in 2015 places a specific focus on drought prevention. The document briefly refers to blue infrastructure as a means for tackling long-term droughts . National Biodiversity Strategy of Czech Republic (2016 – 2025) represents major conceptual document which defines the policy priorities in the field of sustainable use of biodiversity and conservation within the Czech Republic. The strategy also considers the existing EU level commitments, such as the EU Biodiversity Strategy (2020). The document also stresses

	<p>out the need of creation/development of green infrastructure which would support the increase of biodiversity in urban areas. New Strategy for Education 2030+ published by the government of Czech Republic in 2020 defines that the main objective of the education for sustainable development is to equip citizens with skills, knowledge and attitudes to act in a socially and environmentally responsible manner (which implies to act responsibly towards people and nature).</p>
Denmark	<p>The Green Map of Denmark provides a strategic framework for nature policy. It contributes to targeting ongoing/new initiatives with the greatest impact in terms of ecosystem services, e.g., reduced CO2 emissions, cleaner aquatic environments, CO2 storage in the soil, better recreational opportunities and improved conditions for storing water after extreme rainfall (e.g., in the cities). The Danish Strategy for Adaptation to a Changing Climate refers to the use of green corridors/belts and measures to reduce coastal hazards and urban flooding via blue infrastructure as potential ways of adapting to and mitigating climate change. In September 2020 the Danish Government published the first national strategy for investments in green research and innovation – Green Solutions of the Future – which sets clear objectives to accelerate the development of technologies that can support the strengthen the development of green infrastructure, enable reduction of GHG reductions and booster green jobs in Denmark. During the same year, in October 2020, the Danish Government also introduced a new Global Climate Action Strategy – A Green and Sustainable World – which sets directions for Denmark's international climate effort and sets the following objectives: reduce GHG emissions globally; strengthen focus on actions towards sustainable development and climate change adaptation, strengthen cooperation with private sector to develop green solutions and shift financial flows towards green transition.</p>
Estonia	<p>The nationwide spatial plan 'Estonia 2030+' aims to achieve a rational use of space in Estonia. The main principles include 'preserving the qualities of settlement pattern and landscape' and 'preserving the good condition of the natural environment'. The plan emphasises the importance of green infrastructure in the preparation of spatial measures. Estonia's 2030 National Energy and Climate Plan defines country's long-term goals in terms of transitioning to a low-carbon economy. The transition implies implementing reforms in energy sector to become resource efficient and environmentally friendly. Moreover, Estonia's Recovery and Resilience Plan for 2030 sets the following objectives for the country: support private companies in their transition towards green technologies and developing green skills; reduce oil dependency in electricity generation and facilitate energy efficient innovations; support sustainable mobility such as harmonising the transportation system and investments into rail and multimodal connections. Newly adopted Estonian Education Strategy (2021 – 2035) is a part of the larger national plan – Estonia 2035 – which focuses on citizens; health, preparedness for change and fostering positive relationship with surrounding environment.</p>
Finland	<p>No dedicated legislation or policy for green infrastructure or NBS has been found. However, there is a government publication on NBS. Practical Implementation of Nature-Based Solutions in the Provinces and Municipalities of Finland elaborates how NBS can be useful in improving biodiversity and mitigating weather effects (e.g., creating stormwater wetlands or green roofs). However, Finland has incorporated a strong policy vision for sustainable development in Early Childhood and Education Care (ECEC) policy documents. For example, the Finish National Curriculum for ECEC (2018) states that one of the primary objectives of the early childhood education is to guide "ethically responsible and sustainable activities". Early childhood education should promote sustainability, repair and re-use of resources.</p>
France	<p>Target 5 of the National Biodiversity Strategy 2011-2020 is to: 'Build Green Infrastructure including a coherent network of protected areas'. The Strategy underscores that 'defining, preserving and restoring the green and blue infrastructure to good condition is a priority, although we must be alert to its impact on the movements of invasive alien species and its role as a pathway for the transmission of disease.' It is further stated that green/blue infrastructure must be designed coherently on all levels'. The National Strategy for Ecological Transition - Towards Sustainable Development (2015-2020) provides a policy framework for all national,</p>

	<p>public and private stakeholders in the field of sustainable development. The first priority identified by the strategy is to 'Protect and strengthen the capacity of territories to supply and to benefit from ecosystem services'. The Nouveau plan national d'adaptation au changement climatique: Premières pistes mentions the use of green and blue infrastructure in preventing and mitigating urban flooding. The plan also presents several recommendations revolving around NBS to tackle climate change. Scholarly articles on the topic reveal that in French policy documents the terms related to NBS vary based on the field where it is applied. For example, in urban hydrology 'blue green solutions' or 'blue green infrastructures' are widely used; for the purposes of water and coastal management the term 'soft solutions' is applied (Versini et al, 2023).</p>
Germany	<p>The National Biodiversity Strategy is the basis for the protection and restoration of biodiversity and the integration of biodiversity and ecosystems into other sectors. In setting priorities for implementing Target 2 Action 6a of the EU Biodiversity Strategy, Germany has focused on ecosystems suffering severe deterioration. The intention is to fully exploit the synergy effects between biodiversity conservation, climate action and adaptation to climate change. Thus, Germany's work towards meeting the EU restoration target focuses on peatland and floodplain ecosystems. Realisation of a biotope network, reforestation and restoration of peatland are important climate mitigation and adaptation measures, in particular for flood management. The Federal Biodiversity Programme launched in 2011 supports the implementation of the National Strategy with projects that are particularly exemplary and benchmarking. Projects are assigned to four funding priorities: National responsibility species, biodiversity hotspots, ecosystem services, and other measures. Some measures that are considered important are restoration of natural riverbeds, increasing ecological value of forests, creating more green spaces in the city and connecting ecosystems. In 2014 Hamburg was the first German city to have adopted a Green Roof Strategy. By developing the strategy Hamburg was aiming to work across different relevant departments and housing industry to make green facades and roofs compulsory by the law. The Strategy was also included in the toolkit of the European Green Capital Network which aims to share the best practices of nature-based solutions implemented by different ms. The Nature Conservation Initiative 2020 has the aim of improving the implementation of the National Strategy for Biodiversity. It describes 40 measures that should improve the condition of biodiversity in Germany. Some areas directly linked to infrastructure greening: natural riverbed restoration, nature areas connectivity, greater green infrastructure presence in the city. The German Strategy for Adaptation to Climate Change mentions water retention basins with green vegetation surrounding them as a mechanism that should be use in water management infrastructure. In German policy frameworks the term Green Infrastructure was first introduced in 2015 by adopting Green Paper "Urban green space" which was followed by the White Paper published in 2017. The paper outlines the national strategic approaches related to the actions towards developing healthier and more liveable German cities. The National Skills Strategy (2019) defines that in order to achieve a successful transformation into a sustainable economy highly educated workers, equipped with relevant skills are required. A country-specific recommendation for Germany that was published by the Council of European Union in 2020 emphasize that in education, Germany needs to direct investments on green and digital transmission, specifically empowering students with digital infrastructure and relevant skills.</p>
Greece	<p>Greece's National Biodiversity Strategy adopted in 2014 refers to Green Infrastructure and highlights the need of a national system of incentives to preserve ecosystems and the functions they provide, with an emphasis on mapping and preservation of natural floodplains and 'maintaining biodiversity islands within the urban fabric'. Greece adopted The National Growth Strategy in 2018 which is in line with the provisions of Sustainable Development Goals; including SDG 4 and specifically SDG 4.7 which relates to the education for sustainable development. In May 2022 Greece adopted its first National Climate Law – Transition to Climate Neutrality and Adaptation to Climate Change, Urgent provisions to Address the Energy Crisis and Protect Environment. The aim of the new law is to provide framework to reduce GHG emissions gradually and achieve carbon neutrality by 2050.</p>

Hungary	<p>The National Biodiversity Strategy emphasises six strategic areas: 1) protection of areas and species subject to nature conservation; 2) maintenance of landscape diversity; 3) green infrastructure and ecosystem services; 4) agriculture-related issues: sustainable forest and game management and protection of water resources; 5) combating invasive alien species /non-indigenous species; and 6) Hungary's role in the fulfilment of obligations arising from international biodiversity protection agreements. Within these strategic areas, the Strategy has two objectives, which are explicitly related to GI: 'Objective 6. Harmonized development of the elements of green infrastructure to maintain and enhance the operability of ecological systems and to promote the adaptation to the effects of climate change, including the improvement of the connections between areas of ecological and landscape ecological function, as well as the reconstruction of potential landscape elements together with the restoration of degraded ecosystems.' And 'Objective 8. Integrate conservation and biological and landscape diversity enhancement aspects into comprehensive and related sectoral policies, with the tools of green infrastructure and ecosystem services, with special focus on spatial planning'. The National Climate Strategy (2008- 2025) identifies three major directions of actions for the long-term climate change policy: 1) reduce emissions of climate change gases as well as prevent the increase thereof; 2) set of actions against unfavourable ecological consequences of climate changes as well as actions to improve the adaptability to the consequences of climate change and 3) increase social awareness regarding the climate change. The policy documents related to spatial planning and regulation in Hungary, do not provide direct definitions of "green infrastructure". However, the ACT XXVI of 2003 on the National Spatial Plan sets national regulations of land use and the spatial framework of spatial planning to harmonize land-use in Hungary's settlements and regions of different features to develop a uniform infrastructure network. The plan ensures the protection of nature and landscape across the different zones. Since 2004, the National Core Curriculum of Public Education in Hungary aims to weaken the traditional division of fragmented system of subjects and instead tries to integrate physical and mental health education, career orientation and environmental education into one domain. The Action plan for 2016–2020 – Shifting of Gears in Higher Education Mid-Term Policy Strategy states number of objectives that Hungarian higher education system should achieve; for example, to increase the activity of higher education institutions in managing social challenges that Hungary faces. The identified challenges include: (I) having safe, clean, and safe energy sources; (ii) developing environmentally friendly transportation system and (iii) deal with climate change, support environmental protection and achieve resource efficiency. Notably in the Hungarian policy documents in connection to green infrastructure and NBS, the term "sustainable management" is the most used expression.</p>
Ireland	<p>Dublin City Development Plan includes an environmental aim of developing a green infrastructure strategy and Green Infrastructure Network. The Network includes and integrates open spaces, green corridors for cycling and walking, areas of high biodiversity value, and recreational areas and thereby connects green spaces and other natural features such as rivers and canals to different parts of the city and also links to towns and to areas in the city region (see implementation below for further details). In the draft Biodiversity Action Plan for 2017-2024, Target 1.1 focusses on responsibility for the conservation of biodiversity and the sustainable use of its components, and will be addressed through actions including 1.1.1: 'All public authorities and private sector move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in green-blue infrastructure'. The National Adaptation Framework published in 2018 discussed 'green adaptation', i.e., measures used to utilise ecological properties to enhance the resilience of human and natural systems to climate change impacts. An example of this is the re-installment of dune systems to act as buffers against coastal storm damage. Another example mention in the framework is choosing tree species and forestry practices less vulnerable to storms. National Strategy for Higher Education to 2030 does not stress out importance of integration of NBS into education; however, it emphasizes that Irish higher education system should enable Irish citizens dealing with world's major environmental challenges together with prevalent social and economic issues. It appeared that Irish policy documents most frequently use the term 'environment' while referring to the topics relevant to NBS and green transition.</p>

Italy	<p>In 2013, Italy adopted the National Law on the Development of Green Urban Areas aimed at promoting green areas for the provision of ecosystem services. The law identifies a set of measures including green urban planning and monitoring, support to local-level initiatives, safeguarding trees and tree lines as significant features for landscape, nature, history and culture. The Charter of Rome on Natural and Cultural Capital launched in 2014 underlines that the concept of greening infrastructure is a driver for transition to a green economy and has many natural, cultural, social and economic connections. To address this challenge, the Charter specifically promotes: i) identification of inter-connections and multi-functionality of natural and semi-natural areas; ii) Improvement of synergies between natural and semi-natural areas (including protected areas), green infrastructure, urban and rural areas; iii) mapping, assessment, monitoring, evaluation, planning and management of the territorial links between natural and semi-natural areas; iv) considering green infrastructure as a cost-effective alternative or complementary measure to ‘grey infrastructure’ in support of both nature and people. Recently Italy introduced environmental sustainability as a core part of civic education curriculum in primary and secondary schools (starting from 2020/2021 academic year). Under this initiative the curriculums are expected to focus on three main dimensions: Citizenship and Constitution, Digital Citizenship and Sustainable Development. In primary and lower secondary school settings students are expected to learn about community and environment, sustainable and just development, respecting ecosystem and sustainable use of environmental and natural resources. While students at upper secondary level are supposed to learn how to preserve and improve environment. In 2021, Italian government published a National Plan for Recovery and Resilience (Future La Scuola Per L’Italia Di Domani), which aims (among other objectives) to develop infrastructure for higher education institutions that will be tailored to the new training needs required for the green transition. The terminology used in Italian policy documents referring to NBS varies among “Environmental Sustainability”, Sustainable Development” and “Green Transition”.</p>
Latvia	<p>The National Development Plan 2014-2020 is the main medium-term strategic policy for the country’s environmental development. It includes an objective on natural capital, which seeks to ‘Maintain the natural capital as the basis for sustainable economic growth and promote its sustainable uses while minimising natural and human risks to the quality of the environment.’ The plan includes green infrastructure-related targets such as increasing forest coverage, promoting the sustainable use and biodiversity of land, and other natural resources and species conservation measures. The Sustainable Development Strategy of Latvia until 2030 (2010) mentions green corridors as part of environmentally friendly and comfortable transport within the city and acknowledges that maintaining natural capital and ecosystem services can lead to opportunities for Latvia. The plan states that the government should introduce a framework for the preservation and restoration of natural capital at state level, which would also include spatial planning of nature preservation and restoration. Latvia’s National Development Plan for 2021 – 2027 defines country’s strategic plans for future development in various sectors. It also includes strategic views to comply the European Green Deal goals; such as increase green zones especially in urban areas; invest in green infrastructure and increase national support for green procurements. The aim of the Basic Education in Latvia (as stated in the National Core Curriculum) is to foster learners’ responsible attitude towards society and environment.</p>
Lithuania	<p>No dedicated legislation or policy for green infrastructure or NBS has been found. However, the Ministry of Environment of the Republic of Lithuania has published a statement ‘Green Infrastructure and Town Ecosystem Services’ where NBS is discussed as a necessary component in future urban development. National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030 states that under the Operational Program for 2021-2027 the government is committed to promote biodiversity and green infrastructure in the urban environment. The strategy states that by 2030 municipalities should have green spaces providing diverse ecosystem services based on the demand and specific needs of municipalities.</p>
Luxembourg	<p>The National Nature Protection Plan (PNPN2) targets five sectors: agriculture, forestry, water management, urban planning and land use planning. The first part of the PNPN2 is a national</p>

	<p>biodiversity strategy which is in line with the EU Biodiversity Strategy and thus includes the aim of implementing green infrastructure and restoring ecosystems and their services, in particular wetlands, valuable structured semi-open landscapes, extensive grasslands, heathland and dry grasslands. Land use and fragmentation is to be significantly reduced by integrating biodiversity concepts into urban and regional planning and by promoting the concept of green infrastructure and its potential to deliver multiple services to urban areas and their inhabitants. Green infrastructure is described at different scales and includes all the different building blocks. Multiple benefits of green infrastructure as well as its cost-effectiveness are emphasised. Luxembourg Agenda 21 (adopted in 2008) provides guidelines how cities can promote biodiversity such as being tolerant with spontaneous vegetation in urban areas, sustainable management of municipal forests and use permeable and planted surfaces. National Plan for a Green, Digital and Inclusive Transition has a clear focus on country's green transitions. The plan implies to mobilize significant investments in developing green infrastructure or in general support green transition. It also supports protection of diversity and restoration activities through cooperation between the central and municipal governments.</p>
Malta	<p>National Environment Policy (2012) guides action from 2012 to 2020. It explicitly mentions green infrastructure for the restoration of ecosystems, establishing that an action plan will be drawn up to restore 15% of degraded ecosystems using green infrastructure through the Measure 2.6.22 'Draw up action plan to restore at least 15 % of damaged ecosystems by 2020'. Strategic Plan for the Environment and Development – SPED (2015) addresses the spatial issues for the Maltese Islands in the coming years. Green infrastructure and references to 'greening open spaces'; 'developing ecological corridors' and 'improving the quality of design, and life, in urban areas, by providing quality green open areas are included. Malta's National Strategic Plan for Further and Higher Education (2022 – 2030) acknowledges the need of enhancing education policy towards supporting higher integration of environmental and E&I policies into education sector by equipping teachers and learners with an essential skills and competences needed for green transition and adoption of more sustainable lifestyle. Accordingly, enhancing green, R&I, digital and societal relevance of education at all levels as well as green, R&I, digital, and societal relevance of education at all levels as well as exploring green /digital partnerships (with regard to international education) represents one of the key priorities for 2022-2023 strategy. Notably in the relevant policy documents from Malta, the terms 'sustainability' and 'sustainable development' are the most widely used with regards to NBS.</p>
Netherlands	<p>The National Nature Vision 2014 is a strategic document meant to guide nature policy towards national and international long-term goals. It recognises that 'nature combinations' need to be formed: a combination of nature with agriculture, private estates, recreation, water extraction, cities, business areas, water ways, etc. The Room for the River Programme uses technical and natural solutions to accommodate increasing water levels and flows. It aims for safe river basins and improving the quality of the immediate surroundings. The Adapting with Ambition: National Climate Adaptation Strategy addresses the challenges related to river flooding, urban flooding and how they can be addressed by employing non-grey infrastructure solutions. In 2014, the Ministry of Infrastructure and Environment submitted the bill for the Environmental and Planning Act to the Dutch Parliament. It is expected the Act to enter into force in 2023. The Act will replace 26 existing laws, including the Water Act, the Spatial Planning Act and the Crisis and Recovery Act. Sustainable development issues are also incorporated in Dutch educational framework. The Netherlands' national plan on Education for Sustainable Development ('DuurzaamDoor') is mainly based on the high level on participation of all relevant stakeholders, social innovation and transformative learning. This plan incorporates three cross-cutting areas in education: curriculum and whole-school approach; integral decision-making for sustainable development, and regional co-operation supporting grassroots activity. The Dutch policy frameworks related to environment are not characterized with high adoption rate of EU vocabulary such as using terms NBS or Green Infrastructure. Instead, most of the national policy documents use the terms such as "building with nature", "natural climate buffers" and "allowing natural processes more space". The lack of adoption of EU vocabulary into national policy documents can be explained by the fact that the Netherlands has a long and well-</p>

	established history of implementing and financing NBS-related policies and concepts at the national level.
Poland	The Long-Term National Development Strategy (DSRK) covers spatial development via green and blue infrastructure: ecological connectivity and coherence of the nature conservation area network, including the designation of ecological corridors at national level, and the interconnection between open space and urban areas. The Polish National Strategy for Adaptation to Climate Change (SPA 2020) published in 2013 proposes that one of the ways climate change consequences might be addressed is via solutions 'which are the least intrusive to the natural environment, in particular nontechnical <...> protection methods'. The plan is to address coastal hazards and flooding using non-grey infrastructure. NBS is outlined as a valuable approach that will become increasingly important due to intensifying climate.
Portugal	Biodiversity in the City of Lisbon: A strategy for 2020 comprises an extensive characterization of Lisbon's biodiversity and ecological features. One of the aims is to 'implement nature-based solutions against natural disaster risks, such as floods'. National Ecological Reserve Act of Portugal (2008) incorporates several elements of Green Infrastructure , such as creation/conservation of protected areas, sustainable use of land and natural connectivity features. In 2020 the Portuguese government issued National Energy and Climate Plan for 2030 according to which solar power should become a leading energy source in order to achieve carbon neutral economy. At the same time the Government enacted the National Strategy for Hydrogen , which states that Portugal will largely invest in green hydrogen, which implies that hydrogen will be exclusively obtained from the renewable sources.
Romania	The Territorial Development Strategy of Romania 2035 refers to Green Infrastructure as a more efficient way of adapting to climate change and diminishing natural risks, compared to using grey infrastructure alone . Specific measures foreseen by the strategy include the development of green spaces in urban areas, as well as green belts in the surroundings of major cities. More broadly, the strategy mentions that 'developing green infrastructure, avoiding landscape fragmentation and reducing the impact of fragmentation through ecological networks, especially Natura 2000, is key to maintaining a sustainable environment'. Recently, in February 2023 Romania approved a methodological framework for carrying out " Green Week Program " which is a compulsory program for pre-schools across Romania. The framework defines the objectives of the program as well as educational activities performed during the program to form pupils' behaviours with regard to environment and sustainable development.
Slovakia	The Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change includes a few measures that relate to NBS, such as ensuring vegetation cover on vulnerable areas to prevent landslides, creating water retention areas, applying good agricultural practices to decelerate water runoff, strengthening natural regeneration of natural forests and their sustainable use, diversification of landscapes, and increasing landscape connectivity by means of GI. Envirostrategy 2030 (Strategy of the Environmental Policy of the Slovak Republic Until 2030) sets specific targets for 2030 for various areas of concern, such as greenhouse gas emissions, sustainable land management, air quality, circular economy and environmental education. Slovak Environmental Agency manages the green education fund (since 2017) funded collaboratively by the state budget and private companies. The fund aims to support spread of environmental education at national and regional level. Under this initiative, Slovak Environmental Agency developed a concept paper to develop environmental education and public awareness actions by 2023. This includes to develop educational programs in four main directions: programs for kindergartens, primary schools, secondary schools (including secondary VET) and develop interactive digital tools in cooperation with schools.
Slovenia	Slovenia's Development Strategy 2014–2020 is a national strategic document that defines the well-being of the population as the highest development goal. According to the draft strategy, Slovenia's development will be directed toward ensuring a green living environment by investments in green infrastructure, measures for nature protection and biodiversity conservation, and the provision of a biosafety system (parts, relevant for green infrastructure). The Government Office for Development and European Cohesion Policy (GODC) is the lead

	<p>institution for Slovenia's development Strategy. Biodiversity Conservation Strategy is a national level policy document of Slovenia which aims to increase citizens' awareness on climate change as well as identify measures that mitigate negative impact of socio-economic development on biodiversity. Environmental Protection Act of Slovenia is designed to regulate the environmental protection system based on the principles of sustainable development. The Act defines fundamental principles of environmental protection, protection measures and monitoring. In 2015 the Government adopted a Framework for Transition to a Green Economy. The framework defines long-term vision for the transition of the economy towards Green and Circular Economy.</p>
Spain	<p>Various regional laws focus on the connectivity of natural areas. Furthermore, green infrastructure is acknowledged in several laws on ecosystem service delivery, such as Law 9/1995 on territorial, soil and city-planning policy measures in the Autonomous Community of Madrid. Barcelona's Green Infrastructure and Biodiversity Plan 2020 was released in 2013 and lists over 70 projects and actions with the following aims: provide environmental and social services, introduce nature into the city, increase biodiversity, increase connectivity among patchy green infrastructure and make the city more resilient. Law on Heritage and Biodiversity (adopted in 2007) establishes the basic legal framework (as well as sets number of goals, objectives and actions) across the country for conservation, restoration and sustainable use of natural heritage and biodiversity. The law sets number of goals, objectives and actions for sustainable development. The law requires each autonomous region of Spain to have green infrastructure strategies. Climate Change Adaptation Strategy for the Spanish Coast (2016) specifically sets objectives to improve the resilience of the Spanish coasts to climate variability and climate change in general as well as aims to integrate adaptation to climate change I the planning and management of Spanish coasts. Notably, the strategy frequently uses the EU adopted terms such as "Nature based Solutions" and/or "Ecosystem Based Approaches". Spain has a long history of incorporating environmental and sustainable development issues in education policies. For example, the White Paper on Environmental Education (Libro Blanco de la Educación Ambiental en España) was developed back in 1991. The document guided the definition objectives and principles of environmental education in Spain. Recently, in 2020 the document was updated through the Environmental Education Action Plan for Sustainability (Plan de Acción de Educación Ambiental para la Sostenibilidad, PAEAS). Moreover, in 2012 the Conference of Rectors of Spanish Universities (CRUE in Spanish) has drafted a document – SUST – which defines four core sustainability competences that need to be integrated into the higher education system. This document states that at the first phase it is essential to empower teachers by giving them initial trainings which will provide them efficient methodological strategies how to deliver sustainability competences in the teaching process. In 2014, the Spanish government introduced a mandatory requirement in primary and secondary schools to integrate national climate change curriculum in the areas such as geography, geology, applied and environmental sciences which also are relevant for NBS.</p>
Sweden	<p>The Swedish Strategy for Biodiversity and Ecosystem Services cover regional action plans developed by county administrative boards. The strategy covers landscape planning in the context of sustainable management of land and water, as well as provides a pseudo-framework for landscape planning based on nature conservation initiatives. The Swedish Building and Planning Code (2010) requires consideration of climate impacts and relevant adaptation measures in the planning process. The code outlines the parameters for the sustainable planning and conservation of land, water and development. According to the Ministry of Education and Research of Sweden, main policy documents of Swedish education system (at all levels) incorporate the principle of Education for Sustainable Development. For example, Curriculum for the Preschool states that preschool education should allow kids to gain knowledge on how to contribute in sustainable development from economic, social and environmental perspectives. Curriculum for Compulsory School, Preschool Class and School Age Educare (revised in 2018) defines that every student should be able to obtain knowledge for sustainable development and good environment. Lastly, the Higher Education Act of Sweden (adopted in 1992, revised in 2021) stresses out that higher education institutions under the scope of their competences/operations are expected to promote</p>

	<p>sustainable development to assure the existence of healthy environment for current and future generations. In Swedish policy documents the term NBS is not frequently applied. Instead, “Green Infrastructure” and “Ecosystem Services” are more commonly used, particularly since 2014 (Davis, 2018)</p>
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Source: Compiled by PPMI

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