

Nature-based Solutions for climate adaptation in the European Union

PART I MAPPING EU AND NATIONAL INITIATIVES

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Sciences Po Paris

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Nature-based Solutions for climate adaptation in the European Union:

PART I MAPPING EU AND NATIONAL INITIATIVES

Valeria de los Casares and Marc Ringel

“Any region’s economic competitiveness and security—in the long run—depends directly on sustainable use of natural resources.”

(Maes and Jacobs, 2017)

Abstract

Since the mid 2010s, the European Union (EU) has embarked on a mission to be at the global forefront of Nature-based Solutions’ (NBS) research and innovation. Currently, NBS implementation in Europe is still in early stages, with the EU investing its efforts into building the knowledge and frameworks to “develop, upscale and mainstream” NBS. This paper is the first of a two-part series on NBS for climate change adaptation in Europe. It develops a comprehensive stocktaking exercise of NBS activities across EU and Member States.

It first presents a mapping exercise at the EU level, looking at key policy documents, legal provisions and EU-funded projects. Secondly, we look into how these ambitions have been translated at the national level. We analyse Member States’ take-up of the NBS concept across three types of key adaptation policy: (1) National Energy and Climate Plans (NECPs), (2) National Long-term Strategies (LTSs) and (3) National Adaptation Strategies (NASs) and their Action Plans (NAPs). We use the software MAXQDA to conduct a thematic analysis of NBS terminology and phrases. This analysis shows a higher take-up in the National Adaptation Strategies and Plans, and we develop an assessment grid to evaluate the presence of concrete provisions on aspects such as governing and financing. Our results show that the NBS concept is not being sufficiently taken up and that specifically provisions in financing and governing NBS are lacking from Member States’ adaptation policy. These aspects will be analysed in detail in a consecutive working paper.

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1. Introduction

Nature-based solutions (NBS) have been increasingly in the focus of public and private actors for their ability to contribute to the climate transition while remaining cost-effective, “no-regret” solutions with multipurpose benefits in fields such as biodiversity, air quality, water management or soil productivity. A study from the Nature Conservancy and other organisations found that NBS can provide over thirty percent of the cost-effective climate mitigation needed through 2030 to hold global warming to below 2 °C, while simultaneously tackling other significant environmental and social objectives (Griscom et al., 2017). In 2014, the European Commission launched the first expert group on the topic and has since pledged to become a global frontrunner by promoting research and funding of several NBS projects and putting the concept on the agenda of key policy strategies (Faivre et al., 2017). Since then, the science and policy of nature-based solutions has been rapidly developing and efforts have been focusing on building a knowledge base that would serve to identify successful models in order to replicate them and advance in the institutionalisation of NBS (Davies et al., 2021; Faivre et al., 2017). The Commission’s research agenda on Nature-based Solutions has served to centralise knowledge and incentivise these efforts, but much of the challenge still remains of developing and institutionalising a successful approach to NBS that stems from EU ambitions and is present at national and regional policy.

While NBS as a concept has been developed in recent years, it picks up much of the science and developments from earlier terms such as green infrastructure or ecosystem services (Escobedo et al., 2019). In fact, the novelty of this term resides in the way these solutions are framed, and on “rebranding” concepts that were previously reserved for field experts (Escobedo et al., 2019; O’Sullivan et al., 2020; Cohen-Shacham et al., 2019). Moreover, the NBS concept focuses on the multipurpose nature of these projects and on economic and social aspects working together alongside the environmental benefits. This new approach has given policymakers and researchers the capacity to look at a wide range of solutions under a unified lens, bringing the science-policy interface closer together.

The literature employing the NBS concept has been developed over the last 15 years. While barriers to scaling up and promoting this approach have been identified (Calliari et al., 2022; Taxopeus and Polzin, 2021), their interplay on central aspects such as governance and financing of NBS has not been sufficiently analysed. It becomes thus essential to carry out research to understand who are the main actors that are financing these projects, what are the financial barriers to implementing NBS and how to further incentivise investment in them; as well as how to identify and promote successful models of governance.

Our contribution to advancing this goal is twofold and organised in two working papers. This paper, Part I, puts forward a comprehensive stocktaking exercise and mapping of EU and Member State actions on NBS for climate adaptation. At the EU level we look at (i) key strategies and policy papers; (ii) legal provisions for NBS; and (iii) projects, databases and guidelines. At the Member State level, we focus on carrying out a qualitative analysis of NBS provisions throughout key policy documents on climate adaptation. These are, (i) Energy and Climate Plans, (ii) Long-term Plans; and (iii) National Adaptation Plans and the related Strategies.

In Part II, we further explore this gap and zoom into the barriers for advancing NBS uptake by the means of in-depth expert interviews.

1.1. Motivation of paper and research goal

Since the concept was introduced in Europe, nature-based solutions have served to unify efforts in advancing projects that promote biodiversity and simultaneously serve other goals in areas such as wellbeing, water management and climate change adaptation (e.g., through carbon capturing). Promoting NBS would offer a cost-effective option for advancing climate change mitigation, but institutionalisation of NBS remains limited (Davies et al., 2021; Griscom et al., 2017).

In this context, our study positions itself alongside previous efforts that have aimed at understanding how to successfully implement and upscale the deployment of nature-based solutions for climate change adaptation in order to mainstream them in the European Union. Particularly, we consider that developing governance and financing aspects is crucial for the promotion of these interventions, especially considering the stage we are in –that is, previous to an institutionalisation of NBS (Davies et al., 2021).

Our research goals address the following points:

1. Take stock of current EU strategies, policies and mechanisms to support nature-based solutions.
2. Analyse national schemes and action plans concerning their support for nature-based solutions and dedicated financing and governance schemes.

Investigating these issues allows to take stock of the present status of applying NBS across Europe. However, it does not explain the underlying factors that support or impede the application of NBS. We therefore enlarge our research to the following aspect that will be dealt with in the second volume of this working paper series:

3. Gain a deeper understanding of the choices for dedicated financing and governance provisions as well as for barriers hindering the implementation of these institutional settings.

Before we set out to define the methodology to address these research questions, we first need to establish a clear definition of what we mean with the term “Nature based solutions”.

1.2. Defining NBS in a European framework

The term ‘Nature-based Solutions’ (NBS) has significantly risen in popularity over the past 10 years, sparking interest across policy makers, researchers, civil society actors as well as the private sector, and entering into the mainstream policy debate. ‘NBS’ is generally employed as an umbrella for an array of ecosystem-based solutions or ‘solutions working with nature’, which can range from green and blue infrastructure to sustainable forest management, or urban corridors. While the term ‘nature-based solution’ is not explicitly employed in older literature and policy reports, such as those closer to the 2000s and earlier, we can find reference to these earlier terms, and we observe that the popularity of each nomenclature has varied depending on the point in time, with NBS being the most novel (Escobedo et al., 2019. Davis et al., 2017).

The concept can then refer to solutions that have different characteristics and respond to different challenges or objectives. Some authors have pointed out to a lack of common conceptualisation across NBS literature or across organisations and institutions that work with implementing these solutions (Castellar et al., 2021). In this sense, they see that the term runs the risk of becoming rather broad, which can lead to analytical ambiguity and to policymakers or private actors claiming that they invest in NBS without these interventions fitting into a strict definition. Seddon et al. (2021) even go so far as to argue that while the breadth and simplicity of NBS constitutes a strength, “it has also led to confusion.” To mitigate this problem, several authors have tried to clarify the conceptualization of NBS (see for example Castellar et al., 2021; Escobedo et al., 2019). Similar efforts have been put into creating a typology for NBS, which has taken different forms depending on the element in focus. For example, the Urban Nature Atlas initiative distinguishes between blue infrastructure, community gardens, parks and urban forests or nature in buildings, among others. On the other hand, studies such as Castellar et al. (2021) have conducted a comprehensive analysis of NBS projects and have developed a conceptual classification. Eggermont et al. (2015) distinguishes 3 types of NBS, type 1 consisting of no or minimal intervention in ecosystems, type 2 on management approaches that develop sustainable and multi-functional ecosystems and landscapes that improve the delivery of selected ES, and type 3 consisting of the creation

of new ecosystems or management of ecosystems in an intrusive way. While still analytical ambiguities remain, work by relevant studies and institutions is making significant progress in creating a common framework. Nonetheless, it is still necessary for NBS studies, such as this paper, to bear in mind the nuances of the concept and the differences that exist between implementing institutions, studies or actors, in terms of their appliance of the term ‘NBS’.

The shift to employing a new term that is much bigger in scope and that broadly encompasses all previous others seems to be driven by practical and political factors. In this sense, O’Sullivan et al. (2019) found that, in the EU, the reframing of previous concepts into the umbrella NBS “makes principles of urban greening more understandable to lay audiences and more politically palatable for urban governments”. Moreover, when actors such as the IUCN started to promote the concept of NBS following the publication of the first widely diffused report on the topic in 2008 by the World Bank, this put solutions working with nature on the agenda for many national and regional governments worldwide (Seddon et al., 2021). The same authors argue that employing a broader term “has drawn together disparate communities of researchers, policymakers and practitioners across climate change, biodiversity and development” (also in Cohen-Shacham et al., 2019; van Ham & Klimmek, 2017; Mell and Clement, 2019). In this sense, we observe that NBS, serving as an umbrella term, can more easily form an appealing policy narrative of nature and natural elements as efficient solutions to societal challenges, without having to recur to technical terms that are often related amongst each other or share similar objectives or elements. This has opened the concept of ‘solutions working with nature’ for a much wider range of actors, also because the concept of ‘NBS’ is not restricted to projects of a certain scale, and they can refer to solutions implemented with low to high budget or by different actors at national or subnational levels. Additionally, in terms of practicality, by employing this term, one can refer to a single NBS that encompasses or features elements from more than one ‘solution working with nature’, develop strategies that span across different sectors or areas of action and create synergies between the implemented interventions (Seddon et al., 2021; O’Sullivan, 2020).

While there is no single definition of Nature-based Solutions, the ones given by the International Union for the Conservation of Nature (IUCN) and the European Commission are the most widely accepted (Seddon et al., 2021; O’Sullivan et al., 2020). This paper will employ the latter, that is at the same time shared by many relevant policy and research papers at the European level (see, for example, Faivre et al., 2017; Maes & Jacobs, 2017; Taxopeus et al., 2020) The Commission’s definition was updated once since 2015 and is reflected in the ‘EU Research and Innovation policy agenda on Nature-based Solutions and Re-naturing Cities’.

The European Commission (EC) understands Nature-based Solutions (NBS) as “Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions.”¹

The IUCN defines Nature-based Solutions as “actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature.” Moreover, the IUCN has developed a series of NBS standards, which are also widely accepted globally. Compared to the IUCN definition, we see that the EC one has a stronger emphasis on cost-effectiveness and on the economic benefits of NBS. Nonetheless they both share important common points, such as the adaptability and social benefits of these solutions. In this sense, nature-based solutions are interventions that put nature and natural features and processes at its core, they have no predefined scale –that is, they can range from the street to the regional level– and can vary greatly in the form of their implementation, as they are place-based, locally adapted and adaptive solutions. Moreover, NBS are often developed as the green alternative to a ‘grey solution’, which represents an artificial construction that does not incorporate natural features. For example, a ‘green

¹ https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en

roof' is often understood as a nature-based solution, as it brings nature, while simultaneously incorporating other benefits such as natural water retention in buildings or cooling down effects, which bring wellbeing while being also cost-effective solutions. It also represents an alternative to traditional construction of buildings.

Finally, a subset or related concept that is particularly prominent is the concept of 'Natural Climate Solutions' (NCS). Several studies have employed this term to focus on the potential that nature-based solutions have for contributing to climate change mitigation, notably by acting as carbon sinks (see Griscom et al. 2017). In an earlier working paper by the European Chair for Sustainable Development and Climate Transition, we focused on the institutional considerations of NCS (Shomeshwar and Guraieb, 2021). However, by adopting nature-based solutions as a lens, we focus on the benefits of these interventions for climate change adaptation, as well as their potential to bring social and economic benefits.

1.3. Organisation of paper

This working paper is organised as follows: Section 2 presents the data and methodology that we used for the stocktaking exercise and the analysis of strategies and policy action. Section 3 reviews policy action, projects and structures at the EU level that are relevant for nature-based solutions. We look at NBS provisions throughout key EU policy documents (e.g., strategies, directives, action plans; Section 3.1) and legal provisions for NBS (Section 3.2). Then, we move to review EU-funded projects that stem from this research agenda, including those under programmes such as Horizon 2020, LIFE or Interreg (Section 3.3).

In Section 4, we review NBS provisions in national policy on climate change adaptation from EU Member States. We look into three types of national policy documents on adaptation: National Energy and Climate Plans (NECPs), Long-term Strategies (LTSs), and National Adaptation Strategies (NASs) and Action Plans (NAPs). For the National Adaptation Plans and Strategies, we carry out this review by

employing an assessment grid, given the more significant level of take-up of NBS terminology compared to the other document types. This grid was previously developed through an inductive analysis of policy and enriched by in-depth expert interviews. We pay special attention to references to NBS governing and finance.

Finally, based on these analyses at EU and Member State level, we discuss and conclude on the take-up of the NBS concept in Section 5. Here, we develop a series of policy recommendations to further enhance taking up NBS in Europe.

2. Methodology and data used

The following sections lay out the material analysed and our methodology for the screening of NBS activities in Europe.

2. 1 Analysis of the EU framework for developing NBS

In Section 3, we conduct a mapping exercise of EU activities on Nature-based solutions. For this, we consult relevant EU policy documents, EU reports on NBS policy and EU-funded research and innovation as well as implementation projects, including those that were highlighted in a good practice compilation by the EEA (2021).

Firstly, we analyse EU policy documents that contain relevant provisions for NBS. In particular we look at those policy documents that are relevant for NBS and climate adaptation and that were highlighted by EEA (2021) as showing a strong support for NBS. We discuss the EU policy environment for NBS in section 3.1. The policy documents, including strategies and directives, are reflected in Table 1 and Table A.1 in the Annex. The latter summarises the EEA (2021) assessment of the policy documents’ support for NBS.

Table 1. List of consulted EU policy documents

Policy name	Year of Publication
Biodiversity Strategy for 2030	2020
Action plan on the Sendai framework	2016
Green Infrastructure Strategy	2013
Floods Directive	2007
Adaptation Strategy	2021

Source: Own from EEA (2021)

Secondly, we have conducted a scan of available EU publications on NBS, by accessing the ‘Nature-based Solutions resources’² database developed by the NetworkNature initiative and complementing this by performing a keyword search in the EU publications office’s database. The first contains 155 items classified as ‘reports’. We narrow down to those containing ‘Nature-based solutions’ in their title and eliminate those that adopt a natural sciences approach or that focus on the environmental benefits of NBS. We look at the reports developed by European institutions such as the European Commission or the European Environment Agency. Finally, we perform a similar search in the EU publications office database and use the results to complement and validate our initial search. We obtain 12 relevant reports. Table 2 shows the results from this search and we include a brief description of each publication consulted. Other resources that do not fall under these conditions were accessed through these databases and appear in the bibliography section.

Table 2. List of consulted EU publications on NBS*

Title	Main entity/ Corporate author	Description	Year of publication
The vital role of nature-based solutions in a nature positive economy	European Commission, Directorate-General for Research and Innovation	Addresses knowledge gaps in the potential economic benefits of NBS and the challenges facing Nature Based Enterprises (NBE).	2022
Nature-based solutions and the challenges of water	European Commission, Directorate-General for Research and Innovation	After the third EU–Brazil Sector Dialogue on NBS, this book gathers knowledge and experiences from a diversity of authors to bridge the gap between science and the realisation of a new vision for sustainable cities.	2022
Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction	European Environmental Agency (EEA)	This report shows that NBS and related concepts are increasingly integrated in the global and EU policy frameworks. However, the concept is not yet sufficiently embedded.	2021

² https://networknature.eu/nbs-resources?mefibs-form-search-combine=EU&mefibs-form-search-mefibs_block_id=search

Evaluating the impact of Nature-based Solutions: a handbook for practitioners	European Commission, Directorate-General for Research and Innovation	https://networknature.eu/nbs-resource/24935	2021
Nature-based solutions for climate mitigation	European Commission, Directorate-General for Research and Innovation	https://op.europa.eu/en/publication-detail/-/publication/6dd4d571-cafe-11ea-adf7-01aa75ed71a1/language-en/format-PDF/source-search	2020
Public procurement of nature-based solutions: Addressing barriers to the procurement of urban NBS : case studies and recommendations	European Commission, Directorate-General for Research and Innovation	This report provides an overview of the major challenges facing NBS procurers in the EU, along with case studies of success in addressing those barriers across nine European cities.	2020
The EU–Brazil sector dialogue on nature-based solutions	European Commission, Directorate-General for Research and Innovation	https://op.europa.eu/en/publication-detail/-/publication/12818f2c-f545-11e9-8c1f-01aa75ed71a1/language-en/format-PDF/source-285824197	2019
Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities	European Commission, Directorate-General for Research and Innovation	Final report of the Horizon 2020 expert group on 'Nature-based solutions and re-naturing cities'	2015
Biodiversity and nature-based solutions	European Commission, Directorate-General for Research and Innovation	This report presents findings from a review of over 30 EU-funded research and innovation projects conducted as part of the EC's Valorisation of NBS Projects Initiative. The aim was to determine their contribution to EU biodiversity, climate and other policy objectives.	2020
Nature-based solutions: State of the art in EU-funded projects	European Commission, Directorate-General for Research and Innovation	This report summarises outcomes from the EC individual expert reports delivered through its 'Valorisation of NBS Projects' initiative.	2020
Nature-based solutions: Horizon 2020 research projects tackle the climate and biodiversity crisis	European Research Executive Agency	Infographic with Horizon 2020 NBS projects	2021
CORDIS results pack on nature-based solutions	European Commission, Directorate-General for Research and Innovation	This Results Pack showcases nine EU-funded projects that have developed important tools and expertise to address these challenges through nature-based solutions for building sustainable, resilient and prosperous	2020

		societies.	
Nature-based solutions towards sustainable communities: Analysis of EU-funded projects	Bulkeley, H.; European Commission, Directorate-General for Research and Innovation	This report examines how far NBS can contribute to transformative action for sustainable communities. It examines how such initiatives enable participation and inclusion in the design and implementation of sustainability at the local level.	2020

Source: Own.

*Excluding reports that look exclusively at the environmental benefits of NBS and do not focus on the policy or governance aspects.

Finally, we consulted a series of databases to identify NBS case studies as well as EU-funded research and innovation projects, in order to assess the state of NBS financing and promotion in the EU. These databases are presented in Table 3. We include a description of the database as well as number of entries and author. We also look at case studies and research and innovation projects mentioned under EU reports (see Table 2 and Table A.2). The latter compiles research and innovation projects in the report by the Directorate-General for Research and Innovation (European Commission) (2021).

Table 3. List of consulted databases on NBS projects³

Database	Author	Nature of entries	Number of entries
Urban Nature Atlas	NATURVATION	A collection of urban NBS case studies globally with a European focus.	1240
NBS Knowledge Database	NetworkNature	A database of European research, policy, projects and market-based tools	708
Oppla Case studies	Oppla	A collection of NBS case studies globally with a European focus.	520
Research and innovation projects on nature-based solutions	NetworkNature	A database of EU-funded R&I projects working with NBS	262
Atlas of Natural Climate Solutions	European Chair for Sustainable Development and Climate Transition	A collection of Natural Climate Solutions case studies globally.	148

³ Updated as of May 2023.

Urban Innovative Actions project list	Urban Innovative Actions	A list of projects on sustainable urban development supported by European and in particular ERDF funds.	86
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Source: Own

The results from this review will be presented in Section 3.

2.2 Review of national NBS activities

Following the stock-taking at EU level, we evaluate how suggestions, good practices and experiences have been taken up at national level. For this, we review three types of national policy documents related to climate action: (i) National Climate and Energy Plans (NECPs), (ii) Long-term Strategies (LTSs) and (iii) National Adaptation Plans (NAPs) and the related Strategies (NASs), for all available EU Member States. Tables 4 and 5 summarise availability for these documents, including the year of publication or of the latest update.

Table 4. Information on National Energy and Climate Plans and Long-term Strategies across EU member states.

Country	NECP	Last Updated	LTS	Last Updated
Austria	Yes	2019	Yes	2019
Belgium	Yes	2019	Yes	2020
Bulgaria	Yes	2019	Only summary available	2022
Croatia	Yes	2019	Yes	2021
Cyprus	Yes	2019	Yes	2022
Czechia	Yes	2019	Yes	2019
Denmark	Yes	2019	Yes	2019
Estonia	Yes	2019	Yes	2019
Finland	Yes	2019	Yes	2020
France	Yes	2019	Yes	2020
Germany	Yes	2019	Yes	2020

Greece	Yes	2019	Yes	2020
Hungary	Yes	2019	Yes	2021
Ireland	Yes	2019	No	
Italy	Yes	2019	Yes	2021
Latvia	Yes	2019	Yes	2019
Lithuania	Yes	2019	Yes	2021
Luxembourg	Yes	2019	Yes	2021
Malta	Yes	2019	Yes	2021
Netherlands	Yes	2019	Yes	2019
Poland	Yes	2019	No	
Portugal	Yes	2019	Yes	2020
Romania	Yes	2019	No	
Slovakia	Yes	2019	Yes	2020
Slovenia	Yes	2019	Yes	2020
Spain	Yes	2019	Yes	2020
Sweden	Yes	2019	Yes	2019

Source: European Commission.

When looking into climate adaptation policy, the Climate-ADAPT platform provides a knowledge database for EU policy on this topic, including updated and easily accessible information on Member States' current progress on NAPs and NASs.⁴ By accessing this resource, we obtain 26 National Adaptation Strategies and 19 National Adaptation Plans (see Table 5) and we conduct an analysis of NBS' provisions in such documents. We find that only Latvia lacks a NAS and five countries, Croatia, Greece Italy, Malta, Poland, Slovakia, Slovenia and Sweden have not published a NAP. Italy and Sweden, nonetheless, have published sectoral adaptation plans. Table 5 contains this descriptive information.

⁴ <https://climate-adapt.eea.europa.eu>

Table 5. Information on National Adaptation Plans and Strategies across EU member states.

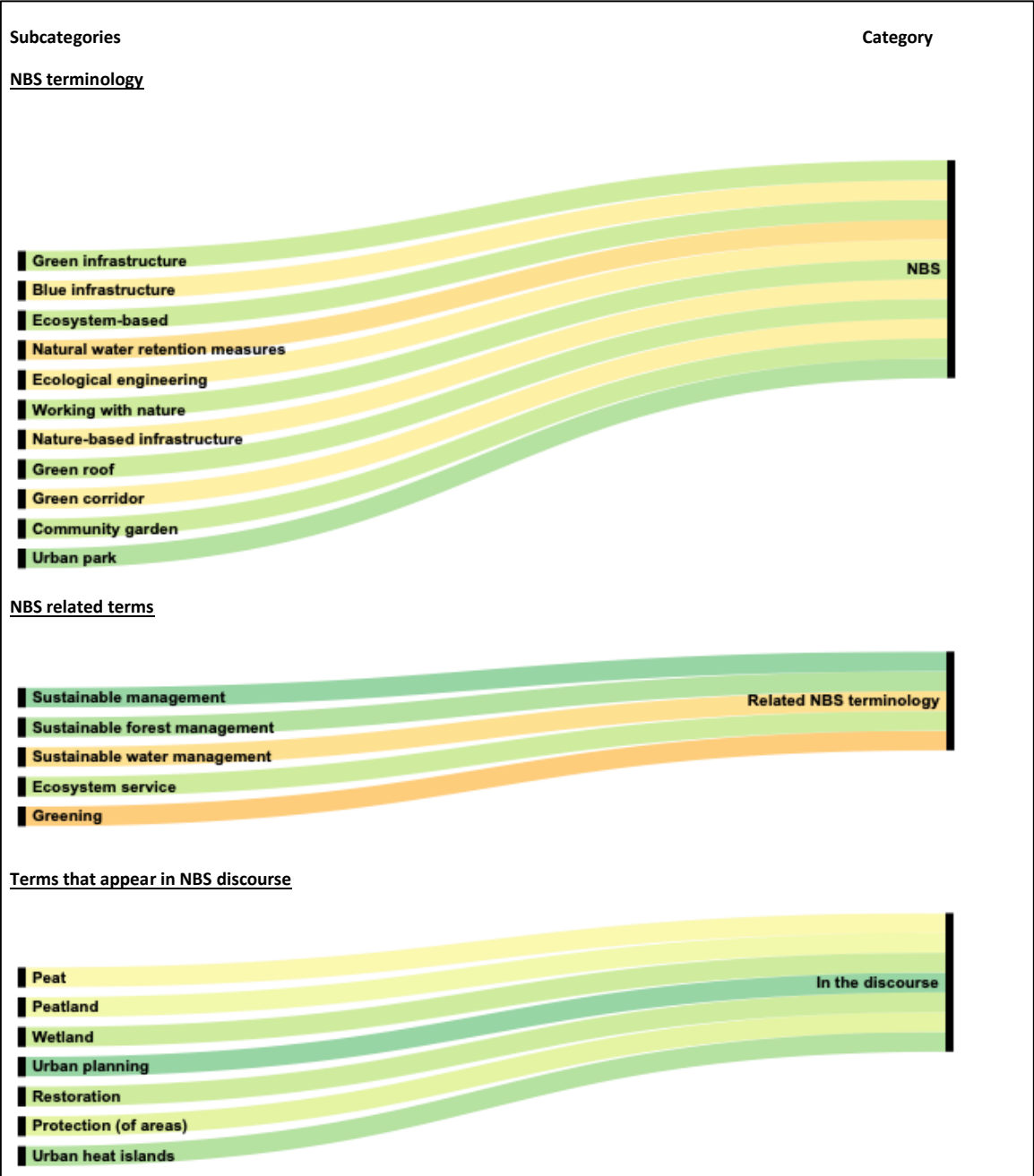
Country	NAS	Last Updated & coverage	NAP	Last Updated & coverage
Austria	Yes	2017	Yes	2017. Coverage not specified
Belgium	Yes	2010	Yes - superseded	2016. Coverage 2017-2020
Bulgaria	Yes	2019	Yes - same document as Strategy	2019. Coverage 2020-2030.
Croatia	Yes	2020. Coverage 2020-2040	No	
Cyprus	Yes	2017	Yes	2017
Czechia	Yes	2021. Coverage 2021-2030	Yes	2021. Coverage 2021-2025
Denmark	Yes	2008	Yes	2012
Estonia	Yes	2017	Yes	2017. Coverage 2017-2020
Finland	Yes	2005	Yes	2014. Covers until 2022
France	Yes	2007	Yes	2017. Covers 2018-2022.
Germany	Yes	2008	Yes	2020
Greece	Yes	2016	No	
Hungary	Yes	2018	Yes	2020
Ireland	Yes	2018	Yes	2019
Italy	Yes	2015	No	
Latvia	No		Yes	2019
Lithuania	Yes	2013. Covers 2013-2021	Yes	2021. Covers 2021-2030
Luxembourg	Yes (Strategy and Action Plan in one document)	2018. Covers 2018-2023	Yes (Strategy and Action Plan in the same document)	2018. Covers 2018-2023

Malta	Yes	2012	No	
Netherlands	Yes	2016	Yes	2018. Covers 2018-2019
Poland	Yes	2013. Covers until 2030	No	
Portugal	Yes	2013. Covers until 2020	Yes	2019
Romania	Yes	2013	Yes	2016-2020
Slovakia	Yes	2018	No	
Slovenia	Yes	2016	No	
Spain	Yes	2021. Covers 2021-2030	Yes. New in development	2014
Sweden	Yes	2017	No	

Source: Climate-ADAPT

The purpose of this exercise is to assess the level of take-up of the NBS concept in national adaptation policy and to analyse the existing provisions throughout Member States' climate adaptation policy documents in order to identify potential policy gaps. To carry out this review, we have conducted a thematic analysis of NBS and related terminology by employing the qualitative research software MAXQDA for computer-aided text analysis (CATA). Kuckartz and Rädicker (2019) provide methodological grounds for this analysis and we perform a coding and categorising process as described in their book. Three categories are identified to study the up-take or presence of NBS provisions: (i) NBS terms, (ii) NBS-related terms and (iii) terms present in NBS discourse. Moreover, 23 subcategories stem from these three and are illustrated by Figure 1. We understand 'NBS terms' as those that can be understood as nature-based solutions, 'NBS-related terms' such as those that can sometimes be employed to refer to a nature-based solution, and 'terms present in the discourse' as terms that we see often appearing when describing an NBS project or that can refer to actions part of the project or effects of the NBS.

Figure 1. Thematic analysis categories identified for the review of NBS provisions in national adaptation policy



Source: Own

Results from this review are discussed in Section 4. For National Adaptation Plans and Strategies, we identify a much more significant level of support for NBS than for the other policy documents, although this support appears mixed when comparing between Member States. In this light, we applied a two-tier strategy to analyse the contents of the NAP and NAS. Tier 1 consisted of CATA as applied for the

NECPs and LTSs. Based on this, tier 2 followed up with an in-depth assessment. For this, we developed an assessment grid to analyse NBS support across NAPs and NASs, including the presence of concrete provisions for advancing NBS implementation, based on a review of relevant criteria cited in literature. To validate this assessment grid, we asked 19 sector experts to comment on our draft and suggest modifications. This was done through a dedicated section of the in-depth interviews carried out for the second part of this working paper (Part II on ‘Analysing Governing and Financing Barriers for NBS Uptake’). In a dedicated section, we explained the assessment grid to interviewees and discussed what they considered that could pose challenges or potential limitations for our study. With this input, we updated the grid. The finalised analysis grid is presented in Table A.3 in the Annex. It was used to review NBS provisions throughout Member States’ NASs and NAPs. We classify the Plans and Strategies of each Member State according to their level of support for NBS, adopting a ‘traffic light’ system to showcase a general overview of the current state of NBS support (following Davis et al. 2017, also found in EEA, 2021). According to this assessment, countries are rated as showing ‘strong support’, ‘medium support’ or ‘low support’ and we precise if NBS appears or not explicitly. Moreover, we evaluate their support for governing and financing provisions in separate columns, as well as the provision of concrete measures to advance NBS and reference to specific projects, policies or initiatives that support NBS (See Table 9). In order to provide more detailed information, we explain how the Plans and Strategies were identified and reviewed, and we include an assessment of our findings below.

3. Mapping EU activities on NBS

3.1. Strategies and policy papers

In the European Union (EU), NBS are embedded across several policies that form the ecosystem of the European Green Deal (EGD).⁵ While the explicit mention of such term is yet to be fully embraced, the increased reference to NBS and related terms in strategies, regulations or directives is a reflection of the rising prominence of these approaches (Davies et al., 2021). Moreover, the trend indicates that refreshments or updates in these policies are increasingly reflecting the NBS discourse and themes emerging since 2015 (ibid.). The concerned policies include, among others, the Biodiversity Strategy for 2030, the Action Plan on the Sendai Framework (2016), or the EU Adaptation Strategy (EEA, 2021).

While these have different objectives, in light of the EGD, they share a common interest for climate change adaptation and mitigation. Moreover, given the multifocal nature of NBS, they allow to target a variety of objectives that contribute to this interest, such as carbon capturing, disaster risk-reduction, restoration of ecosystems, or even raising awareness and building skills amongst the population. In particular, the final report of the Horizon 2020 Expert Group that aimed to develop a R&I agenda on ‘Nature-Based Solutions and Re-Naturing Cities’ highlights four thematic goals for NBS in Europe: (i) Enhancing Sustainable Urbanisation, (ii) Restoring Degraded Ecosystems, (iii) Developing Climate Change Adaptation and Mitigation and (iv) Improving Risk Management and Resilience. These goals fall into the objectives of several of the policies under the EGD and, as such, NBS become relevant instruments and are mentioned by them as tools to advance these objectives.

A report from the European Environmental Agency assessed the level of support that different European policies express with regards to NBS for climate change adaptation and disaster risk reduction (EEA,

⁵ This paper understands ‘policy’ as any regulation, strategy, action plan, agenda or framework intended to guide political decision making, following EEA (2021).

2021). They found 12 policies (not including the EGD itself) that were rated as showing either ‘strong’ or ‘medium’ level of support for Nature-based Solutions. That level was measured by taking into account different aspects such as the explicit or implicit mention of NBS, the “perceived utility” when achieving the policy objectives or the frequency with which NBS or related terms are mentioned. In particular, the report highlighted ‘strong’ support for NBS across five of the identified policies, in the Biodiversity Strategy for 2030, the Green Infrastructure strategy, the Action plan on the Sendai Framework, the Floods Directive, and the EU Adaptation Strategy. The policies showing medium level of support were the Bioeconomy Strategy, Forest Strategy, LULUCF (Land use, land use change and forestry) Regulation, Water Framework Directive, Urban Agenda, Farm-to Fork Strategy and the Common Agricultural Policy. All these policies, although coming from different angles and addressing different challenges, pursue objectives that relate to one or more of the aforementioned thematic goals of NBS that were highlighted in the final report of the Horizon 2020 Expert Group on NBS. In this sense, these different policies recognise the potential of NBS to address a variety of issues while contributing to climate change adaptation. Moreover, we observe that the concept of ‘solutions working with nature’ is progressively being accepted and embedded in key EU strategies, regulations and directives (Davies et al., 2021; Faivre et al., 2017).

The first EU Biodiversity Strategy was adopted in 1998, with its latest update in 2021, the ‘Biodiversity Strategy for 2030’. As mentioned by Cohen-Shacham et al. (2019), since the previous Biodiversity Strategy (2011), there has been a shift in the paradigm of the EU’s policy on biodiversity, from one focused on “nature per se” and on implementing protected areas, to one focused on the interaction between people and nature (also in Davies et al., 2021). This change is reflected in the subheading of the new Biodiversity Strategy, ‘Bringing nature back into our lives’. Throughout this strategy, nature-based solutions are explicitly mentioned several times as interventions that help protect biodiversity and ecosystems, and as “essential for emission reduction and climate adaptation” (pg. 7). One of the critical commitments of this strategy is to “Unlock at least €20 billion a year for nature and ensure that a significant proportion of the 30% of the EU budget dedicated to climate action is invested in biodiversity

and nature-based solutions” (pg. 24). Furthermore, the document stresses the importance of ensuring that the financial system is aligned with biodiversity objectives, developing governance frameworks and bringing back nature to cities and agricultural land.

The EU Green Infrastructure Strategy builds on the work of the Natura 2000 network and it was launched in 2013. It defines green infrastructure (GI) as “a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services” (COM (2013) 249 final). The concept of green infrastructure, as mentioned in the previous section, is closely linked to NBS and often understood as part of the umbrella of nature-based solutions. This strategy seeks to promote the development of GI and, similar to the policy narrative on NBS, argues that GI is a cost-effective alternative to grey infrastructure (Davies et al. 2021)

The Action Plan (2016) on the ‘Sendai Framework for Disaster Risk Reduction 2015-2030’ constitutes the EU’s translation into tangible policy action of the final document adopted at the Third UN World Conference on Disaster Risk Reduction in Japan in 2015. The Plan highlights four implementation priorities: (1) Building risk knowledge in EU policies; (2) An all-of-society approach in disaster risk management; (3) Promoting EU risk informed investments; and (4) Supporting the development of a holistic disaster risk management approach.

Here, under priority number 3, the Action Plan enumerates the main policies and practices that contribute to the promotion of disaster risk reduction investments, such as those related to resilience building or to ecosystem-based approaches. Under the latter we find reference to nature-based solutions, and more specifically to NBS research and innovation, as well as to the Green Infrastructure strategy or the financing instrument “Natural Capital Financing Facility” (now to be replaced by ‘InvestEU’).

The Floods Directive (2007/60/EC) aims to establish a framework for the “assessment and management of flood risks”. In this sense, the policy does not seek to reduce the risk of flood, but rather to mitigate the effects of flooding. While this document does not explicitly mention the term ‘nature-based solution’, the multiple references to the desirability of projects that contribute to the “maintenance and/or

restoration of floodplains, as well as measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activity” can be understood as an indirect reference to NBS. As such, the Floods Directive contributes to the diffusion of nature-based solutions that deal with the management of river basins.

Finally, with regards to the EU Adaptation Strategy, item number 11 of this communication specifically refers to nature-based solutions’ potential for climate change adaptation and mitigation and it highlights three commitments of the European Commission for NBS advancement. These commitments are: incentivising the rollout of NBS in Member States, developing financial aspects of these projects, as well as proposing NBS for carbon removals. This strategy, and in particular the previous EU Adaptation Strategy, served at the same time as a reference for Member States to develop their own National Adaptation Plans (NAPs) and strategies (NASs).

Other policies that include NBS terminology or considerations are the Roadmap to a Resource Efficient Europe (COM(2011) 571) or the policy action on Green Public Procurement⁶ (Davies et al. 2021).

3.2 Legal provisions

Contrary to the broad coverage of NBS policies in EU strategies and recommendations, the EU has so far been reticent to put forward a harmonised legal framework for supporting nature-based solutions. One notable exception to this is the recent proposal for a “Nature Restoration Law”, that at the time of this review is still being negotiated between the co-legislators.⁷

The “Nature Restoration Law” takes the form of a regulation and was adopted by the European Commission on June 22, 2022. It builds on the Biodiversity Strategy for 2030 and complements the Birds and Habitats Directive, the Water Framework Directive, the Marine Strategy Directive and the

⁶ https://ec.europa.eu/environment/gpp/index_en.htm

⁷ See the procedure file of the European Parliament’s Legal Observatory at [https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2022/0195\(COD\)&l=en](https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2022/0195(COD)&l=en)

Invasive Alien Species Regulation. The proposed regulation sets restoration targets at marine, terrestrial, coastal and freshwater ecosystems as well as ensuring no net loss, and the increase of green urban spaces. Moreover, it entails obligations to remove river barriers and reverse the decline of pollinators and describes the requirements for Member States' to submit their national restoration plans. When entered into force, this proposal could provide important legal provisions for NBS in Europe, especially given that it targets different ecosystem types and as well as green infrastructure, and it sets binding targets.

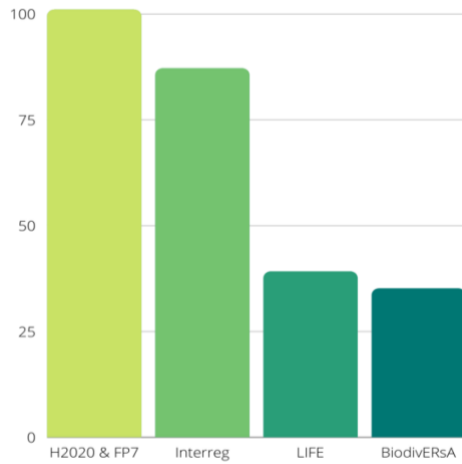
3.3 Projects, databases and guidelines

To work towards building a credible body of knowledge to advance NBS, several projects and research initiatives have been funded in recent years, notably under the Horizon Europe 2020 scheme, but also through the European regional development fund, LIFE+Climate Action or COST actions. These actions are part of the EU's research and innovation policy for nature-based solutions⁸ which stems from the work of the Final Report of the Horizon 2020 Expert Group on 'Nature-Based Solutions and Re-Naturing Cities' (2015). This report stresses the potential for nature-based solutions and their benefits in different areas, establishing thematic goals as well as research & innovation actions. Given the early nature of the report, the focus is on emphasising the need for researching future avenues for NBS implementation and adopting a common framework to do so. The H2020-funded platform NetworkNature developed a database of 262 EU research and innovation projects on nature-based solutions implemented between 2011 and 2021.⁹ They did so by applying keyword searches to projects financed under five R&I and implementation programmes: BiodivERsA, Horizon 2020, Seventh framework programme (FP7), Interreg and LIFE. Figure 1 illustrates the number of projects financed by each of the programmes.

⁸ https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en

⁹ <https://networknature.eu/ridb>

Figure 1. Projects under the NetworkNature database on EU-funded NBS R&I projects.



Source: Own from NetworkNature database information.
Count: 101 H2020 and FP7, 87 Interreg, 39 LIFE Climate Change Adaptation Stream and 35 BiodivERSA.

We find that since 2015, various EU-funded projects, specially under Horizon 2020, on nature-based solutions have aimed to bridge this knowledge gap by following a case-study methodology or by working directly with local authorities implement projects to build best practice casebooks, develop successful business models, or promote NBS both for investors and for policymakers. As of late 2010s, the European Commission had earmarked 240 million EUR to spend on NBS-related projects (Cohen-Shacham et al., 2019). A list of Horizon 2020 NBS projects reviewed by the European Commission (2021) is shown in Table A.2 in the Annex. Initiatives such as CLEVER cities, proGIreg or UNaLab focus on implementing NBS in cooperation with local authorities. At the same time, they use these cases to extract ‘best-practices’ in order to develop replication, monitoring or implementation frameworks; business models; or resources for policymakers. Moreover, in the case of UNaLab, but also under the OPERANDUM, PHUSICOS or RECONNECT projects, ‘living labs’ models are implemented across European cities. The concept of ‘living lab’ is understood as an experimental and collaborative approach to architectural and urban or landscape planning, but also sometimes project design (Lupp et al., 2021).

By employing this type of approach, the cooperative aspect of NBS governance becomes a main goal,

as well as the inclusion of groups traditionally left out of the policymaking process. Additionally, other initiatives focus on developing a network of NBS projects (BiodivERsA), on research and innovation actions (Nature4cities, Naturvation) or on mainstreaming natural capital and working with businesses (MAIA, We Value Nature). In terms of case study databases, ‘Oppla’ and the ‘Naturvation’ or ‘Urban Nature Atlas’ constitute the most significant efforts to build a centralised and accessible platform.

In terms of funding coming from EU schemes, some of the most significant projects have been URBAN GreenUP (EU contribution: 13.97M EUR), RECONNECT (EU contribution: 13.52M EUR), UNaLab (EU contribution: 12.77M EUR), GrowGreen (11.22M EUR) and ProGIreg (EU contribution: 13.52) (European Commission, 2020), all funded under Horizon2020. Contributions to other projects have ranged approximately between 200.000 EUR to 10M. This list does not include projects financed by regional authorities that have received EU support and thus is non-exhaustive and instead should be understood as part of the financing that the EU dedicates to NBS.

Furthermore, this ecosystem of NBS projects has been consolidating for the past 7 years, following the firsts EU targeted calls for proposals for large-scale demonstration projects in this field, for the years 2016-2017 (Faivre et al., 2017). Since then, R&I in NBS has expanded rapidly in the continent. Numerous frameworks to assess different aspects of NBS have been developed, as well as handbooks for practitioners, platforms to share knowledge and more. In this sense, governance and finance aspects have also been in the scope of some of these projects. Nonetheless, attention to this matter has remained limited, given the novelty of the topic and lack of data availability. Moreover, we see that the diversity of projects, and specifically the different levels at which they can be implemented and thus multiple sources and coordinating actors also hinders data accessibility. Some R&I projects have built databases of available case-studies that contain financing and governance information of implemented projects. Notably, the ‘Urban Nature Atlas’ developed by the Naturvation project contains over 1000 case-studies and includes information regarding the management set-up, leading actor as well as budget size and financing source.

4. NBS at Member State Level

Since 2014, the European Union has coordinated efforts into building an ecosystem to foster and upscale nature-based solutions. While much of the research on NBS has focused on analysing this EU ecosystem or on studying concrete local actions and projects, there is a lack of literature that looks at how these EU ambitions have translated at the national policy level. In particular, one area of study that appears missing from the literature is exploring the link between national climate policy and nature-based solutions.

We have decided to analyse NBS in national climate policy motivated by the significant potential for NBS to contribute to climate change adaptation (Griscom et al., 2017). In this sense, the multifocal benefits that are brought by NBS can relate to several objectives found in these policies, such as combatting the heat island phenomenon in cities, preventing floods and other natural disasters worsened by climate change, or promoting better soil or water management. Measuring the level of support for NBS across adaptation policy will contribute to advancing efforts towards developing climate adaptation policy that is aware of the benefits of NBS; which is particularly relevant given that at the time of this review Member States are in the process of developing the second round of NCEPs and, for some, of updating their National Adaptation Plans. We also find that, while most of the literature on NBS adopts a local scale –which stems from the fact that the implementation of NBS is done almost always at that level–, adopting a national lens when analysing NBS policy can be useful to understand if efforts are guided through an integrated approach or to measure the state of NBS support across different sectors (from forestry to urban infrastructure or water management) and be able to identify synergies. This analysis focuses on evaluating NBS up-take by key national adaptation policy documents, which include actions and objectives throughout different sectors.

4.1 Analysis of Energy and Climate Plans

Under the EU ‘Regulation on the governance of the energy union and climate action’ approved in 2018, Member States had to submit their draft NECPs by the end of that year. Following from this work and the EU-wide assessment of the final NECPs in 2020, Member States will have to submit again their updated draft for their NECPs to the Commission by June 2023. These Plans constitute an integral part of climate change adaptation policy and address aspects such as decarbonisation, energy efficiency, energy security, internal energy market and research, innovation and competitiveness.

When performing the thematic analysis on NBS provisions across these documents, we find three main takeaways:

1. There is a low level of take-up reflected in NECPs for NBS and related concepts.
2. Most of the references to NBS appear in the context of carbon removal/sequestration/absorption/storage.
3. Around half of the Member States contain less than 5 references to NBS or related concepts.

Moreover, following from point 2, we see that several Member States reference restoration or sustainable management of resources as desired measures for carbon removal. Biodiversity is also mentioned often under this context. Sustainable management of forests is mentioned several times in the context of biomass and green roofs and similar actions are mentioned, although scarcely, in the context of energy efficiency (e.g., Belgium, Malta, Hungary). Interestingly, two countries mention the idea of potential payment for ecosystem measures (Italy and Portugal) although this is not really taken up.

Across all Member States, we found some 150 references to NBS-related terminology. Only Cyprus explicitly employs the term ‘nature-based solutions’ in its NECP, when acknowledging the potential of NBS for achieving its carbon emission goal for 2030. Moreover, only two countries included more than 10 NBS related concepts in their NECPs, namely Belgium (19) and Italy (11). The most mentioned concepts related to NBS were those related to a ‘sustainable management’ of land (notably forests) or

water; ‘ecosystem services’; and ‘green infrastructure’. We include the count of results for keyword searches of these terms in Table 6.

Table 6. NBS-related terminology in NECPs

Direct NBS concepts	Number of relevant mentions*
Green or Blue infrastructure	22
Nature-based solutions	3
Ecological engineering	1
Related NBS concepts	Number of relevant mentions
Ecosystem service	27
Sustainable management	27
Sustainable forest management	22
Greening	17
Sustainable water management	2
Subtypes of NBS	Number of relevant mentions
Green spaces	14
Green roof	11

Source: Own

*In this context “relevant mentions” means that keyword results have been manually revised and those results that did not accurately fit with the NBS concept or approach have been removed from the table.

4.2 Analysis of National Long-term Strategies

National Long-term Strategies (LTSs) of Member States represent the countries’ strategies to meet their Paris Agreement commitments and the energy union objectives. Moreover, these must be consistent with NECPs and they are to be submitted every 10 years (next submission is established for 2029). These documents are shorter than NECPs and NASs and NAPs and we find a very low take-up of NBS and related concepts. It must be noted that there are no LTSs available for four Member States: Bulgaria (only summary available), Ireland, Poland and Romania.

Following the analysis of LTSs, we observe a significant lack of support or references for NBS and related concepts in most of the Member States’ documents. In fact, for almost all LTSs we find less than 10 references, with some Member States including no reference to NBS or related terminology. Three countries, France, Malta and Portugal, mention explicitly the term nature-based solutions, the first when speaking about the reduction of emissions in urban areas, the second when talking about the policy context for adaptation policy and the latter when speaking about adaptation of buildings. As with NECPs, we see that most references to NBS and related concepts are made in the context of carbon storage or carbon capturing. Moreover, the documents do not reflect a cross-cutting vision of NBS and there are no references to NBS as a driver of wellbeing or to the multifunctionality of NBS. Instead, we see NBS cited as an example of purely a tool for driving down emissions or to foster biodiversity by enhancing or restoring ecosystems.

Table 7. NBS-related terminology in LTSs

Direct NBS concepts	Number of relevant mentions
Green infrastructure	9
Nature-based solutions	2
Ecosystem-based	0
Related NBS concepts	Number of relevant mentions
Ecosystem service	6
Sustainable management, sustainable forest/water management	10
Greening	5
Subtypes of NBS	Number of relevant mentions
Green roof	4
Green corridor	1
Green spaces	1

Source: Own

4.3 Analysis of NASs and NAPs

From 2005 onwards, Member States began to develop and adopt National Adaptation Strategies (NASs) and Plans (NAPs) to promote and co-ordinate adaptation at the national level. These documents stem from the EU Adaptation Strategy and contain comprehensive information on countries' overarching objectives and action lines when it comes to climate adaptation policy across sectors.

We find that support for nature-based solutions in National Adaptation Plans and Strategies is more significant than for the NECPs and the LTSS, with a much higher reference to NBS and related terminology as well occasional referencing to specific projects, financing programmes and dedicated actions. Moreover, we find more references to NBS in a wider variety of contexts, and documents are more likely to refer to the multi benefits of NBS (such as for health, land use, mobility or infrastructure). Nonetheless, this support varies greatly across countries and is also influenced by factors such as the year of publication of the policy documents, with a higher support for NBS in those documents adopted in recent years. Given that NBS as a concept was introduced in the policy discourse around 2014, earlier documents tend to employ close terms, such as 'ecosystem services' or 'green infrastructure', but they do not explicitly refer to NBS. Out of the 26 Member States that have published a National Adaptation Strategy, just over half (15) have done so in 2015 or later. The proportion is higher for NAPs, 16 out of 19 countries have published or updated their Adaptation Plan in the past 8 years versus 3 whose NAP dates from 2014 or earlier.

Out of all reviewed countries, seven have explicitly employed the term 'nature-based solutions' either in their Adaptation Strategy or Plan (Croatia, France, Germany, Luxembourg, Netherlands, Spain and Sweden). Moreover, this did not necessarily result in those documents containing more extensive provisions on governance and finance related information for NBS. Instead, we observe that the support for NBS and across NASs and NAPs was expressed through a variety of terminology and phrases.

Table 8. NBS-related terminology in NASs and NAPs

Direct NBS concepts	Number of mentions
Green infrastructure	148
Nature-based solutions	31
Ecosystem-based solution or approach	7
Blue infrastructure	8
Related NBS concepts	Number of mentions
Ecosystem service	413
Sustainable management	76
Sustainable forest management	35
Greening	76
Sustainable water management	8
Natural water retention measures	8
Subtypes of NBS	Number of mentions
Green roof	33
Green spaces	61

Source: Own

While the thematic analysis is useful for understanding whether the concept of NBS is present in policy documents, its applicability to evaluate and compare concrete provisions remains limited, as this approach can only be used to explore the presence of certain codes. Given the higher number of references to NBS and related terms in the case of NASs and NAPs, we applied the assessment grid presented in Section 2 to evaluate if this higher number of references also materialises in more concrete provisions, including provisions for financing and governing NBS, that will contribute to the development and upscaling of this nature-based solutions. The results from this assessment process are reflected in Table 9, which contains information on governance and financing provisions as well as on concrete measures or references to targeted NBS programmes, NBS implemented projects or policies.

Table 9. Information on National Adaptation Plans and Strategies across EU member states.

Country	Level of support for NBS	Provides financing provisions (related to NBS)	Provides governance provisions (related to NBS)	Provides concrete measures that target NBS	References specific projects, programmes or other policy that targets NBS
Austria	High (implicit)	Yes	To some extent	Yes	Yes
Belgium	Low (implicit)	No	No	No	Yes
Bulgaria	High (implicit)	Yes	Yes	To some extent	Yes
Croatia	Low (explicit)	No	No	No	No
Cyprus	Medium (implicit)	No	No	To some extent	No
Czechia	High (implicit)	Yes	No	Yes	Yes
Denmark	Medium (implicit)	No	No	To some extent	Yes
Estonia	Low (implicit)	No	No	To some extent	No
Finland	Low (implicit)	No	To some extent	No	No
France	High (explicit)	To some extent	Yes	Yes	Yes
Germany	High (explicit)	Yes	To some extent	Yes	Yes
Greece	Medium (implicit)	No	No	Yes	Yes
Hungary	High (implicit)	Yes	Yes	Yes	Yes
Ireland	Medium (implicit)	To some extent	Yes	To some extent	Yes
Italy	Low (implicit)	No	To some extent	To some extent	No
Latvia	Low (implicit)	No	No	To some extent	No
Lithuania	Low (implicit)	No	To some extent	To some extent	No
Luxembourg	Low (explicit)	No	No	Yes	No
Malta	Low (implicit)	No	No	To some extent	No
Netherlands	Low (explicit)	No	No	To some extent	To some extent
Poland	Medium (implicit)	No	To some extent	No	No
Portugal	Medium (implicit)	To some extent	Yes	Yes	No
Romania	Low (implicit)	No	No	No	No
Slovakia	High (explicit)	Yes	To some extent	Yes	To some extent
Slovenia	Low (not present)	No	No	No	No
Spain	High (explicit)	Yes	To some extent	Yes	Yes
Sweden	Medium (explicit)	No	No	Yes	Yes

Source: Own.

Following this exercise, we observe that countries show mixed levels of support for NBS. While some countries do not contain any concrete measures that support, even implicitly, NBS, others include several examples of good practices of NBS, financing instruments or specific pieces of legislation that target these projects. Countries such as Austria, for example, include specific NBS projects as good practices in their NAP, mentioning the key stakeholders, and the implementation process (for Austria we find projects such as “Adaptive Management Strategies for the Austrian Federal Forests” or “Revitalising Graz’s Courtyards”). Regarding the financing and governance of NBS, we find that there is, in general, little information. Some include references to dedicated programmes, more commonly in a specific subtype of NBS, such as those to promote the creation of urban green spaces. A few countries mention the need to develop more targeted financing or innovative methods to finance NBS (for example, Bulgaria or Spain). Interestingly, Czechia mentions the possibility of using innovative economic instruments to finance protection of ecosystem services, such as through insurance mechanisms or payments for ecosystem services - It is the only country to do so. Moreover, in their policies, Denmark and Estonia refer to the challenge of pricing nature or of assessing the monetary value of ecosystem services. In terms of governance of NBS, we see that this aspect remains undeveloped, with some Member States recognising the multifocal nature of NBS, but with none calling for coordinating action between different departments of government or sectors. In the context of citing relevant measures for climate adaptation, some Member States detail the concerned actors to advance the measure, with some being local or regional actors working alongside Ministries or other national-level bodies. Only Bulgaria mentions the spread of institutional capacities in the context of ecosystem services as a potential challenge for fostering this approach. Lastly, some countries refer to EU or local legislation policies or instruments as working together with the national level, underlining the alignment of interests and coordinated action. Nonetheless, this aspect remains underdeveloped.

In this light, National Adaptation Plans and Strategies reflect, generally speaking, a moderate level of support for NBS. We observe that Member States are increasingly recognising the value of implementing NBS and see this trend evidenced by the fact that policy updates are steadily incorporating the NBS concept. Moreover, references to NBS are found more commonly under a variety of sector

objectives for some Member States and more concrete provisions are being included in the documents. Still, take-up of the concept remains somewhat in its infancy. More than half of the countries reviewed show a Low or Medium level of support for NBS. Moreover, most countries do not recognise the need to coordinate action to implement NBS, but rather cite NBS as a potential or desirable tool to bring green into cities, to create carbon sinks or to protect ecosystems but provide no further indications on how to achieve this. Sectors such as urban planning, forestry or agriculture, still overwhelmingly constitute those with the most NBS references. Only a few countries include NBS as a potential tool to achieve other goals in areas, from health to land management, mobility or infrastructure.

5. Conclusion: Good practices and blind spots to be addressed

Nature-based solutions represent a unique opportunity to advance climate change adaptation in cities and natural landscapes. They provide ecosystem services and bring benefits that come from increased biodiversity closer to the tools of policymakers. Among these benefits, several contribute to climate change adaptation, such as through fighting the urban heat island effect, by constituting natural water retention measures or by offering carbon sinks.

This paper conducted a stocktaking exercise to assess the level of support and adoption of NBS by the European Union and by Member States. We find that at the EU level, there are significant ambitions when it comes to mainstreaming nature-based solutions, with a high level of support for NBS across relevant strategies (including the EU Adaptation Strategy) and financing dedicated for NBS research and innovation. In contrast, harmonised European legislation to support NBS activities is still largely missing. Turning to the national level and the take up of NBS at national level, results are less clear and support for NBS appears to be mixed. In this sense, national adaptation policy incorporates NBS only to some extent and contains little concrete provisions on NBS implementation.

It follows that the take up of NBS by Member States' adaptation policy remains significantly underdeveloped. In the case of the NECPs and the LTSs, even references to NBSs and related terms are scarce and the take-up of the concept remains very limited. While most countries incorporate some reference to the benefits of NBS and include the promotion of NBS or related terms as a good practice in their NASs and NAPs, only a few documents include concrete measures, objectives, or financial instruments to actually carry this out. While some Member States show a higher support level for NBS, the trend is for countries to only include limited referencing and not show 'real' take-up of NBS, or include NBS only in a given sector, when speaking for example, about sustainable forest management. Only few countries demonstrate applying the NBS concept across sectors, have developed dedicated financing programmes or include provisions on multilevel governance.

To further push the development and application of NBS, policymakers need to address the following points:

1. To consider NBS beyond its benefits for biodiversity, acknowledging its multifocal nature and social and economic benefits.
2. To use national policy to coordinate regional and local action on NBS, developing a cohesive multilevel governance.
3. To include provisions on financing NBS, such as financing instruments, incentives or showcasing earmarked projects.
4. To acknowledge that the multifocal nature of NBS calls for an integrated approach that requires coordination between different sectors or departments, going beyond the competencies of the Environment Ministry.
5. Following point 4, to explore the potential benefits of NBS for a wider variety of sectors and objectives
6. To promote or showcase research & innovation action on NBS.

While these points will help to develop NBS in general, further analysis is needed regarding the support framework. This notably concerns governance arrangement and (innovative) financing schemes, which are often identified as blind spots with the development of NBS. Here the remaining question is, what has so far hindered the adoption of concrete governance and financing provisions in national adaptation policy and how can these barriers be overcome. These issues will be further developed and analysed in the consecutive Working Paper Part II.

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Annex

Table A.1. Use of Nature-based solutions terms, references to climate change adaptation and disaster risk reduction, and level of support as measured by EEA (2021)

EU Policy	Explicitly mentions term 'NBS'	Explicitly mentions related terms	Level of support for NBS for CCA and DRR
European Green Deal	Yes	No	Strong
Bioeconomy Strategy (update)	Yes	Yes	Medium
Biodiversity Strategy for 2030	Yes	Yes	Strong
Green infrastructure strategy	Yes	Yes	Strong
Forest strategy	No	Yes	Medium
LULUCF Regulation	No	Yes	Medium
Action plan on the Sendai Framework	Yes	Yes	Strong
Adaptation Strategy	Yes	Yes	Strong
Floods Directive	No	Yes	Strong
Water Framework Directive	No	Yes	Medium
Urban Agenda	Yes	Yes	Medium
Farm-to-Fork Strategy	Yes	Yes	Medium
Common Agricultural policy	No	Yes	Medium

Source: EEA (2021)

Note: LULUCF, Land use, land use change and forestry

Table A.2. Projects working with NBS in Europe, finalised and ongoing (2007-2022).

Projects	Scope
BiodivERsA	Network of national and regional funding organisations promoting pan-European research on biodiversity and ecosystem services
CLEARING HOUSE	Sino-European research project on urban forests and urban trees
CLEVER cities	Promoting green cities data and information to improve policymaking
CONNECTING Nature	brings in actions to feed the initiation and expansion of economic and social enterprises in production and large-scale implementation of NBS in urban settings
EdiCitNet	EdiCitNet implements, monitors and transfers Edible City Solutions in close cooperation with city authorities and other local stakeholders.
EKLipse	Research project project focusing on knowledge synthesis, identifying research priorities, and building the Network of Networks that will support the other actions
EnRoute	EnRoute is a project implemented in the framework of the EU Biodiversity Strategy and the Green Infrastructure Strategy. It provides scientific knowledge of how urban ecosystems can support urban planning at different stages of policy and how to help policy-making for sustainable cities.
GREEN SURGE	GREEN SURGE prepared strategies to design urban green approaches: integrating green and grey approaches, connecting green areas, utilising the multipurpose character of the green approach and involving citizens in urban planning.
GROW GREEN	GROW GREEN aims to invest in NBS (high-quality green spaces and waterways) while promoting climate and water resilience and habitable cities capable of dealing with major urban challenges, such as flooding, heat stress, poor air quality... in long term city planning.
Inspiration	Inspiration aimed to develop a Strategic Research Agenda (SRA) to inform environmentally friendly, socially acceptable and economically affordable soil and land use management that meets societal needs and challenges.
MAES	The Working Group on Mapping and Assessment on Ecosystems and their Services (MAES) was established under the Common Implementation Framework (CIF) to support the effective delivery of the EU Biodiversity Strategy to 2020. The objective of the MAES Working Group is to provide guidance for the implementation of Action 5 by the EU and its Member States, including development of a coherent analytical framework to ensure consistent approaches are used to map ecosystems and their services.
NAIAD	NAIAD is focused on developing a strong conceptual framework for evaluating the assurance and the insurance value of ecosystem services. The project has developed the concept of natural assurance schemes, and the range of tools and methods to design them.
Nature4Cities	Nature4Cities aims to create a comprehensive reference platform for nature-based solutions, offering technical solutions, methods and tools to empower urban planning. This balance entails collaborative models from citizens, researchers, policymakers and industry leaders through co-creation processes.

Naturvation	NATURVATION assesses NBS achievements in cities, examines their innovation process and works with communities and stakeholders to develop the knowledge and tools required for the recognition of NBS potential for meeting urban sustainability goals.
Network Nature	NetworkNature is a European and global platform providing resources for the nature-based solutions community and creating opportunities for local, regional and international cooperation to maximise the impact and mainstreaming of NBS. All interested stakeholders can access and contribute cutting-edge, innovative knowledge and expertise on NBS to the NetworkNature platform.
OpenNESS	OpenNESS aims to translate the concepts of Natural Capital (NC) and Ecosystem Services (ESS) into operational frameworks that provide tested, practical and tailored solutions for integrating ESS into land, water and urban management and decision-making.
OPERAs	OPERAs combined NBS with traditional engineered solutions by constructing and maintaining semi-fixed dunes on Barcelona's (Spain) urban coastline, aiming to optimise ecosystem benefits and augment coastal defence against sea-level rise.
OPERANDUM	OPERANDUM is developing a set of co-designed, co-developed, deployed, tested and demonstrated innovative NBS for the management of the impact of hydro-meteorological risks (HMRs), especially focused in European rural and natural territories:
PHUSICOS	PHUSICOS is demonstrating the effectiveness of NBS and their ability to reduce the impacts from small, frequent events (extensive risks) in rural mountain landscapes.
proGReg	proGReg focuses on the implementation and observation of eight different NBS for creating productive GI to improve living conditions and reduce vulnerability to climate change, while providing measurable economic benefits to citizens and entrepreneurs in post- industrial urban districts.
RECONNECT	RECONNECT aims to rapidly enhance the European reference framework on NBS for hydro-meteorological risk reduction by demonstrating, referencing, upscaling and exploiting large-scale NBS in rural and natural areas.
REGREEN	REGREEN aims to substantially advance evidence and tools by systematically modelling and combining ecosystem services and biodiversity as the basis for urban NBS in Europe and China.
ThinkNature	ThinkNature developed a platform that supports the widespread understanding and the promotion of NBS.
TURaS	TURaS offers examples of approaches for enhancing urban sustainability, e.g., green walls that can be adopted in any location and at an affordable cost.
UNaLab	UNaLab aims to develop a European Reference Framework on benefits, cost-effectiveness, economic viability and replicability of NBS by promoting smart, inclusive and sustainable urban communities through co-creation of Urban Living Lab (ULL), demonstrations and evaluation of NBS for climate and water challenges.
URBAN GreenUP	URBAN GreenUP aims to develop, apply and validate a methodology for Renaturing Urban Plans to mitigate the effects of climate change, improve air quality, water management and increase the sustainability of cities through innovative NBS.
URBiNAT	URBiNAT focuses on the regeneration and integration of deprived social housing districts. Interventions focus on the public space to co-create with citizens new urban, social and nature-based relations within and between different neighbourhoods.

Source: Adapted from Directorate-General for Research and Innovation (2021).

Table A.3. Assessment grid to evaluate concrete provisions for NBS in NASs and NAPs.

INCLUSION OF THE CONCEPT 'NATURE-BASED SOLUTIONS'	
	Explicit mention of term 'Nature-based Solution'
	Explicit mention of NBS terminology (See Figure 1, on the thematic analysis)
	Explicit mention of NBS related terms (See also Figure 1, on the thematic analysis)
REFERENCE TO FINANCING OF NBS (YES/NO/ TO SOME EXTENT)	
	Reference to dedicated government support programmes (for NBS or that potentially include NBS)
	Reference to NBS projects earmarked in public budgets
	Reference to private-public partnerships or public procurement (for NBS)
	Reference or has as objective leveraging private investment
REFERENCE TO GOVERNANCE OF NBS (YES/NO/ TO SOME EXTENT)	
	Reference to governance models (for NBS)
	Has as objective stakeholder engagement or inclusion
	Reference to competencies at national, regional and local levels

REFERENCES SPECIFIC PROJECTS, PROGRAMMES OR OTHER POLICY THAT TARGETS NBS (YES/NO/ TO SOME EXTENT)	
Reference to implemented projects as good practices or as actions to advance policy objectives	
Reference to governance aspects of the projects	
Reference to financial aspects of the projects	
Reference to regulation or planning standards that entail NBS promotion	
Reference to other complimentary policy (such as Biodiversity strategies, Forestry directives) that targets NBS	
Reference to funding programmes for NBS implementation or research	
PROVIDES CONCRETE MEASURES THAT TARGET NBS (YES/NO/ TO SOME EXTENT)	
Reference to objectives or measures that target NBS or a type of NBS (such as green spaces or natural water retention measures). Binding or voluntary	
Has as objective to institutionalise the promotion of NBS via further legislation or policy	

Source: Own

Views expressed in this publication reflect the opinion of an individual author(s) and not those of Sciences Po.