

**Aligning National
Adaptation Frameworks
with Local Actions.
Climate Shelters as Tool
for Urban Adaptation**

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**Aligning National Adaptation Frameworks with
Local Actions. Climate Shelters as Tools for Urban
Adaptation**

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**MAIN
CODE**

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INDEX

Acknowledgments	11
Abstract	12
Abbreviations	15
CHAPTER 1 Introduction	17
1.1 Background	18
1.2 Problem Statement	20
1.3 Research Objective and Questions	21
CHAPTER 2 Theoretical Framework	23
2.1 Introduction to Climate Adaptation Policy	24
2.2 Climate Adaptation Governance in Europe	27
2.3 National Adaptation Policies (NAS & NAP)	31
2.4 Multilevel Governance in Climate Adaptation	34
2.5 Experimentation for Climate Adaptation	38
2.6 Climate Shelters as a Local Adaptation Experiment	39
CHAPTER 3 Methodology	43
3.1 National Level Analytical Approach	46
3.1.1 Scope of the National Level Analysis	46
3.1.2 Definition of the Targeted Keywords	48
3.1.3 Data Retrieval and Keyword Screening	51
3.1.4 Categorisation and Clustering	54
3.2 Local Level Analytical Approach	54
3.2.1 Spatial Overlay of the Clusters and Cities with Climate Shelters	55
3.2.2 Selection of the Case Study Cities	56
3.2.3 Analysis of Case Studies	58

CHAPTER 4 | Analysis of the National Level 61

4.1 Clustering of Member States Based on Identified References	68
4.2 Cluster 1 Explicit Reference to Climate Shelters	70
4.2.1 Spain	70
4.2.2 Cyprus	71
4.2.3 France	72
4.2.4 Austria	73
4.3 Cluster 2 Implicit Reference to Climate Shelters	76
4.3.1 Luxembourg	76
4.3.2 Romania	77
4.3.3 Italy	78
4.3.4 Estonia	78
4.3.5 Hungary	79
4.3.6 Czechia	79
4.3.7 Croatia	80
4.3.8 Germany	80
4.3.9 Ireland	82
4.3.10 Latvia	83
4.3.11 Lithuania	83
4.3 Cluster 3 No Reference to Climate Shelters	86

CHAPTER 5 | Analysis of the Local Level 89

5.1 Lille - France Cluster 1	94
5.2 Erfurt - Germany Cluster 2	100
5.3 The Hague - The Netherlands Cluster 3	104

CHAPTER 6 | Conclusion 111

6.1 Key Findings from the National Level	112
6.2 Key Findings from the Local Level	118
6.3 Comparative Policy Pathways for Climate Shelters	119
6.4 Recommendations for Mainstreaming Climate Shelters in National Adaptation Policies	122
6.5 Directions for Future Research	124
References	125
Annexe	137



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Thank you.

Teşekkür ederim.

Photo | Paris OASIS Schoolyard (Source: MAINCODE)

ABSTRACT

Cities are at the forefront of climate change adaptation, facing rising risks from extreme weather events while also serving as key sites for adaptation efforts. In recent years, climate shelters have emerged as local adaptation initiatives that transform critical public spaces into safe and inclusive environments to protect vulnerable populations from climate events. European Union Member States structure climate adaptation policies through a range of policy instruments that serve as central frameworks guiding adaptation at the national level. However, the extent to which locally implemented climate shelter initiatives are recognised, supported, or integrated within national adaptation policy frameworks remains unclear.

This thesis aims to demonstrate that adaptation policies are not solely driven by top-down approaches but are also informed and enriched by bottom-up actions through the lens of climate shelters. It explores how local climate shelter initiatives align with, diverge from, and inform national adaptation policies, and how local experimentation can strengthen national adaptation governance. A multi-step qualitative design is adopted to analyse National Adaptation Strategies and National Adaptation Plans across the 27 EU Member States through keyword screening and content analysis to identify how climate shelters are referenced and framed in these national policy instruments. The analysis identifies three clusters (i) explicit reference to climate shelters, (ii) implicit reference to climate shelters, and (iii) no reference to climate shelters, and examines one representative case from each, illustrated by case studies from France (Lille), Germany (Erfurt), and the Netherlands (The Hague). The findings are then synthesised to identify patterns of vertical alignment between local and national levels.

The study reveals that while national adaptation policy frameworks provide an overarching framework for adaptation, the vertical alignment differs for three case studies. It highlights the role of climate shelters in informing national strategies and offers recommendations for vertical upscaling and integration of these initiatives into national adaptation policies to support urban regeneration and strengthen adaptation pathways.

Keywords | Climate Adaptation, Climate Governance, National Adaptation Plans, Local Actions, Climate Shelter



Abbreviations

CCC - Climate City Contact

CDDG - European Committee on Democracy and Governance

EEA - European Environment Agency

EU - European Union

EUI - European Urban Initiatives

GCoM - Global Covenant of Mayors for Climate & Energy

HKA - The Hague Climate Agreement (Haags Klimaatakkoord)

IPCC - Intergovernmental Panel on Climate Change

LCP - Local Climate Plan

MLG - Multi-level Governance

NAP - National Adaptation Plan

NAS - National Adaptation Strategy

NbS - Nature-based Solutions

SDG - Sustainable Development Goal

UCS - Urban Climate Shelters

UNDP - United Nations Development Programme

UNFCC - The United Nations Framework Convention on Climate Change

Photo | Barcelona's Climate Shelter in Schoolyard (Source: MAINCODE)

CHAPTER 1

CHAPTER 1 | Introduction

This chapter introduces the background of the thesis by drawing on the context of climate adaptation while framing the emerging role of climate shelters in urban environments. It then defines the research problem and highlights the existing gaps in current adaptation policy frameworks. Lastly, the chapter presents the research aim and objectives, followed by the main research questions guiding the study.

1.1 Background

In the twenty-first century, climate change adaptation largely takes place in cities (Evans, 2011), as they are concentrated centres of production, consumption and waste disposal that significantly influence climate change (Grimm et al., 2008). On the other hand, they are also characterised by institutional density and creative capacity, positioning them as focal points for potential solutions and new forms of climate governance (Evans, 2011; Grimm et al., 2008).

The role of cities as central in climate action has also been recognised in major international frameworks (Grönholm et al., 2022). In the 2015 Paris Agreement, cities are highlighted as major actors in advancing ambitious climate measures, while the 2016 New Urban Agenda places urban areas at the centre of climate change responses and promotes multi-level governance across international, national, and local scales (UNFCCC, 2015; United Nations, 2015). This recognition is strengthened by UN Sustainable Development Goal 11, which calls for the development of sustainable and resilient cities and communities (United Nations, 2015). Demographic trends further underline the urgency of urban climate action in cities. In 2025, over 12,000 cities worldwide have populations of at least 50,000, together accommodating approximately 45 per cent of the global population (United Nations, 2025), making cities particularly vulnerable to adverse climate impacts.

Cities function as central actors for developing and implementing climate action efforts since they are at the crossroads of local actions and national and international climate commitments (Heidrich et al., 2016; Reckien et al., 2018). They play a crucial role in implementing mitigation and adaptation actions because of their proximity to citizens and their capacity to manage local climate risks (Heidrich et al., 2016). They are also environments where synergies and trade-offs between mitigation and adaptation are most evident (Landauer et al., 2015). In the light of this, cities hold a crucial role in transnational climate governance by promoting learning and knowledge exchange between local governments and other sub-national organisations, mobilising local capacities for practical implementation, and attracting political and business support for local climate action on the international stage (Broto, 2017; Reicken et al., 2018). However, to tackle climate

change effectively, cities require coherent support and coordination from higher levels of government within a coordinated multi-level approach (Heidrich et al., 2016).

As climate-related hazards such as heatwaves, flooding and droughts intensify, cities are under growing pressure to develop effective adaptation measures that safeguard vulnerable communities and essential infrastructure. In recent years, urban areas have become important spaces for climate adaptation experimentation, where new solutions are developed, tested, and applied at the local level. This experimental approach is widely seen as a way to bridge the gap between top-down climate policies and the challenges of scaling up bottom-up innovations (Antikainen et al., 2017). Among emerging adaptation approaches, climate shelters have gained growing attention as responses to rising heat-related risks in urban environments. Within the wide range of applications, the MAINCODE project aims to transform schoolyards into climate refuges to provide safe and accessible spaces for all as a promising cooling demonstration approach. The project frames Urban Climate Shelters (UCS), defined as:

“a long-term strategy for climate mitigation and adaptation in urban contexts, which aims to protect populations, particularly the most vulnerable groups, during extreme climate events in a network of safe, inclusive, and accessible public spaces to enhance urban liveability, improve human health, and promote urban regeneration when implemented through nature-based solutions and co-design processes” (Pincegher et al., under review).

By transforming critical public spaces such as schoolyards, parks, and community facilities into protective safe spaces from climate hazards for vulnerable populations, UCS initiatives represent an accessible and inclusive adaptation measure.

Across Europe, national adaptation frameworks serve as an overarching structure for climate adaptation actions. Policy tools such as National Adaptation Strategies (NASs) and National Adaptation Plans (NAPs) are established by EU Member States as central policy mechanisms for guiding and coordinating adaptation efforts at the national scale. However, while cities are increasingly implementing climate shelter initiatives as local responses to rising climate risks, it remains unclear to what extent these locally driven adaptation measures are recognised, supported, or integrated within national adaptation policy frameworks. Understanding this relationship is essential for assessing how urban adaptation innovations can be scaled up and aligned with broader national climate strategies.

1.2 Problem Statement

Adaptation to climate change is widely recognised as a multi-level governance challenge, as climate impacts and corresponding responses cut across governmental levels, sectors, and societal domains (Bauer, 2012). In this context, effective national adaptation governance depends not only on top-down policy frameworks but also on bottom-up processes, such as how local adaptation efforts are recognised, supported, and integrated into higher-level decision-making (Caldarice et al., 2021).

In response to adverse climate impacts, cities increasingly develop innovative local adaptation experiments, such as climate shelters. These initiatives commonly generate practical knowledge, governance innovations, and place-based solutions that can inform and strengthen national adaptation frameworks. Although the implementation of climate shelter initiatives is expanding across European cities, their recognition and integration within European Member States' NASs and NAPs is unclear. This indicates a limited understanding of how climate shelters are framed in national adaptation policies and how national policy contexts influence local implementation. As a result, opportunities for policy learning, coordinated multi-level action, and the mainstreaming of successful local adaptation practices remain constrained.

This study addresses this gap by examining how local climate shelter initiatives are referenced in national adaptation policies and how interactions between local actions and national policies shape adaptation governance. Drawing on adaptive governance theory, it approaches adaptive governance as a process that fosters adaptability and transformability in social–ecological systems, highlighting the importance of institutional arrangements that enable learning and change across governance levels (Walker et al., 2004). Therefore, it seeks to clarify the vertical and horizontal relationships between local climate shelter initiatives and national adaptation policies and to strengthen multi-level climate adaptation governance.

1.3 Research Objective and Questions

The study investigates how local adaptation experiments, particularly climate shelters, are reflected in national adaptation policies. It aims to analyse how climate shelters are framed in national adaptation policies and how differences at the national level result from or influence local-level actions. Based on these objectives, the primary research question is:

How do local climate shelter initiatives align with, diverge from, and inform national adaptation policies, and how can local experimentation strengthen national adaptation governance?

The main research question is further supported by sub-questions that guide the analytical steps of the study. Specifically:

1. How is the concept of climate shelters reflected and framed within NASs and NAPs across EU-27 Member States?
2. How are climate shelter initiatives implemented at the local level in selected case-study cities?
3. What similarities and differences emerge between national policy framings of climate shelters and their local implementation in the case-study cities?
4. What are the recommendations to mainstream climate shelters in national adaptation policies to strengthen vertical and horizontal coordination?

The research question and sub-questions are answered through the following structure. Chapter 1 presents the introduction, Chapter 2 outlines the theoretical framework, and Chapter 3 describes the methodological workflow. Chapter 4 presents the results of the national-level analysis, and Chapter 5 presents the results of the local-level analysis. Finally, Chapter 6 summarises the key findings followed by recommendations.

CHAPTER 2

CHAPTER 2 | Theoretical Framework

This chapter establishes the conceptual and theoretical foundations that guide the thesis. It first introduces key concepts in climate adaptation policy and governance, with particular attention to European adaptation policy instruments, namely NAS and NAP. Building on this foundation, the chapter discusses multilevel governance. Despite there is no universally accepted definition of multilevel governance, it serves as a critical, multi-scalar framework for climate adaptation, connecting vertical, nested tiers of government (national, regional, local) with horizontal, cross-sectoral actions (e.g., transport, housing). As in UNPD (2025, p. 9), it can be characterised by two key features: (i) “it involves both vertical and horizontal dimensions of coordination and policy negotiation”; and (ii) “it engages both government and non-government participants in the governance process”. Following this, the chapter introduces experimentation as a local adaptation practice to generate knowledge, innovation and sustainable transformations. The chapter finalises by introducing climate shelters as a local adaptation experiment to position them as an analytical entry point to explore how locally grounded initiatives interact with national adaptation policies.

2.1 Introduction to Climate Adaptation Policy

Climate change is causing increasingly severe impacts on natural ecosystems and human societies worldwide. Mitigation and adaptation are the two fundamental responses to the risks caused by climate change (Füssel & Klein, 2006). They are complementary strategies for reducing and managing the adverse effects of climate change. In the glossary of Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC), mitigation is defined as “a human intervention to reduce emissions or enhance the sinks of greenhouse gases.” (IPCC, 2022a, p. 2915). In the same report, adaptation is defined as “the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects” (IPCC, 2022a, p. 2898). Climate change adaptation aims to minimise risks and vulnerabilities associated with climate impacts, while strengthening resilience, improving well-being, and enhancing the capacity to anticipate and effectively respond to change (IPCC, 2022b). Adaptation can be anticipatory, occurring before the impact of climate change becomes evident, or reactive, occurring after the impact is observed. It can also be planned, as the result of intentional policy decisions responding to actual or expected change to achieve a desired state or autonomous, involving spontaneous adjustments not directly planned in response to climatic stimuli but triggered by changes

in human systems such as ecological, market, or welfare (IPCC, 2022b). Furthermore, it can be initiated and implemented by all levels of government or initiated and implemented by private companies, households and individuals (IPCC, 2022b). The anticipatory, planned and strategic adaptation is typically carried out by public decision-makers (Dessai & Hulme, 2004).

There are several concepts interrelated to adaptation and adaptation policies. IPCC defines vulnerability as “the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt” (IPCC, 2022a, p. 2927). It has three components: sensitivity, exposure and adaptive capacity. Sensitivity is the degree to which a system is affected by climatic variations, exposure is the presence of communities and ecosystems in places that could be affected, and the adaptive capacity is the ability of these systems to adjust to reduce, seize and manage the consequences (IPCC, 2022a). A system is vulnerable when it experiences exposure and is sensitive to its effects while possessing limited adaptive capacity. On the contrary, vulnerability decreases when it is less exposed and is less sensitive while demonstrating a strong ability to adapt (Smit & Wandel, 2006). According to IPCC (2022a), risk refers to the potential for adverse consequences for human or natural systems arising from the interaction of climate-related hazards with the exposure and vulnerability of people, infrastructure, and ecosystems.

Thus far, through exposure, hazards and vulnerability, climate change generates risks and impacts that can exceed the limits to adaptation, resulting in damages and losses (IPCC, 2022b). Adaptation is therefore understood as the process of reducing vulnerability and climate risks. Lastly, resilience refers to the ability of social, economic, and environmental systems to cope with climate disturbances while maintaining essential functions and continuing to learn and transform (IPCC, 2022a).

From this perspective, climate adaptation policies refer to the strategies, plans, and actions developed by governments to reduce the vulnerability of human and natural systems to the impacts of climate change and manage climate-related risks (Burton et al., 2002; IPCC, 2022b). In one of the pioneer frameworks, Dessai and Hulme (2004) identified two complementary approaches that inform adaptation policy: the top-down and bottom-up approaches. The top-down approach begins at the global scale, moving from socio-economic development and greenhouse gas emissions to global climate models, regional climate projections, and assessments of physical climate impacts and vulnerabilities. This pathway emphasises climate science and modelling as the foundation for defining adaptation priorities, particularly for long-term strategic planning. In contrary, the bottom-up approach begins at the local level by examining social vulnerability and adaptive capacity, based on indicators such as economic resources, infrastructure, institutions, technology, and knowledge. Rather than relying primarily on climate projections, this

approach focuses on present local conditions and capacities that shape how societies experience and respond to climate risks. Additionally, Dessai and Hulme (2004) argue that these approaches are not contradictory but complementary, as they provide different types of information needed for effective adaptation decision-making. A key aspect of this model is that the timescales and planning horizons are different for both approaches. While social vulnerability assessments tend to focus on present and near-term conditions, physical vulnerability assessments tend to address mid to long-term climate futures, resulting in mismatches (Dessai and Hulme, 2004). As illustrated in their framework, climate adaptation policy emerges at the intersection of these two approaches, where scientific assessments of physical climate vulnerability meet locally grounded understandings of social vulnerability and adaptive capacity. This highlights that effective adaptation governance requires both top-down guidance from national and international frameworks and bottom-up insights from local contexts, reinforcing the importance of multi-level governance in climate adaptation (see Figure 1).

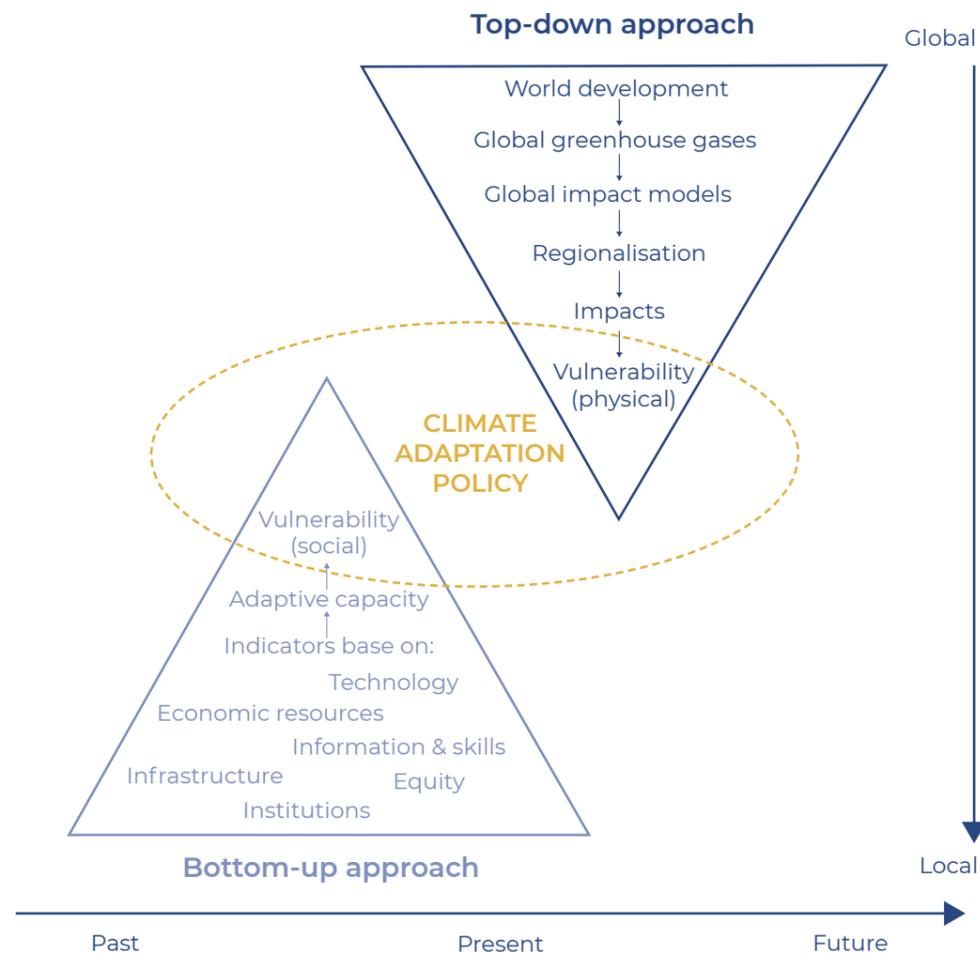


Figure 1 | Two approaches Informing Climate Adaptation Policy (Adapted from Dessai and Hulme, 2004)

The literature highlights a persistent gap between local adaptation actions and national policy frameworks. In practice, adaptation is still largely implemented and financed through top-down approaches that prioritise physical vulnerabilities identified at higher governance levels (Pörtner et al., 2022). To close this implementation gap, multi-level governance integration is required with inclusive participation, and sustained enabling conditions (Covenant of Mayors, 2021; Mickwitz et al., 2009; IPCC, 2022). Lastly, to avoid maladaptation, adaptation should be conceptualised not only as an “outcome” but as an ongoing “process” (Schipper, 2020).

2.2 Climate Adaptation Governance in Europe

Global attention to climate change increased with the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988, which became the principal body for assessing climate science (Rodríguez-Rojo et al., 2025). With the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, national governments have been encouraged to develop strategies for limiting global temperature increases and addressing the impacts of climate change (Pietrapertosa et al., 2018). With the Kyoto Protocol, a major milestone was established in 1997, by setting emission reduction targets for developed countries for 2020 and 2030 (Pietrapertosa et al., 2018). These emerging international actions set up the foundation for climate policies for the EU to develop its own responses to climate change.

In the early phase of climate policy, mitigation was long prioritised as the primary response to climate change within the international arena, with a strong commitment to reducing greenhouse gas emissions (Biesbroek et al., 2010). Additionally, the EU was a prominent actor in establishing ambitious policies of emission reduction goals and advancing climate change research (Biesbroek et al., 2010; Schreurs & Tiberghien, 2007). However, with the growing evidence of climate change impacts, adaptation started to gain recognition in the global agenda, shifting the view from “fatalistic strategy” (Biesbroek et al., 2010; Schipper, 2006).

In light of this, Finland was the first Member State to adopt an explicit adaptation strategy in 2005 (Rayner and Jordan, 2011). Additionally, the European Climate Change Program (ECCP) formed a working group on climate change impacts and adaptation in 2005 (Rayner and Jordan, 2011). With the publication of the 2007 Green Paper “Adapting to climate change in Europe – options for EU action” (European Commission, 2007), followed by 2009 White Paper “Adapting to climate change: Towards a European framework for action” (European Commission, 2009), the requirement for comprehensive adaptation strategies for EU Member States was recognised (Biesbroek et al., 2010).

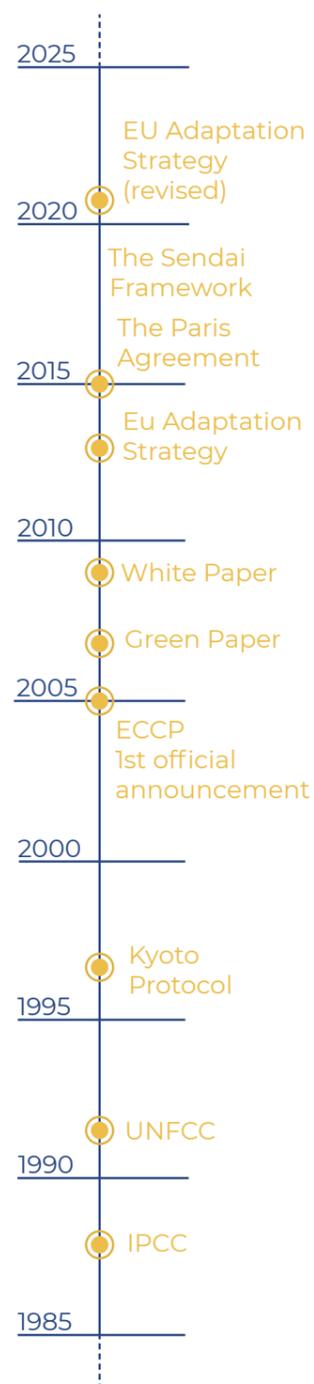


Figure 2 | International Political Agenda for Climate Change (Source: Adapted from Rodríguez-Rojo et al., 2025)

While these founded the basis for a common adaptation policy framework for identifying the climate impact, related vulnerabilities and measures. The introduction of 2013 “EU Strategy on Adaptation to Climate Change” (European Commission, 2013) provided the comprehensive guidelines for European policymakers (Pietrapertosa et al., 2018). Furthermore, the major global commitments such as the 2015 UNFCC Paris Agreement, the 2015 Sendai Framework and the 2030 Agenda for Sustainable Development released in 2016 highlighted the need for comprehensive and integrated climate action addressing both mitigation and adaptation (Rodríguez-Rojo et al., 2025; EEA, 2024) (see fig 2).

In parallel with global policy developments, there has been a remarkable rise in ambition for climate adaptation at both national and subnational levels in recent years across Europe and EU Member States. (EEA, 2024) (see Fig. 3). The 2019 European Green Deal provides an overarching plan for Europe’s economy, energy and transport industries for a sustainable future (European Commission, n.d.). It establishes the objective of making Europe’s economy and society climate-neutral by 2050 (European Commission, n.d.). In addition, it sets an intermediate target of reducing net greenhouse gas (GHG) emissions by at least 55% by 2030 (European Commission, n.d.).

The European Green Deal’s target of climate neutrality by 2050 became legally binding for all EU institutions and all Member States through the adoption of the 2021 European Climate Law (European Commission, n.d.). It includes measures to monitor the progress and to take necessary actions (European Commission, n.d.). These are based on several existing instruments and systems, such as the preparation of National Energy and Climate Plans (NECPs) by Member States, regular reports by the European Environment Agency (EEA) and the use of the recent scientific evidence on climate change and its impacts (European Commission, n.d.). Regarding

the adaptation, the 2021 Climate Law requires ongoing progress in the adaptive capacity enhancement, reinforced resilience and minimised climate change vulnerabilities (EU, 2021; European Commission, 2024).

A key policy of the EU on climate adaptation is the EU Strategy on Adaptation to Climate Change. It was initially introduced by the European Commission in 2013 and updated in 2021 (European Commission, 2024). The strategy aims to help Europe become climate resilient by 2050, focusing on smarter, faster, and more systemic adaptation, alongside reinforced international actions on climate resilience (European Commission, n.d.). Furthermore, it aims to mainstream adaptation awareness and planning across local level stakeholders as well as protect people, livelihoods and nature from climate risks (European Commission, 2024). Overall, it serves as a blueprint for realising the climate resilience and international emission reduction goals defined in the Paris Agreement (European Commission, 2024) and forms a key component of the European Green Deal (European Commission, n.d.).

There is a range of EU initiatives and programmes to support the implementation of adaptation strategies (EEA, 2024). The Mission on Adaptation to Climate change under the Horizon Europe programme aims to support a minimum of 150 European regions and communities to build climate resilience by 2030 (EEA, 2024). Following this line of reasoning, the Mission on Climate-Neutral and Smart Cities aims to deliver European 100 climate-neutral smart cities by 2030 by transforming them into innovation hubs for testing and scaling climate action solutions in the urban space in line with the EU climate-neutrality target for 2050 (EEA, 2024). Additionally, the 2020 European Climate Pact provides a platform for collaborating, exchanging knowledge and driving climate action across all governance levels, as well as local authorities (EEA, 2024). The New European Bauhaus then connects the 2020 European Green Deal by living spaces and experiences for climate neutral Europe by 2050 (EEA, 2024). Operationally, the European Urban Initiative (EUI) operationalises the key pillars of the New European Bauhaus by providing practical examples of sustainable development. It seeks to strengthen integrated and participatory approaches in cities, reinforce links between local action and EU policies, and support urban areas through innovation, capacity and knowledge-building, and policy development (EEA, 2024). In addition, the EUI promotes multi-level governance, intergovernmental cooperation, and the implementation of the Urban Agenda for the EU (EEA, 2024). The Covenant of Mayors (CoM) unites 10,738 local governments to carry out three key pillars for climate change, such as reducing other greenhouse gas emissions, strengthening resilience, preparing for the impact of climate change and eliminating energy poverty for a just transition (Covenant of Mayors, 2026). The URBACT IV programme supports the knowledge sharing, capacity building and sustainable urban development within the cities.

It aims to strengthen urban policies and enhance cohesion policy implementation, while contributing to the Urban Agenda for the EU and the Leipzig Charter’s vision of green,

just, and productive cities (EEA, 2024). Overall, these initiatives and mechanisms promote multi-level governance, knowledge exchange, innovation, and local capacity-building for climate adaptation across Europe (see Fig. 3).

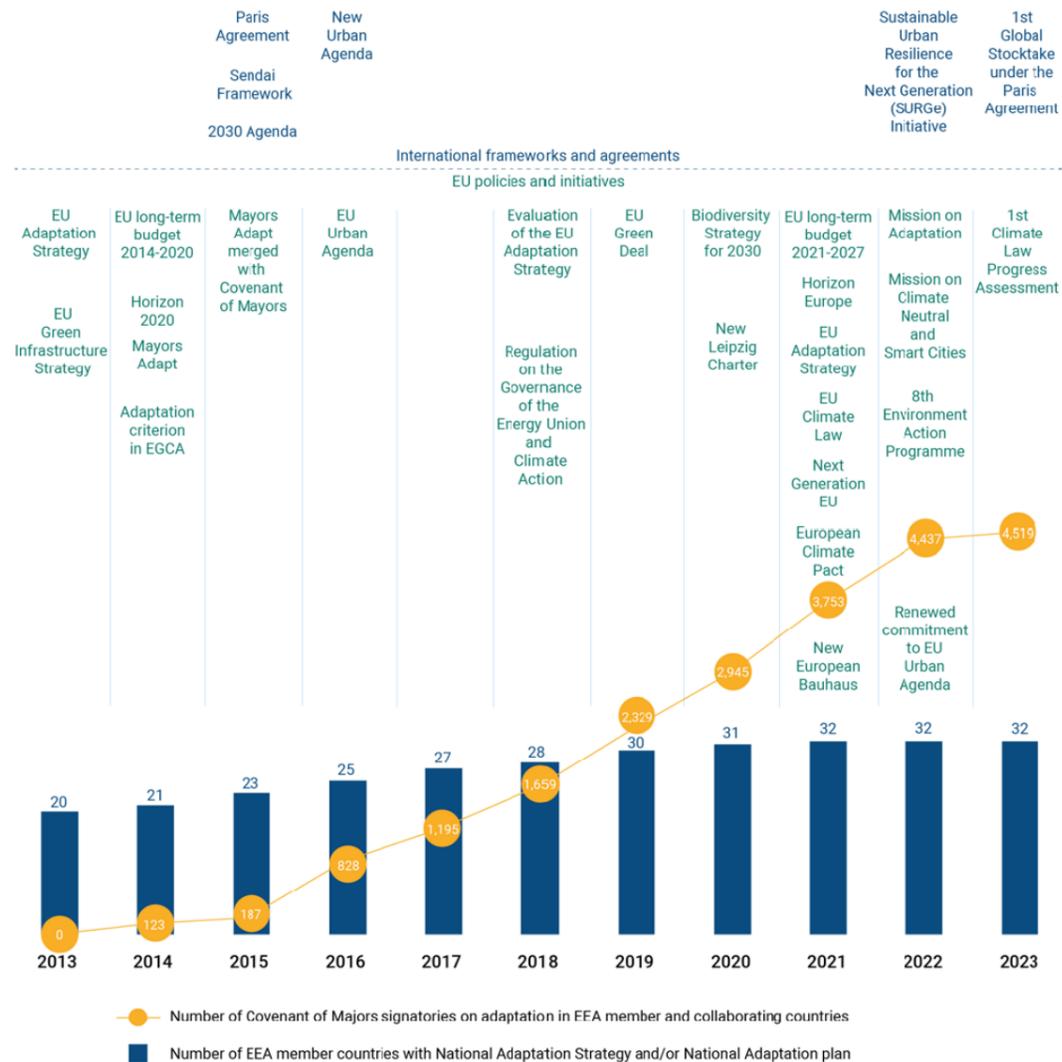


Figure 3 | Evolution of European Climate Adaptation Governance (2013–2023) (Source: European Environment Agency, 2024)

There is a similar pathway to adaptation across the countries of Europe, such as the creation of coordinating structures, investment in science–policy interfaces, stakeholder involvement, the development of NASs and subsequent NAPs, the use of soft implementation instruments, and the establishment of monitoring and evaluation mechanisms (EEA, 2014). The principal responsible body for adaptation efforts is usually the ministries of environment, establishing mechanisms for coordination between levels of governance and administrative divisions (EEA, 2020). These mechanisms range from

interministerial committees, coordination councils, to working groups (EEA, 2020). Both vertical and horizontal coordination between the governance levels, actors and sectors also varies for each country. While most countries have established some form of coordination, gaps remain in a few cases, regarding the horizontal and vertical coordination (EEA, 2014). Moreover, the developed coordination mechanisms tend to be vertical, across governance levels, rather than horizontal, across sectors (EEA, 2014).

2.3 National Adaptation Policies (NAS & NAP)

Within the evolving adaptation governance in the EU, a range of policy instruments is used at the national level. Among these, NASs and NAPs become the primary tools for guiding the countries' climate adaptation efforts. Across countries, there is a notable variety in how national adaptation policies are defined, thereby making it hard to provide a clear definition of NAS and NAP (EEA, 2020). However, despite the differences in their policy scope, policy pillars and content, some general characteristics can be defined (EEA, 2020). According to the European Environment Agency, the NAS is defined as “a broad policy document that outlines the direction of action in which a country intends to move in order to adapt to climate change” (EEA, 2013, p. 68). This means that NASs are high-level policy documents that define the long-term vision and frame the strategic approach of a country to climate adaptation, as well as climate-related risks and vulnerabilities (Leitner et al., 2024). Furthermore, they provide a framework for coordination across sectors and governance levels for adaptation activities and identify the key actors and sectors that require actions (Leitner et al., 2024). Through the provided framework, they establish a base for more detailed adaptation prioritisation and planning, enhance the coordination of adaptation actions horizontally and vertically, and advance the stakeholder engagement and awareness (Leitner et al., 2024; EEA, 2020).

The European Environment Agency further defines the NAP as “a more detailed document providing a roadmap for the implementation of specific adaptation actions that are being planned” (EEA, 2013, p. 68). In more detail, it articulates how a country needs to implement its NAS and by whom (EEA, 2020; EEA, 2014). Typically, it structures the planning process of putting adaptation into practice by setting out measures with various levels of detail, objectives and subsequent steps and specifies the actors, timelines and deadlines (EEA, 2020; EEA, 2014).

The first NAS was adopted by Finland in 2005, followed by Spain and France in 2006 (EEA, 2020) (see Fig. 5). From 2011 onwards, the adoption of NAS and NAP has increased significantly (EEA, 2020). In the literature, different reasons exist regarding this increase in the national adaptation policies (Massey et al., 2014). Some suggest that this growth is the result of the work of international organisations such as the IPCC, UNFCCC, and

the European Commission (Massey et al., 2014; Swart, 2009). Others attribute it to the increasing occurrence of extreme events such as heatwaves, floods and storms (Massey et al., 2014; IPCC, 2014). A third line of the argument highlights the role of economic growth (GDP), suggesting that the adaptation policies are primarily introduced by countries with adequate resources (Biesbroek et al., 2010; Jordan & Huitema, 2014; Lesnikowski et al., 2013; Massey et al., 2014). Swart et al. (2009) summarise all the key drivers and facilitating factors for the adoption of NASs (see Fig. 4).

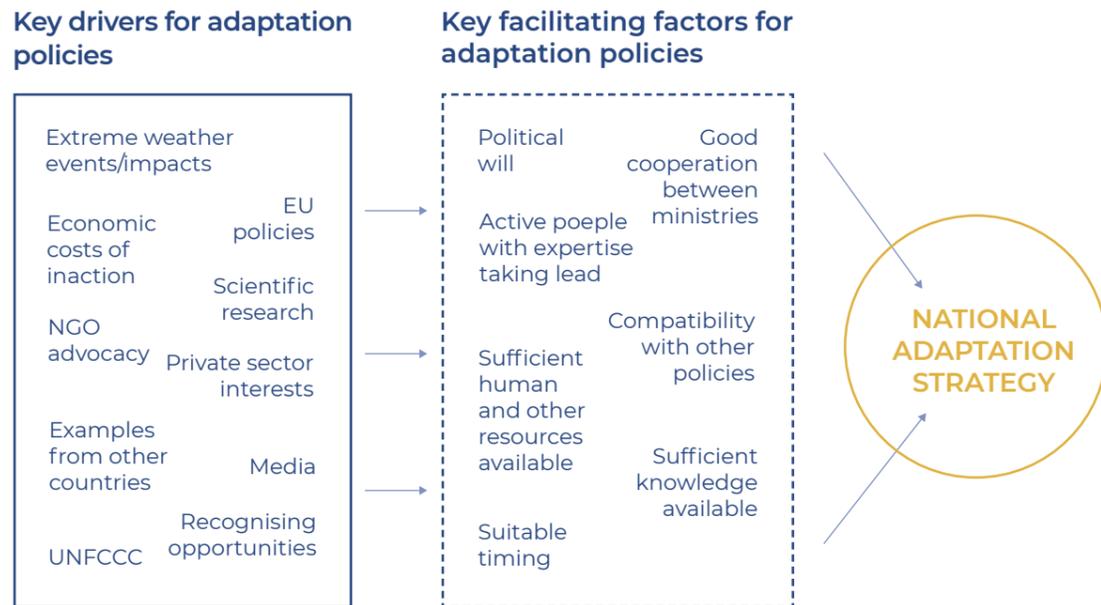


Figure 4 | Drivers and Enabling Factors in the Development of National Adaptation Strategies (Source: Adapted from Swart et al., 2009)

From the adoption year of the EU Adaptation Strategy in 2013 to 2019, the number of countries with NAS rose from 21 to 30, and the number of countries which adopted NAP rose from 9 to 20 (EEA, 2020) (see Fig. 5). In 2020, Croatia adopted its first NAS as the last EU Member State (EEA, 2020).

The European Climate Law obliges EU Member States to adopt, implement and regularly revise national adaptation strategies and plans, and to report on adaptation actions every two years (EEA, 2024). While some countries develop NASs and NAPs in parallel or merged into a standalone document, NASs typically address longer timeframes and are revised less often than NAPs (EEA, 2024). Furthermore, the absence of a formally adopted NAP does not imply any lack of adaptation measures at the national level (EEA, 2024).

The development and oversight of NAS and NAP are usually led by the ministries of environment or, in some cases, by the ministries that are responsible for climate policy or civil protection (Leitner et al., 2024). The implementation responsibility is allocated

between the relevant ministries, sectoral agencies and involved regional and local authorities (Leitner et al., 2024). Moreover, depending on the institutional agreements, implementation responsibilities may extend beyond the state to non-state actors such as the private sector and populations (Leitner et al., 2024).

Biesbroek et al. (2010) highlight that NASs are central government instruments that aim to ensure adaptation practices across different governance levels over time and space. However, they are usually not developed through an inclusive governance approach; only a limited group of experts and representatives from government and society are involved in the process. Regional and local representatives are commonly disregarded (Biesbroek et al., 2010).

Overall, NASs and NAPs function as instruments for framing adaptation by coordinating how climate change is addressed across relevant sectors, spatial scales, and decision-making levels (EEA, 2014). They establish a general framework for guiding the adaptation activities at the national level (EEA, 2014). Although they are mostly non-binding and vary widely in content, NASs and NAPs help place climate change adaptation on the political agenda (Biesbroek et al., 2010; EEA, 2014; Hildén et al., 2014; Russel et al., 2014).

EEA Member States	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Austria													*		
Belgium															
Bulgaria															
Croatia (*)															
Cyprus															
Czechia															
Denmark															
Estonia															
Finland															
France															
Germany															
Greece (*)															
Hungary (*)															
Ireland (*)															
Italy															
Latvia (*)															
Lithuania															
Luxembourg															
Malta (*)															
Netherlands (*)															
Poland															
Portugal															
Romania															
Slovakia															
Slovenia															
Spain															
Sweden (*)															
United Kingdom															
Iceland															
Liechtenstein															
Norway															
Switzerland															
Turkey															

Figure 5 | Evolution of NAS and NAP Adoption of EEA Member States between 2005-2019 (Source: EEA, 2020)

2.4 Multilevel Governance in Climate Adaptation

Clark (1985) highlights that climate change operates across a vast range of spatial and temporal scales, from immediate local impacts to long-term global trends, involving complex interactions between climatic, ecological, and social systems. This multi-scalar and interconnected nature contributes to climate change being widely characterised as a super wicked problem due to its urgent time constraints, shared responsibility between problem-causers and problem-solvers, weak central authority, and a tendency to discount future impacts (Levin et al., 2012). Together, these features require complex and multidirectional governance responses rather than simple or one-way solutions (Levin et al., 2012).

Moreover, Gupta et al. (2007) describe climate change as a phenomenon driven by local activities, accumulating into a global challenge and producing global impacts that are ultimately experienced at the local level. It is therefore a “glocal” issue that calls for multi-level governance approaches and solutions (Gupta et al., 2007). Accordingly, climate change demands “an unprecedented level of cooperation, not only between countries, but also between different levels of governments, development agencies and the private sector” (Da Boer, 2009, p. 2).

These characteristics make it clear that climate change cannot be effectively governed through single-level or purely top-down approaches. Instead, they necessitate multi-level governance frameworks that coordinate actions, responsibilities, and knowledge across various levels.

Multilevel Governance (MLG) is defined as “a dynamic process with a horizontal and vertical dimension, which does not in any way dilute political responsibility” (Committee of the Regions, 2009). The approach was derived from the understanding that it is not possible to effectively manage many policy matters on a single level of governance or entity, thereby cooperation and distribution of powers across government levels is needed (CDDG, 2023). MLG emerged in the early 1990s as a conceptual framework to describe the increasingly complex and multi-layered nature of European policymaking following the Maastricht Treaty, where decision-making shifted from being state-centred to involving continuous negotiation across supranational, national and subnational levels (Marks, 1993; Stephenson, 2013). MLG is not solely a top-down process of translating national or supranational objectives into subnational or local actions, but also a bottom-up process in which local and regional priorities are integrated into higher levels (Committee of the Regions, 2009). It can be applied effectively along with the regionalisation, decentralisation and federalisation tendencies (CDDG, 2023).

Nowadays, MLG also emphasises collaboration, shared responsibility, and joint decision-making to develop sustainable and equitable solutions to complex problems that extend

beyond national borders (CDDG, 2023). It operates by interlinked policymaking across different governance levels, where no level holds dominance over the others, creating a system of mutual interdependence (Stephenson, 2013). This means that effective governance depends on the active participation and cooperation of diverse actors in both decision-making and implementation, including civil society organisations, non-governmental actors, private sector entities, and intergovernmental networks across different levels (CDDG, 2023).

MLG mainly covers three dimensions (CDDG, 2023) (see Fig. 6):

- The multilevel dimension, referring to the vertical coordination and engagement between the global, supranational, national, subnational and local.
- The multi-sector dimension, referring to coordination horizontally between sectors and entities at the same governance level (such as cooperation between regions or municipalities).
- The multi-actor dimension, referring to the stakeholder involvement and participatory notion both vertically and horizontally, referring to national governments and parliaments, regional, intermediate and local authorities, private sector actors, civil society organisations, individual citizens, inter-municipal and regional cooperation structures, local and regional government associations, multi-actor networks and programmes (such as universities and research centres), transnational networks, and supranational institutions (such as the EU).

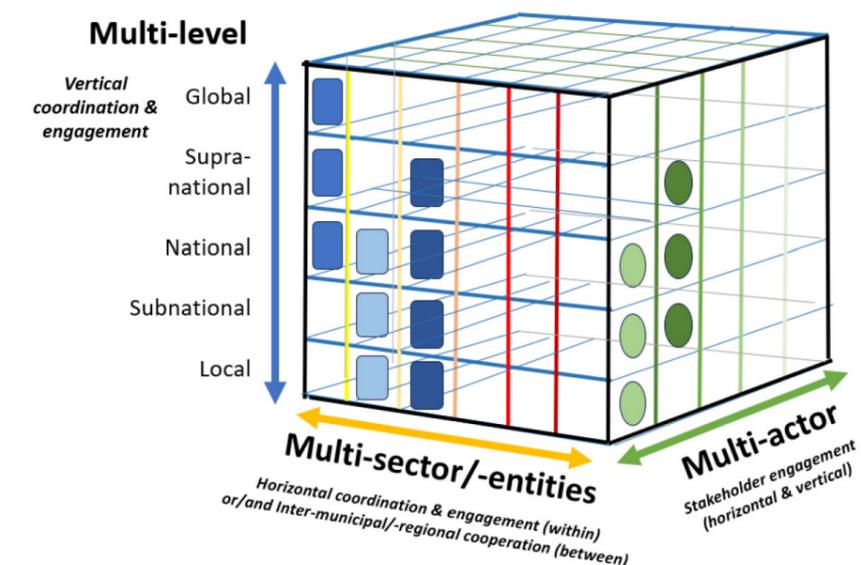


Figure 6 | Three Dimensions of Multilevel Governance (Source: CDDG (2023), adapted from Neistroy et al.,2019)

Together these three dimensions and their relationships demonstrate that effective multi-level governance relies on integrated vertical coordination, horizontal cross-sectoral cooperation, and inclusive participation of diverse actors, enabling more efficient, flexible, collaborative, and responsive policy processes.

For a successful MLG approach, two key elements are essential: institutional structures and dialogue processes (Covenant of Mayors, 2021). Structures refer to the formal and informal frameworks that define participation and representation, while dialogue processes create opportunities for interaction and knowledge exchange among stakeholders. Rather than following a single standard model, MLG arrangements must be tailored to local, regional, and national contexts to strengthen policy frameworks. When effectively implemented, MLG improves coordination across governance levels, aligns policy instruments, reduces institutional conflicts, and fosters shared ownership of both policy development and implementation (Covenant of Mayors, 2021).

MGL is a widely applicable approach to climate change in research, policymaking and treaty-making due to its opportunities for flexibility and learning, although complicating the coordination between levels, sectors and actors (Regions, 2019).

As a matter of fact, it is an essential prerequisite for effective climate action, since the complexity of urban challenges requires coordinated responses across multiple issues and scales. Effective climate action, therefore, depends on the involvement of all levels of government, enabling collaborative governance that delivers more durable and impactful solutions for low-carbon and climate-resilient futures (UN-Habitat, 2024).

Adaptation to climate change is broadly recognised as an MLG challenge that operates across multiple levels, since climate impacts and response measures extend across governmental, sectoral, and societal boundaries (Bauer et al., 2012). Climate adaptation policies are characterised as a cross-sectoral, multi-level and multi-issue policy field (Leitner et al., 2024). They require an adequate governance mechanism that can coordinate, cooperate and exchange information to mainstream and integrate adaptation into relevant sector policies effectively and coherently (Leitner et al., 2024). In this sense, MLG provides the overarching framework within which adaptation policies are aligned, implemented, and mainstreamed across all levels (Brunetta et al., 2024).

MLG raises the question of the allocation of roles, power, and responsibilities across actors and scales, while also creating opportunities for learning from past initiatives and supporting adaptation policy development at all levels (Mickwitz et al., 2009). For example, the multi-actor dimension of MLG emphasises stakeholder involvement in the development of adaptation policies. Such participation enhances policy effectiveness by integrating local knowledge, building shared understanding, improving the identification of priority areas and understanding the stakeholders' capacity and viability for adaptation to the impacts (Biesbroek et al., 2010).

Upscaling is an important component of multilevel governance. In the European context, there are three main types of upscaling: horizontal, vertical, and hierarchical (Kern, 2019) (see Fig. 7).

- Horizontal upscaling happens when cities learn from each other voluntarily. Leading cities share best practices, experiments, and innovations through networks. It mainly spreads ideas among frontrunner cities but often does not reach weaker cities. The main challenge is that experiments and innovations frequently fail to diffuse beyond leading cities, leaving followers and laggards behind.
- Vertical upscaling links cities with higher levels of government (national and EU). Governments and EU institutions provide funding, guidelines, and incentives, while city networks lobby upward. This helps follower cities catch up by giving them support and resources. The key challenge is differentiation: cities have unequal capacities and ambition levels, so targeted support is needed, and some municipalities still remain inactive despite incentives.
- Hierarchical upscaling is top-down. National or EU authorities set binding rules and mandatory standards (for example, energy-efficiency laws or required climate plans). This forces laggard cities to act, even if they would not do so voluntarily. The main challenge is regulation and implementation: binding standards can create compliance gaps in weaker municipalities and may limit the freedom of leading cities to go beyond national rules.

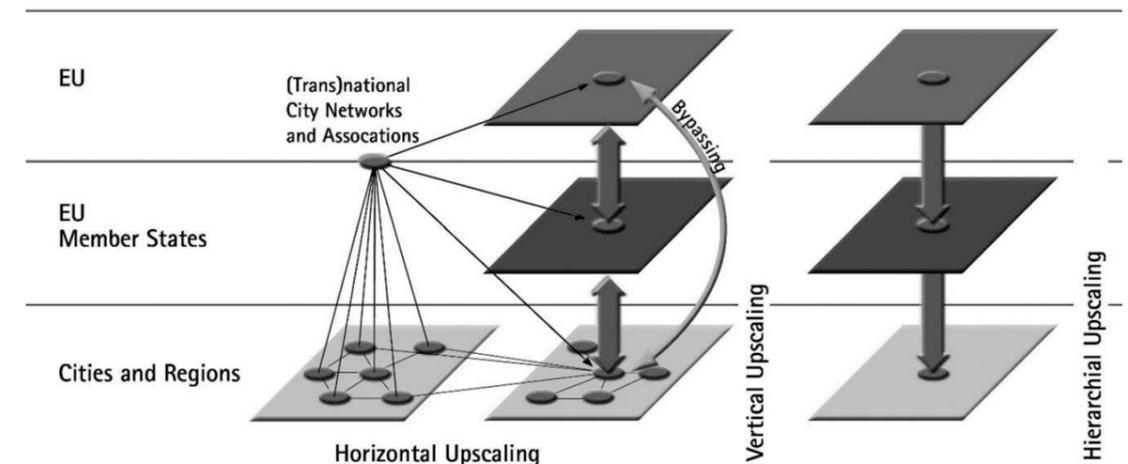


Figure 7 | Horizontal, Vertical and Hierarchical upscaling in EU governance (Source: Kern, 2019)

Horizontal, vertical, and hierarchical upscaling are interdependent: horizontal upscaling spreads innovation among cities, vertical upscaling provides coordination and support from higher governance levels, and hierarchical upscaling ensures universal compliance through binding rules, together enabling system-wide transformation in European

multilevel governance (Kern, 2014; 2019).

Overall, multilevel governance provides a necessary framework for effective climate adaptation, as it enables horizontal, vertical, and hierarchical upscaling, thereby overcoming the limitations of purely top-down approaches and fostering bottom-up input, mutual learning, and coordinated action across governance levels.

2.5 Experimentation for Climate Adaptation

Historically, cities have operated as experimental environments where new knowledge is tested in practice to transform urban governance. This is illustrated by the example of Victorian Britain, where public health professionals entered city administrations to implement sanitation reforms, showing how cities have long served as spaces in which new ideas are tested in practice (Evans, 2011). In this sense, cities function as laboratory-like environments where solutions to urban problems are developed and applied, blurring the boundaries between scientific ideas and administrative practice (Dierig et al., 2003, as cited in Evans, 2011).

Evans et al. (2021), drawing on sustainability experimentation literature, define urban experimentation as a systematic activity in which solutions are introduced in a limited and controlled way into urban environments to generate objective evidence. It is valuable not only for generating evidence about what works, but also for building organisational capacity, stakeholder engagement, and social learning that support broader urban transformation (Evans et al., 2021).

Over the last decade, a first wave of urban experimentation has taken multiple forms, including climate experiments, pilot projects, living labs, experimental districts, and grassroots initiatives (Torrens & Von Wirth, 2021). Evans et al. (2016) revealed that there is an increasing focus on embedding experimentation into long-term strategies, moving beyond isolated actions to stimulate broader urban transformation among policymakers and practitioners.

According to Evans (2011), in the context of climate change governance, if climate change is the driving force, then the goal is resilience, and the transition will happen through the adaptation process. Building on this, experimentation is the practical dimension of adaptation, which is what happens on the ground when policymakers, researchers, businesses, and communities work to develop new pathways (see Fig. 8).



Figure 8 | The relationship between Climate Change, Adaptation, Experimentation and Resilience (Source: Adapted from J. P. Evans, 2011)

Castán Broto and Bulkeley (2013), based on their analysis of urban climate change experiments across 100 cities, reveal that experimentation is an integral component of climate change response since 2005 across the various world regions and sectors. Beyond the economic and social conditions, there are several features. Experimentation takes both social and technical forms, but technical approaches are more common in urban infrastructure (Castán Broto & Bulkeley, 2013). Although municipal governments play a central role in climate experimentation, they frequently collaborate with other actors through diverse partnership arrangements. These patterns suggest that experimentation serves as an important mechanism for creating new political spaces to govern climate change in urban contexts (Castán Broto & Bulkeley, 2013).

Experimentation has been proposed as a way to overcome gaps between top-down-led climate policies and difficulties of upscaling the bottom-up innovations (Antikainen et al., 2017).

Lastly, Pörtner et al. (2022) highlight that while cities increasingly test innovative social and nature-based adaptation solutions, adaptation finance remains dominated by established, top-down funding mechanisms focused on large-scale grey infrastructure, making it difficult to upscale local experiments.

2.6 Climate Shelters as a Local Adaptation Experiment

Cities are where the adverse effects of climate change are most intensely experienced. Climate extremes occurring in urban areas threaten populations' lives and health. However, cities also offer significant opportunities to address these challenges (IPCC, 2023). They serve as key spaces for adaptation activities and as central actors in mitigation efforts, where global targets are translated into local actions (Sharifi, 2021).

Local governments have begun implementing adaptation measures that address the risks posed by climate change by employing Nature-based Solutions (NbS) and ecosystem services (Caldarice et al., 2025b). Among many, climate shelters are gaining recognition as local initiatives that aim to adapt to climate change impacts by transforming critical urban spaces into climate refuges in the urban areas (Caldarice et al., 2025b). In the European context, such practices are increasingly being recognised and implemented. For example, the city of Barcelona emerges as one of the pioneers in the transformation of schoolyards into climate shelters, an initiative also adopted by many other cities, including Paris, London, and Amsterdam (Baró et al., 2022; Ghiani-Beltrán & Gómez-Martín, 2025).

Climate shelter initiatives are tailored to local climate challenges and serve as a direct response to them. Therefore, their emergence and design differ from city to city depending on the specific climate hazards encountered. For instance, Barcelona, Paris, and Madrid focus on heat hazards, while Amsterdam focuses on rainwater absorption (Caldarice et al.,

2025b). London addresses a broader range of hazards, including floods, heat, and droughts, and The Hague tackles flooding and heat (Caldarice et al., 2025b)

In recent years, the potential of transforming schoolyards into climate shelters has been increasingly recognised (Pincegher et al., 2025). This is due to the extensive space schools occupy within the urban fabric, their relatively even distribution across the cities, accessibility to the public through the possible open school policies and their direct reach to vulnerable populations, particularly children (Vetter, 2020; Antoniadis et al., 2020). Moreover, schoolyards are typically paved with high heat-absorbing materials such as asphalt and cement and therefore contribute significantly to the UHI effect in city centres. Typically, climate shelters in schoolyards are characterised by the implementation of NbS and strong co-production activities, in which the school community, particularly pupils, are actively involved (Caldarice et al., 2025b). They can be beneficial for the community by providing access to the public in the after-school hours and extreme climate events (Caldarice et al., 2025b; Ghiani-Beltrán & Gómez-Martín, 2025; Vettel, 2020). In doing so, they contribute to SDG 11.7, which calls for universal access to safe, inclusive, and accessible public spaces, thereby reinforcing the social equity dimension of urban climate adaptation (United Nations, 2015). The implemented NbS may vary from green spaces, trees and shrubs, green roofs and walls, natural or semi-natural water storage and transport structures, infiltration, filtration and biofiltration systems, water retention and flood protection features, and the restoration of ecosystems, soil, and urban spaces. Furthermore, these initiatives generate wider societal benefits, including the provision of spaces for climate education and awareness, which foster social learning and support sustainability transitions (Caldarice et al., 2025b).

Finally, upscaling of climate shelters is a crucial step for enhancing a more significant long-term impact and effectiveness at the city scale while fostering urban resilience (Caldarice et al., 2025b). In several European cities, such as Paris and Barcelona, climate shelters have been integrated into local climate plans as a city-wide strategy. These illustrate the growing recognition of climate shelters as effective practices at the local level, supporting pathways to climate mitigation and adaptation.

From this perspective, climate shelters can be framed as “concrete utopias” in the here and now, supporting planning with transformative potential by exploring alternative ways of thinking, doing, and organising beyond the status quo, as if the world experiencing climate change were radically different from that of the past (Bertolini, 2025).

This chapter presents the theoretical background underpinning the study. In the following chapter, the employed methodological approach is introduced.



Photo | Barcelona's Climate Shelter in Schoolyard (Source: MAINCODE)

CHAPTER 3

CHAPTER 3 | Methodology

In this section of the thesis, the methodological note is presented by outlining the research design, data collection methods, and analytical procedures applied in the study. The research is structured in three phases, and all phases are conducted through desk-based research.

Phase 1 applies a comparative national-level adaptation policy screening through systematic document analysis of NASs and NAPs and targeted keyword research to identify references to climate shelters. It consists of four steps: (i) Scope of the national level analysis, (ii) Definition of targeted keywords, (iii) Data retrieval and keyword screening, and (iv) Categorisation and clustering.

Phase 2 employs a qualitative multiple-case study design at the local level by examining climate shelter initiatives at the selected case study cities. It consists of three steps: (i) Spatial overlay of the clusters and cities with climate shelters, (ii) Selection of case study cities, and (iii) Analysis of the case studies.

Phase 3 focuses on an integrative cross-case synthesis that combines findings from both levels to assess how local climate shelter initiatives align with, diverge from, and inform national adaptation policies in the selected case studies. It consists of three steps: (i) Key findings from the national level, (ii) Key findings from the local level, (iii) Comparative policy pathways for climate shelters. Through these steps, Phase 3 addresses the main research question. The results are also presented through a diagram.

An overview of the methodological workflow, including all phases of the research process, is illustrated in Figure 9. In the following sections, each step undertaken in Phase 1 and Phase 2 is presented individually in further detail.

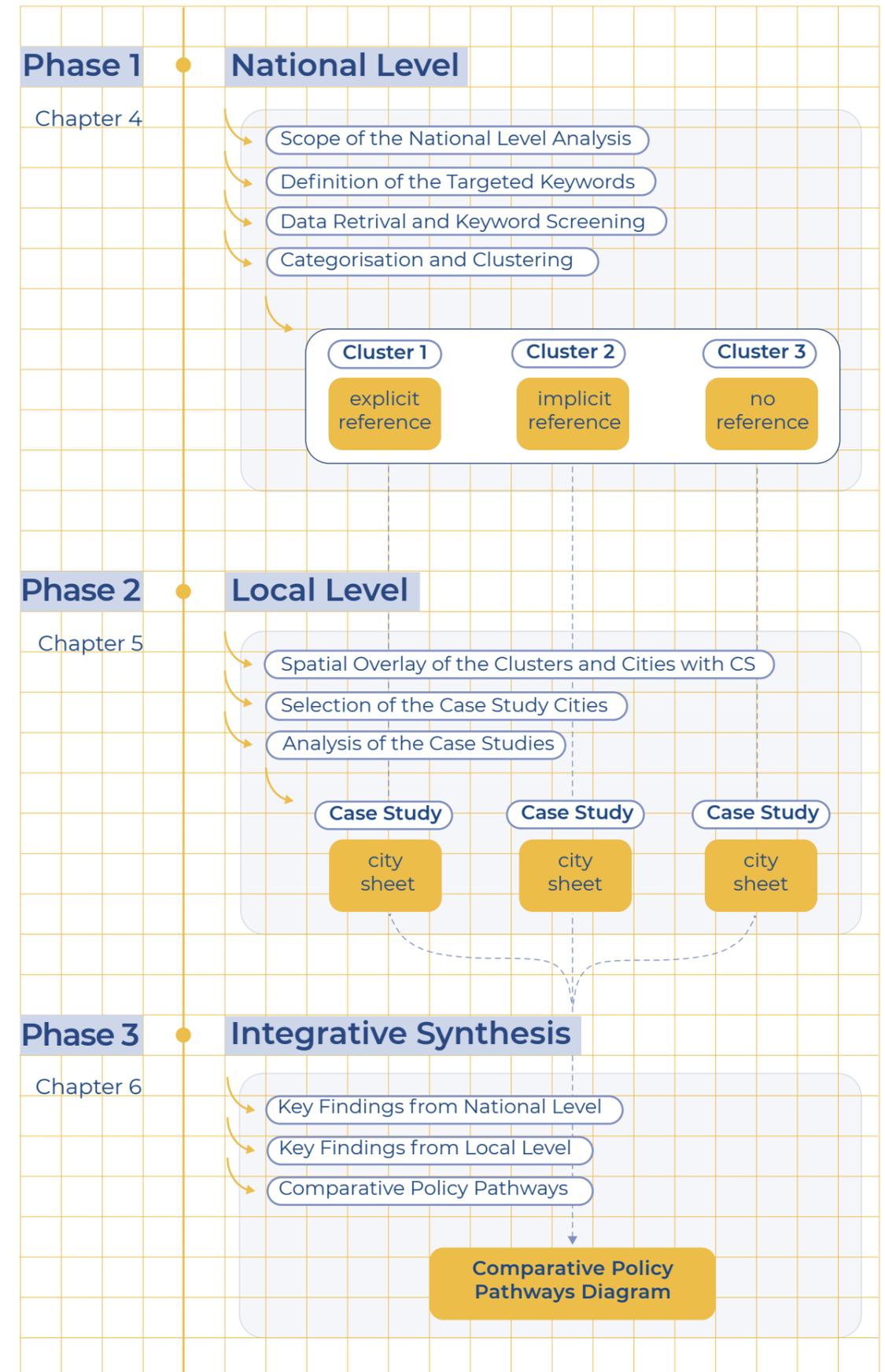


Figure 9 | The Methodological Workflow (Source: Author's elaboration)

3.1 National Level Analytical Approach

This section introduces the analytical approach applied at the national level in Phase 1 of the research. It presents the steps undertaken to examine national adaptation policy instruments, NASs and NAPs, in order to understand their structure and the presence of references to climate shelters in these documents. The following subsections present the scope of the analysis and the methodological considerations guiding this phase.

The Phase 1 analysis focuses on the NASs and NAPs of 27 EU Member States. Targeted keyword research and screening processes are performed as the primary step for identifying and understanding the climate shelter references in these documents. The qualitative analysis of the results has been completed. The identified references are categorised and transformed into three clusters: Explicit reference to climate shelters, Implicit reference to climate shelters, and No reference to climate shelters.

The results from Phase 1 form the base for Phase 2 by informing the selection of the case studies for the local level analysis.

3.1.1 Scope of the National Level Analysis

The framing of the national-level analysis sets the boundaries of Phase 1. To ensure methodological consistency and comparability, 27 EU Member States are focused on since these countries share a common institutional framework for climate adaptation and the associated reporting obligations to the European Commission (see Fig. 10). Furthermore, according to the 2024 European Climate Law, Member States are required to introduce national adaptation strategies. Collectively, this common governance context provides a coherent basis for cross-national comparison.

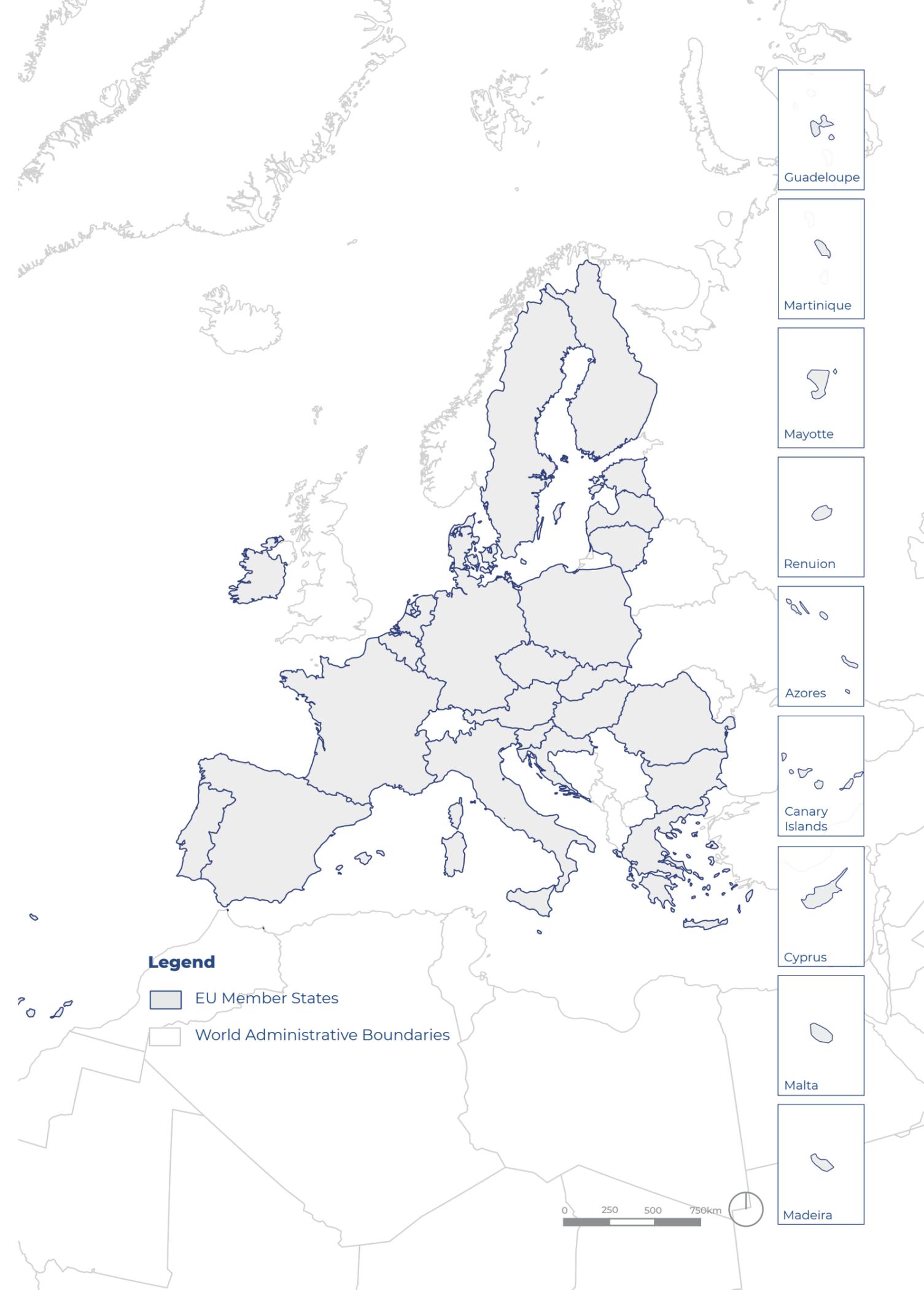


Figure 10 | 27 EU Member States (Source: Author's elaboration)

3.1.2 Definition of the Targeted Keywords

To conduct the keyword screening of the NAS and NAP, a structured set of targeted keywords is developed. Because the concept of climate shelters is relatively new and not yet defined globally, it is essential to construct a keyword set that could capture any reference to the concept directly or indirectly. The definition of this keyword set follows a five-step process: Primary keywords based on the query of the MAINCODE project; additional keywords for conceptual coverage and sensitivity; linguistic translations and keyword breakdowns; pilot testing and refinement of the keywords; and final targeted keywords.

- [Primary keywords based on the MAINCODE project](#)

The first step involves adopting a predefined and validated query developed within the MAINCODE project. In the MAINCODE project, a query on climate shelters is defined for screening scientific publications, grey literature, and online sources for literature review and case study analysis. The query includes terms that cover synonymous or related expressions that capture climate shelters in other terminology. The keywords in the query serve as the initial keywords for screening across all national adaptation documents. The MAINCODE query applied in this research is as follows:

“climate shelter” OR “climate oasis” OR “climatic oasis” OR “urban cooling” OR “cool island*” OR “cooling hub*” OR “shaded shelter*” OR “urban oasis” OR “cooling oasis” OR “urban cool spot*”*

- [Additional keywords for conceptual coverage and sensitivity](#)

As previously highlighted, due to the novelty of the term and the lack of common conceptualising globally, it is expected that not all relevant references to climate shelter would be discovered solely based on the keywords from the MAINCODE query. Consequently, to have a comprehensive qualitative analysis, semantic keywords are included to capture similar interventions, thereby increasing the sensitivity of the analysis. To define the semantic keywords, the definition of climate shelter previously provided is used as a guiding reference. Based on this definition, semantic keywords are generated to reflect the functional, climatic, environmental, and spatial characteristics of climate shelters. These were grouped into four thematic categories. First, climate risk and adaptation context keywords are included to capture the types of hazards and exposure conditions climate shelters aim to address (e.g., extreme climate event, extreme weather event, urban heat island, heat stress, urban hotspot, overheating, surface temperature, flood).

Second, microclimatic regulation and cooling mechanisms are represented through keywords describing how thermal exposure is reduced (e.g., microclimate regulation,

thermal relief, thermal control, cooling effect, cooling measures, shaded space, shaded area).

Third, nature-based solutions (NbS) and green measures are included to capture how adaptation actions are implemented within climate shelters through natural and vegetated elements (e.g., nature-based solutions, NbS, green infrastructure, vegetation, urban regeneration, and renaturalisation).

Finally, spatial characteristics are represented through keywords referring to urban spaces that can be identified and designated as climate shelters (e.g., public space, refuge, refugia, spot, hub, park, urban garden).

Semantic keywords are considered indicative of climate shelters only when used in contexts consistent with the definition of the climate shelter. Keywords referring to other topics are excluded. The final set of additional targeted keywords used in the analysis is as follows:

“extreme climate event”, “extreme weather event”, “urban heat island”, “heat stress”, “overheating”, “surface temperature”, “flood”, “microclimate regulation”, “thermal relief”, “thermal control”, “cooling effect”, “cooling measures”, “shaded space”, “shaded area”, “nature-based solutions”, “NbS”, “green infrastructure”, “vegetation”, “urban regeneration”, “renaturalisation”, “public space”, “refuge”, “spot”, “hub”, “park”, “urban garden”

- [Linguistic translation and keyword breakdown](#)

As a result of the diversity of the official languages across Member States, the national adaptation frameworks are developed in different languages. Therefore, the targeted keywords need to be translated from English to the corresponding languages for the screening process. Furthermore, to reduce the risk of translation mistakes and to capture any matches, the multi-word keywords are broken down into single words when screening the non-English documents. This approach aims to increase the likelihood of catching relevant terms or phrases expressed differently in various linguistic contexts.

- [Pilot testing and refinement of the keywords](#)

A preliminary screening of a group of documents is carried out to test whether the predefined keywords capture the references to climate shelter. Moreover, this initial screening is used to identify additional terms as well as overly generic terms, particularly when multi-word expressions are broken down into single-word searches, that are not suitable for use in the screening. According to the pilot testing, it is revealed that multiple grammatical variants of keywords need to be included (e.g.,

cool and cooling or shade, shading and shaded) since the screening is conducted manually through keyword searches within PDF files rather than automated linguistic processing. This approach is applied to minimise the translation mistakes since the linguistic roots and word formation rules vary across languages. Another outcome of the preliminary screening is that not all multi-word keywords can be broken down into single words meaningfully. The glossary of climate adaptation, such as urban heat island, nature-based solutions (NbS), as well as climate shelters for the purpose of this study, serves as established phrases and decomposing these keywords resulted in overly generic words that are not suitable for manual document screening. However, some variants (e.g., heat island) are included to capture alternative terminology. Similarly, other multi-word keywords cannot be meaningfully broken down, as their decomposition results in overly generic terms that are impractical to screen manually across documents. For instance, expressions such as extreme weather event and extreme climate event cannot be divided into individual words (e.g., extreme, weather, event), as these terms are widely and generically used in climate adaptation documents and would have generated an unmanageable number of irrelevant matches. In addition, single-word terms such as green, urban, heat, hot, measure, public, regulation, relief, and control, which come up during the keyword breakdown, were also excluded for the same reason. Overall, keywords are included or excluded based on their conceptual specificity and their practicality for manual screening, with priority given to terms that directly reflect the defining characteristics of climate shelters.

- [Final keyword framework](#)

Following all the steps, a final keyword framework is established for the manual screening of NAS and NAP.

“climate shelter”, “oasis”, “extreme climate event”, “extreme weather event”, “urban heat island”, “heat island”, “island”, “heat stress”, “surface temperature”, “overheating”, “flood”, “microclimate”, “thermal relief”, “thermal control”, “thermal”, “cool”, “cooling”, “cold”, “shade”, “shaded”, “shading”, “nature-based solutions”, “nature based solutions”, “NbS”, “green infrastructure”, “greening”, “vegetation”, “urban regeneration”, “renaturalisation”, “public space”, “space”, “refuge”, “refugia”, “shelter”, “spot”, “hub”, “centre”, “park”, “garden”

3.1.3 Data Retrieval and Keyword Screening

After defining the analytical scope of the study, the next step is accessing and preparing the national adaptation documents for the analysis. Several methods are used to access the national adaptation documents of the 27 EU Member States. It is important to highlight that several assumptions and standardisations are made to ensure a consistent and comparable dataset.

To start with, the primary source is accepted as the Climate-ADAPT platform, which provides centralised access to the most recent NAS and NAP of Member States. The Climate-ADAPT¹ portal serves as the primary reference point for verifying whether EU Member States have officially adopted a NAS and a NAP. It also provides official links to the publicly available documents. By using this platform, it is aimed to avoid some complications. These complications are challenges arising from the different naming of the documents or understanding whether the NAS and NAP are integrated or separate documents. In addition, the Reportnet², which is the portal of the European Environment Agency (EEA), is used to verify the details of the NAS and NAP documents.

In cases where the existence of a NAS or NAP documents are mentioned on the Climate-ADAPT platform, but the corresponding document cannot be accessed through the link, the documents are accessed through the official government sources. Inaccessible or non-functioning links are excluded from the scope of the study. Furthermore, the English version of the documents is preferred for screening if available.

Collectively, the most recent version of the NAS and NAP documents available at the time of data collection (December 10, 2025) is recorded for each country. For organising the collected information systematically, a database is developed with the fields shown in Table 1.

The database begins with the country profile and the characteristics of the adaptation documents. Then it is followed by a set of fields related to the research objectives. These include whether the NAS or NAP exists, and if yes, the details of each document, such as its original title, publication year, language, and the official source from which it is retrieved.

The second set of fields focuses on identifying references to climate shelters within the analysed documents by specifying whether a reference exists and providing a direct text excerpt and translation, if necessary. Furthermore, it clarifies how the document refers to climate shelters by categorising the findings. The final field indicates the cluster type assigned after the screening and categorisation process. Overall, the structure of the database serves as the foundation for the subsequent keyword screening of NAS and NAP documents.

¹ Climate-ADAPT (European Climate Adaptation Platform) is an official portal of the EEA and the European Commission. It provides access to the national adaptation strategies, plans, and related policy documents across Europe (EEA, n.d.).

² Reportnet is the EU's official environmental and climate data reporting system (EEA, n.d.).

An additional field is also included to capture whether the national frameworks require municipalities to prepare Local Adaptation Plans (LCPs) to provide insight into the vertical relationships in adaptation governance.

Upon structuring the database for the analysis, the retrieval of the documents and the screening process are initiated. Each NAS and NAP are accessed and downloaded in PDF format. Subsequently, the predefined keywords provided before are searched manually across all documents. In the following step, if any keyword is caught during the research, it is reviewed manually to confirm its relevance by examining the context in which it appeared. References in which the context is observed as nature, habitats or the sea instead of the urban are excluded. The acquired references are entered into the database accordingly.

The completed database table presenting the details is included in Annexe 1.

Fields	Description	Answer Type
Country Code	Two-letter ISO code used to identify each Member State	Text (e.g., FR, IT, DK)
Country Name	Full official name of the EU Member State	Text (e.g., Italy)
Adaptation Instrument (NAS / NAP)	Indicates which national adaptation instrument the row refers to. If instruments are separate, one row is recorded for NAS and one for NAP. If integrated, one row labelled NAS/NAP is recorded.	NAS/ NAP/ NAS & NAP
Document available	Indicates whether the corresponding adaptation instrument exists for the Member State.	Yes / No
Document type	Specifies whether the country provides a NAS, NAP, or an integrated framework	Separate / Integrated
Original title of the document	Official title of the adaptation document in its original language.	Text
Year	Year in which the most recent version is published	YYYY (e.g., 2016)
Source link	Link to the platform or government website from which the document is retrieved	URL
Language	Language in which the document is available	Text (e.g., English, Italian)
Does it mention climate shelters?	Identifies whether the document refers to climate shelters directly, indirectly, or not at all	Yes / No
Text excerpt (Quotation)	Direct quotation extracted from the document illustrating the reference	Text excerpt from policy document
Text excerpt translation (Quotation)	Translation of the direct quotation into English (if applicable)	Translation of the text excerpt from the policy document into English
How does it refer to climate shelters?	Categorisation of the type of reference	Direct term / Conceptual coverage / No reference
Cluster type	Indicating the cluster type	Cluster 1 Explicit/ Cluster 2 Implicit/ Cluster 3 No Ref.
Is it compulsory to have a Local Adaptation Plan (LCP)?	Indicates whether the national framework mandates municipalities to adopt local adaptation plans	Yes / No

Table 1 | Database Fields (Source: Author's elaboration)

3.1.4 Categorisation and Clustering

After the completion of the screening process, the qualitative analysis of the extracted material is conducted by carefully reviewing the excerpted text from the documents. Each excerpted text is categorised according to the nature of its reference to climate shelters by answering how it referred to the concept. As a result of this process, two main categories have emerged: (i) Direct term, where climate shelters are referenced with a specific terminology; and (ii) Conceptual coverage, where functionally equivalent interventions are described without using the direct terminology. Building on this categorisation, the results are then assigned into three analytical clusters: Cluster 1 Explicit Reference; Cluster 2 Implicit Reference; and Cluster 3 No Reference (see Fig. 11).

- Cluster 1 Explicit Reference includes documents where climate shelters or equivalent terms were clearly and directly stated in the text.
- Cluster 2 Implicit Reference captures documents in which climate shelter related concepts were addressed indirectly through functionally similar measures or objectives, without direct use of climate shelter terminology.
- Cluster 3 No Reference comprises documents where no identifiable link to climate shelters or analogous measures was detected. This categorisation provides the basis for the comparative analysis presented in the subsequent sections.

When assigning Member States to clusters, the presence of references in the NAS or NAP is assessed hierarchically. If any direct term reference is identified in a NAS or NAP, the Member State is assigned to Cluster 1. If no direct term reference is present, but conceptual coverage is identified, the Member State is assigned to Cluster 2. Member States with no references in either category are assigned to Cluster 3.

To conclude, each Member State is assigned to only one cluster, following a hierarchical logic in which explicit reference takes precedence over implicit reference, and implicit reference takes precedence over no reference.

3.2 Local Level Analytical Approach

This section outlines the analytical approach adopted for the local-level analysis in Phase 2 of the research. It focuses on the scope and the methodological considerations applied to select and analyse the case studies at the local level. The subsections that follow describe each step in further detail.

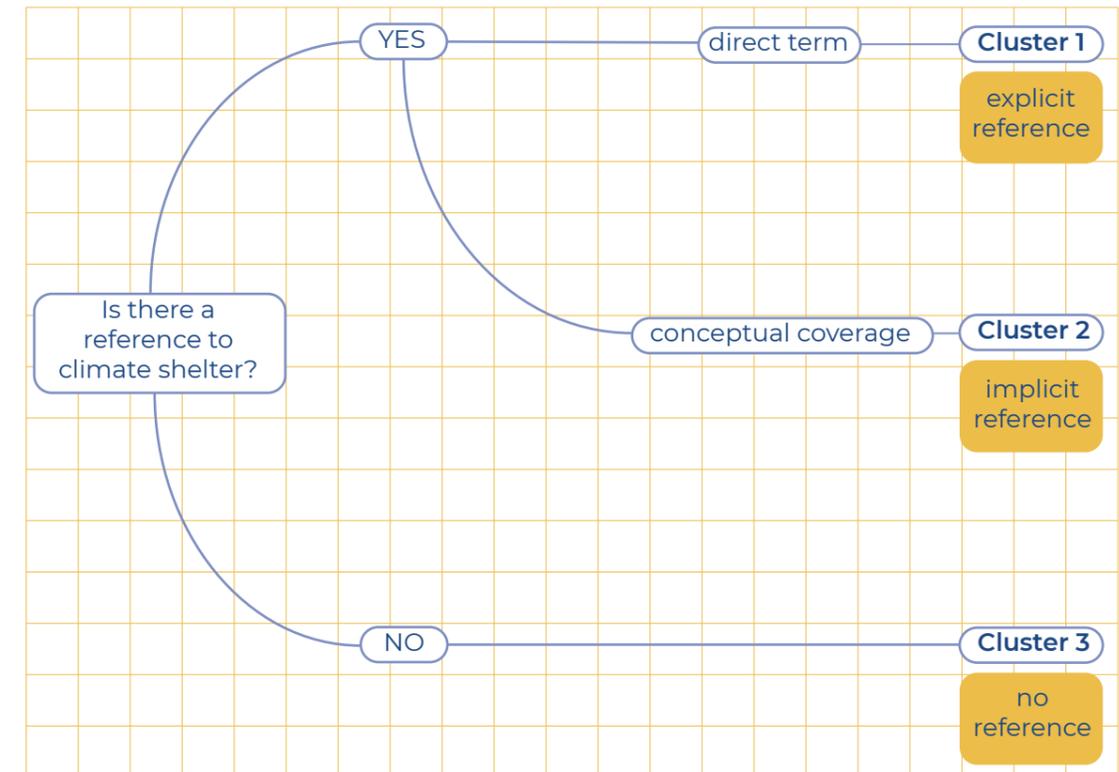


Figure 11 | Flowchart of Phase 1 (Source: Author's elaboration)

3.2.1. Spatial Overlay of the Clusters and Cities with Climate Shelters

Phase 2 starts with performing the spatial overlay of the results of clustering with the cities with climate shelter initiatives, following the MAINCODE case study analysis (see Fig. 12). This approach is adopted since it allows to observe how the differences at the national level are the result of or affected by the actions at the local level or vice versa.

The MAINCODE case study analysis was conducted in October 2025 to identify which cities across Europe demonstrate climate shelter initiatives. It is a keyword research analysis by using the same query previously mentioned in the Google engine. The scope of the study is defined using the NUTS 2-level¹ regions, focusing on the representative or capital city of each NUTS 2-level region to ensure a coherent and comparable analytical framework. During the analysis, keyword queries are translated into the official local languages of the cities. The result of the analysis reveals 88 cities with climate shelters (see Fig. 13).

Lastly, in this step, the identified reference being in the NAS or NAP of the Member State is not taken into account. The results of the spatial overlap shown on the map inform the next step, which is the selection of cities as case studies for the local-level analysis.

¹ The NUTS 2 level refers to the European Union's classification of territorial units representing basic regions for statistical analysis and the implementation of regional policies, as defined by Eurostat (Eurostat, n.d.)

3.2.2 Selection of the Case Study Cities

This step begins with the identification of three representative Member States from different clusters using the map. It is followed by an analysis of cities with climate shelter initiatives in these Member States. Based on two criteria, three cities are chosen as case studies to carry out the local-level analysis. These criteria are population size and the type of urban space where the climate shelters are located. These criteria are used to ensure the selected cities have a similar technical and resource capacity. In the subsequent analysis, the selected case study cities are examined.

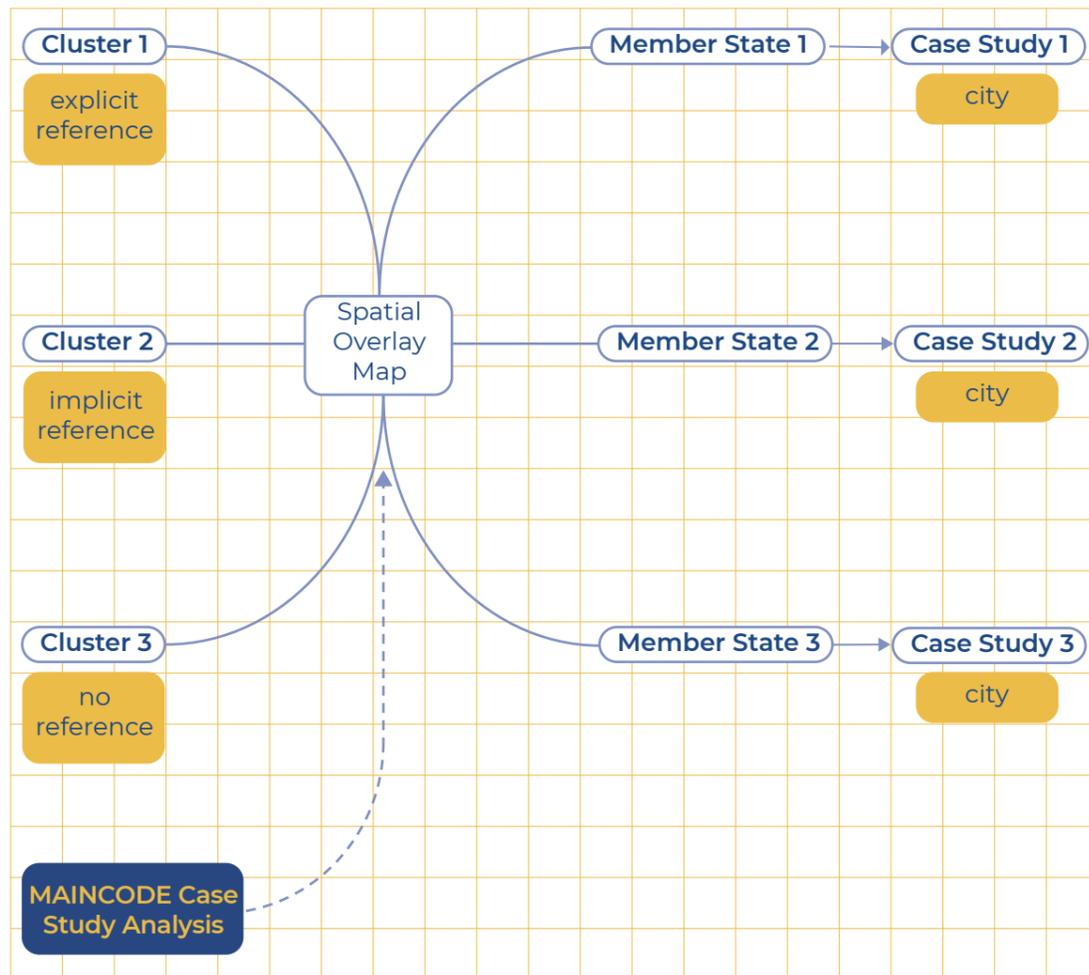


Figure 12 | Selection of the Three Case Studies (Source: Author's elaboration)

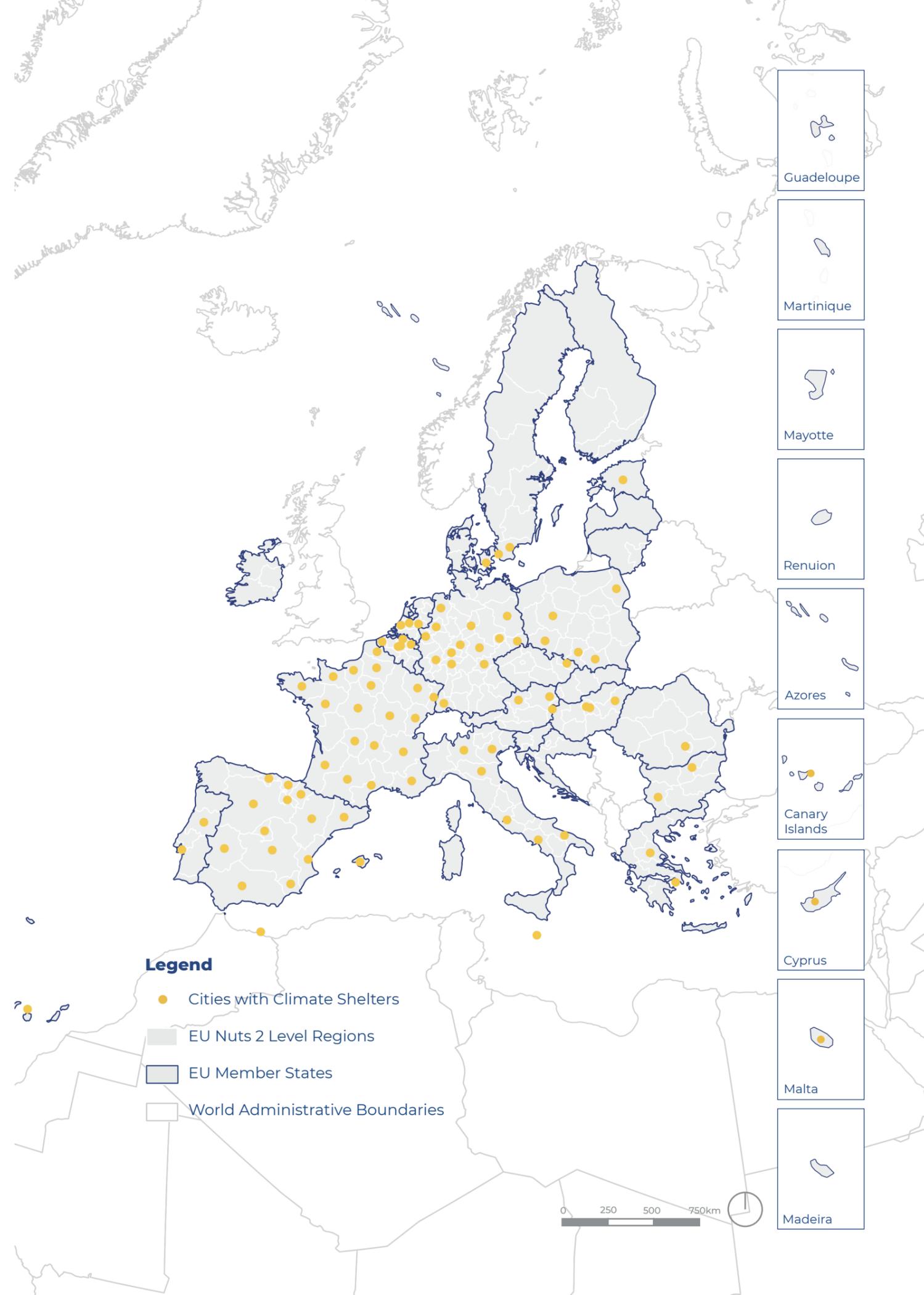


Figure 13 | MAINCODE Case Studies (Source: Adapted from Caldarice et al., 2025a)

3.2.3 Analysis of Case Studies

The analysis of the selected cities as case studies is conducted in five steps. Each city is examined in terms of its general profile, existing Local Adaptation Plans (LCPs), the presence of references to climate shelters in LCPs, climate shelter initiatives, and approaches to climate shelter implementation. The results are summarised in individual city sheets.

a. General Profile

The analysis begins with introducing the cities, such as their population and area. It is followed by their climate and climate vulnerabilities to understand the climate hazards the cities face and the reasoning for implementing climate shelters.

b. Local Climate Plan

In this section, LCPs of the cities are researched and presented if available. LCPs are defined as “planning documents prepared at the city level that contain policies that are relevant to climate change adaptation and/or mitigation” (Reckien et al., 2018, pp. 208-209). The published LCPs of EU Member States’ cities vary in terms of form, detail, structure and scope (Reckien et al., 2018). Some are stand-alone climate adaptation or mitigation plans, while others are integrated into broader policy documents, such as sustainability, resilience, or spatial development plans, for instance, sectoral plans or air quality plans (Reckien et al., 2018). Following Reckien et al. (2018)’s typology, this thesis focuses on LCPs that have a clear emphasis on climate change and are developed as stand-alone documents covering the entire urban area. Lastly, the general legal framework of LCPs, such as the existence of any legal obligations to develop, is further highlighted for each city.

c. Reference to Climate Shelters in Local Climate Plans

References to climate shelters are examined by using the same keyword-based method applied at the national level. The results are also categorised into direct reference, indirect reference and no reference.

d. Climate Shelters as Local Adaptation Experiment

This section presents the identified climate shelter initiatives in the MAINCODE analysis. It focuses on how climate shelters are implemented at the local level in greater detail. This step is followed by wider research on the presence of other climate shelters in other type or urban spaces, if available.

e. Climate Shelter Approach

Following the MAINCODE methodology (Caldarice et al., 2025a), the cities are assigned into three approaches to climate shelters: (i) Pilot, (ii) Thematic, and (ii) Sheltered City (see Fig. 14). Each approach represents a different level of implementation of the concept at the local level.

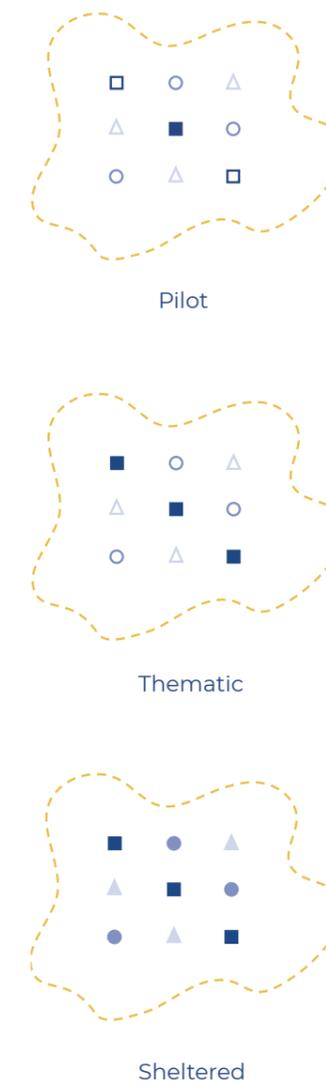


Figure 14 | Climate Shelter Approaches (Source: Author's elaboration adapted from Caldarice et al., 2025a)

• Pilot Approach

Implementation of single and stand-alone projects is included in this approach. These pilot projects are typically used for testing innovative concepts and evaluating their feasibility before broader adoption (Caldarice et al., 2025a).

• Thematic Approach

Implementation of multiple projects focusing on a single type of urban space, such as only in schoolyards or only in gardens and public parks are included in this approach. This approach focuses on targeted interventions and the development of specialised knowledge (Caldarice et al., 2025a).

• Sheltered City Approach

Implementation of a coordinated set of projects across diverse yet interconnected types of urban spaces is involved in this approach. They aim to create an integrated network of climate shelters (Caldarice et al., 2025a). These shelters can be in various urban spaces such as gardens, public parks, schoolyards, libraries, civic centres, sports centres, and community buildings. They are usually distributed strategically to ensure the access of the population to a climate shelter within a specified target time (Caldarice et al., 2025a).

A case study sheet is developed for each city to summarise the main findings of the analysis. The results of the Phase 2 provide a grounded understanding of how climate shelters are addressed and framed at the different levels. These findings serve as a foundation for Phase 3, where they are interpreted and synthesised to explore the interactions between local actions and national adaptation policies.

CHAPTER 4

CHAPTER 4 | Analysis of the National Level

This section provides an overview of the national adaptation policies adopted by the 27 EU Member States. It focuses on the structure, configuration and timing of NAS and NAP. Although all Member States are required to develop adaptation policies under EU climate governance, the analysis reveals a variety in how they are developed across the Member States.

As of 2025, all of the Member States have national adaptation policies (EEA, 2025). However, there are some differences in how these documents are structured. Of these 27 Member States, 24 of them adopted NASs, and 21 of them adopted NAPs (EEA, 2025) (see Fig. 15). Some Member States developed only a single NAS document, such as Greece, Belgium, Hungary, Croatia, Slovenia, and Poland. In contrast, other Member States adopted only a single NAP document, such as Finland, Latvia and Denmark (see Fig. 16). Several Member States established continuous frameworks or integrated single documents for both NAS and NAP, such as Austria, Romania, Germany, Luxembourg, Bulgaria, Sweden and Malta. The remaining Member States currently have a separate NAS and a separate NAP (EEA, 2025). Notably, for this thesis, the continuous framework documents are treated as separate instruments, as they are clearly distinguished by NAS and NAP sections, which are analysed accordingly.

The names of documents also vary for each Member State. The titles of the NAS and NAP documents differ and lacks standardised way. This is exemplified in the case of Spain, where the document of NAS is titled the National Climate Change Adaptation Plan 2021-2030. Another example is from Ireland, where the National Adaptation Strategy is titled the National Adaptation Framework (NAF). Similar cases are observed for Austria and Germany, where the term national is avoided in the title of their NASs. A further example is found in NAPs, which are occasionally referred to as action programmes or implementation programmes.

An example is the case of the Netherlands, where the document of NAP is named the National Climate Adaptation Implementation Programme.

An example is the case of the Netherlands, where the document of NAP is named the National Climate Adaptation Implementation Programme.

The adoption date of NAS and NAP also differs for each Member State. The dates found in this study refer to the most recently adopted and currently valid NAS and NAP documents. No conclusions are formed regarding the update frequencies or intermediate revisions of Member States, as information on prior documents is not within the scope of this study.

Regarding the NASs, the temporal distribution shows variation (see Fig. 17). The earliest and still valid NAS was adopted in 2006 by France. The most recent was by Cyprus in 2025.

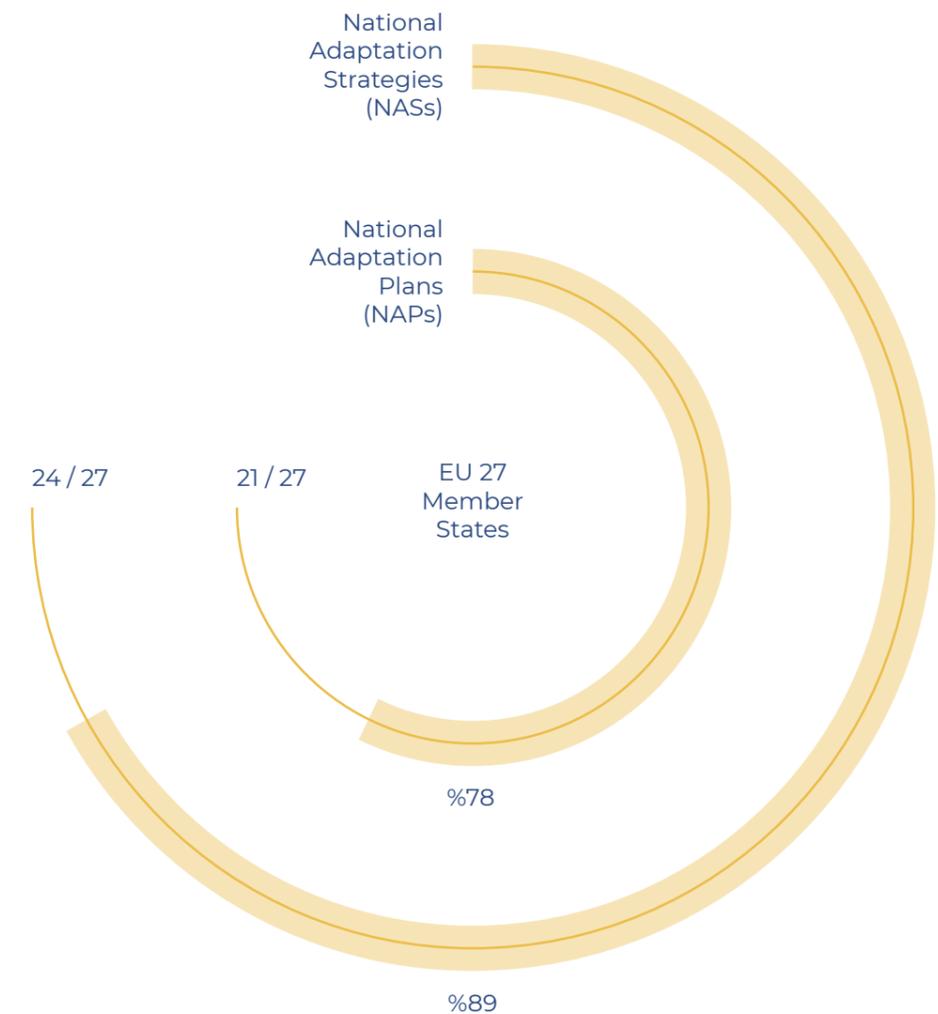


Figure 15 | Adoption of NASs and NAPs across EU Member States (Source: Author's elaboration)

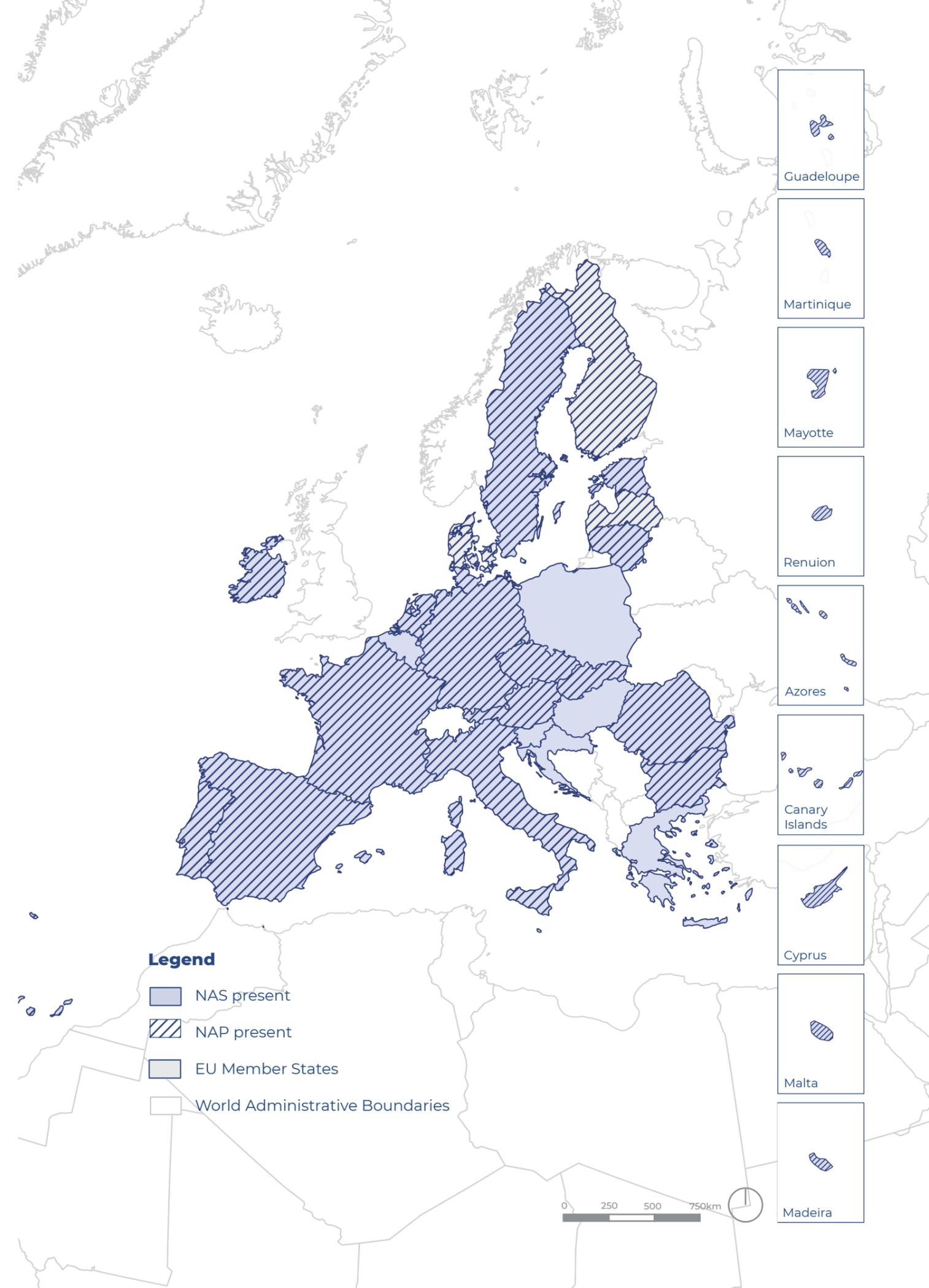
Early adoptions are observed between 2006 and 2013, including France (2006), Belgium (2010), and Poland (2013). The assumed driving factors and influences have been highlighted in the literature. A large group of Member States adopted their currently valid NASs between 2014 and 2018. This group includes Italy and Portugal (2015), Greece and the Netherlands (2016), Estonia (2017), and Luxembourg, Hungary, and Slovakia (2018). Another concentrated group exists from 2019 onwards, with Bulgaria (2019), Spain and Croatia (2020), and Czechia, Lithuania, and Malta (2021). The most recent NASs were adopted between 2024 and 2025 in Germany, Ireland, Austria, Sweden, Romania, and Cyprus.

In regard to NAPs, the adoption years of the currently valid documents also display variations (see Fig. 18). The earliest and still valid NAP dates to 2012, Denmark. The most recent NAPs were adopted by France (2025), Ireland (2025), and Cyprus (2025). Early adoptions are observed in 2018 and 2019, including Luxembourg (2018) and Latvia (2019), Portugal (2019), and Bulgaria (2019). Another group of Member States, including Spain, Czechia, Slovakia, Estonia, and Malta, is observed for 2021. More recent adoption years are observed between

2023 and 2024, with Italy (2023), the Netherlands (2023), Austria (2024), Germany (2024), Finland (2024), Lithuania (2024), Sweden (2024), and Romania (2024).

Overall, the timelines of currently approved and still valid NAS and NAP documents indicate a wide heterogeneous timeline. While grouping of both instruments is observed in certain periods, the interpretation of this finding should be interpreted carefully. Because, as mentioned above, the analysis is limited to the recently adopted and valid documents, so it is not possible to understand the trends or patterns of the adoption timeline, the frequency of the revisions or policy maturity across Member States.

Figure 16 | Presence of NAS and NAP across the EU 27 Member States
(Source: EEA, 2025; Author's elaboration)



Adoption Date of National Adaptation Strategies NASs Across the 27 EU Member States

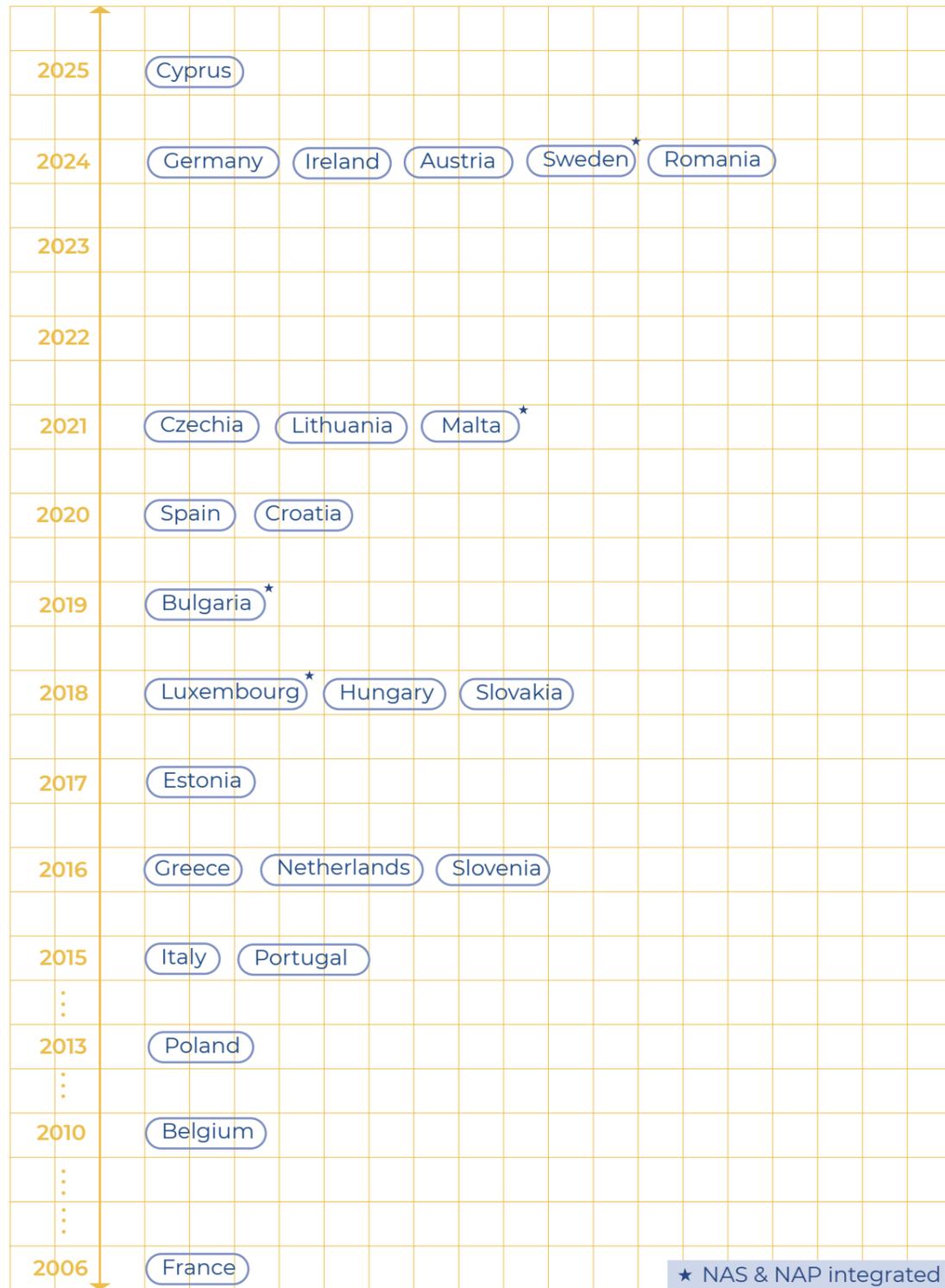


Figure 17 | Adoption Date of the Latest NASs across EU Member States (Source: Author's elaboration)

Adoption Date of NAPs Across the 27 EU Member States

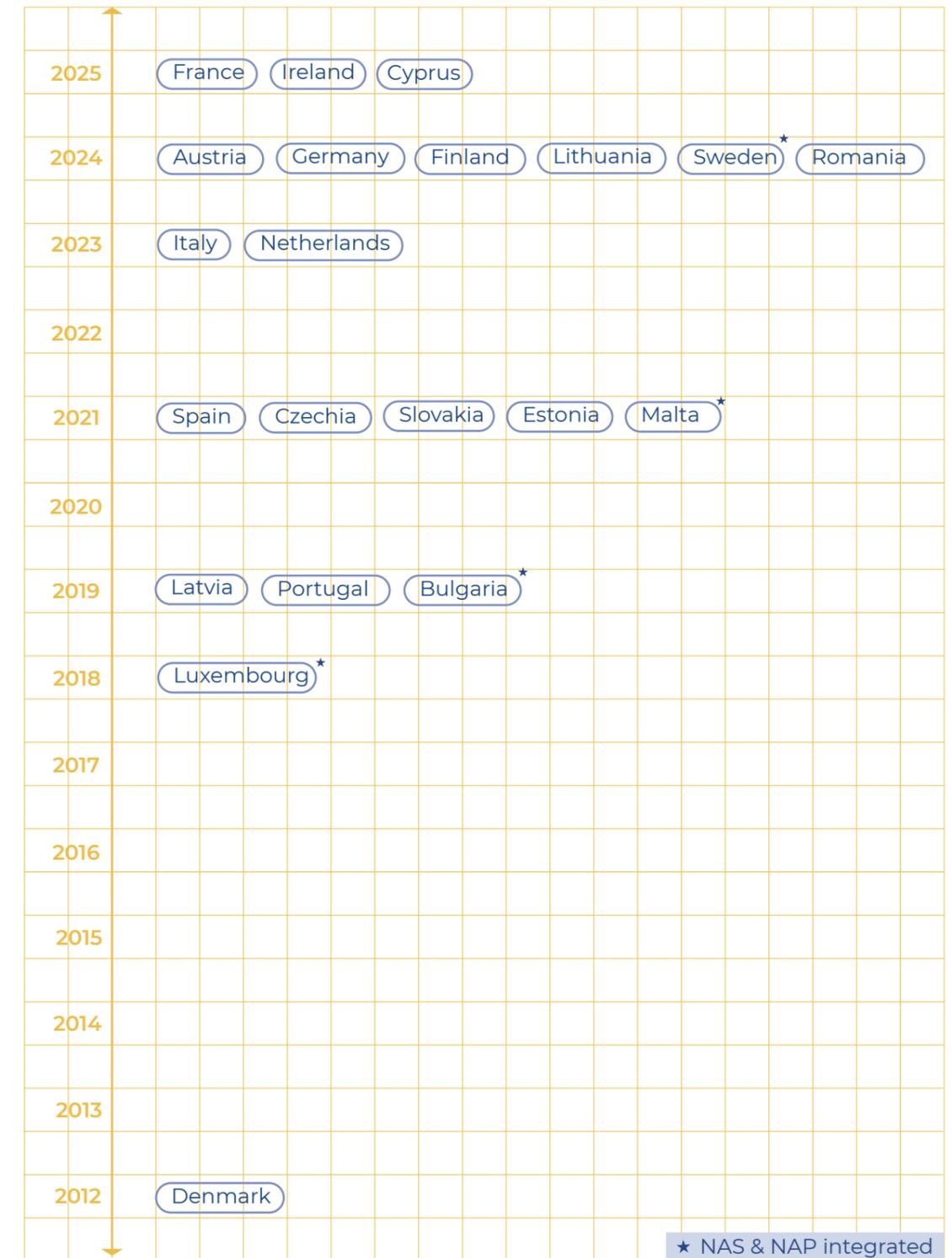


Figure 18 | Adoption Date of the Latest NAPs across EU Member States (Source: Author's elaboration)

4.1 Clustering of Member States Based on Identified References

In this section, the results of the clustering analysis of the 27 Member States are presented. Based on the category of the identified references, three clusters emerged, and each Member State is assigned to one (see Fig. 19).

- **Cluster 1 Explicit reference** includes four Member States which are Spain, Cyprus, France and Austria.
- **Cluster 2 Implicit reference** includes eleven Member States which are Luxembourg, Romania, Italy, Estonia, Hungary, Czechia, Croatia, Germany, Ireland, Latvia and Lithuania.
- **Cluster 3 No reference** includes twelve Member States which are Portugal, Belgium, the Netherlands, Denmark, Sweden, Finland, Poland, Slovenia, Malta, Greece, Bulgaria and Slovakia.

The clustering analysis reveals that only a limited number of Member States have direct reference to climate shelters in their national adaptation policies. In the meantime, indirect reference and no reference clusters are similar in size and cover the biggest portion in numbers among the analysed Member States. The results of the clustering are also displayed spatially (see Fig. 20). In the following section, the Member States of each cluster and the identified references are presented to further detail the analysis.

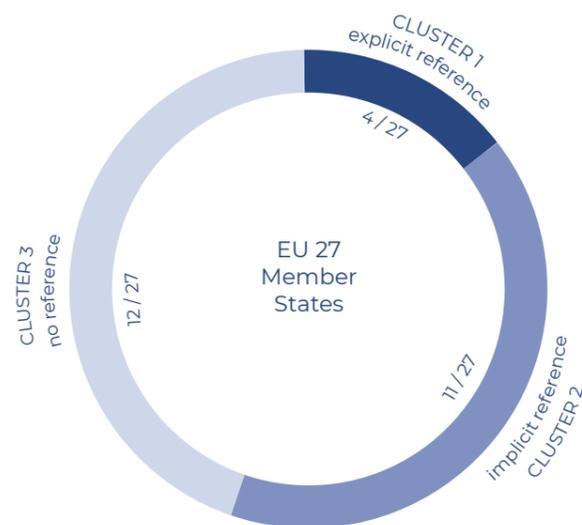
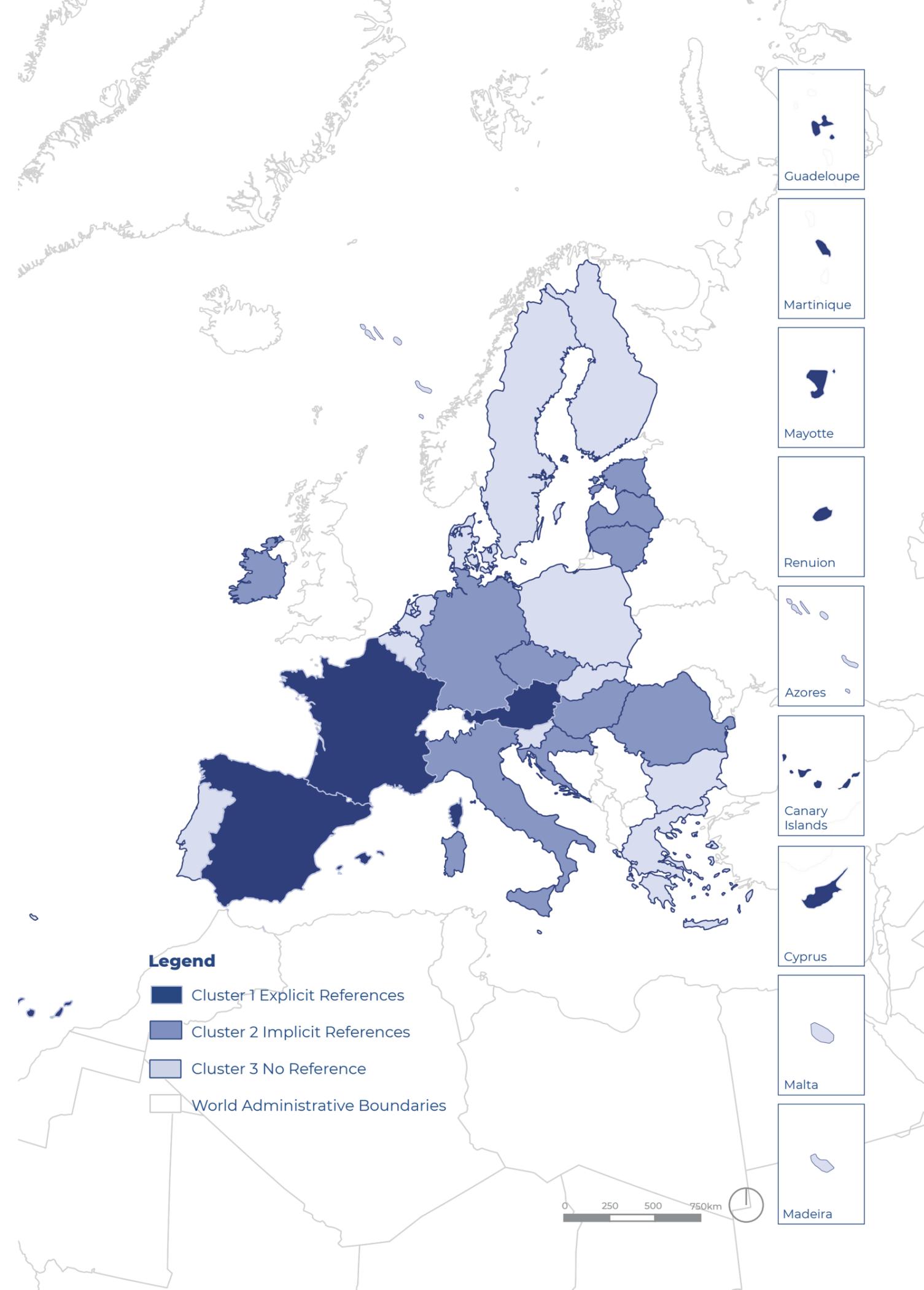


Figure 19 | Clustering of Member States (Source: Author's elaboration)

Figure 20 | Clustering of 27 Member States based on the Identified References (Source: Author's elaboration)



4.2 Cluster 1 | Explicit Reference to Climate Shelters

This section presents the Member States assigned to Cluster 1 in further detail. It provides insights and examples of the references classified as direct references. The cluster consists of four Member States (see Fig. 21): (i) Spain and Cyprus, where explicit references are identified in both NAS and NAP; and (ii) France and Austria, where explicit references are identified exclusively in the NAP.

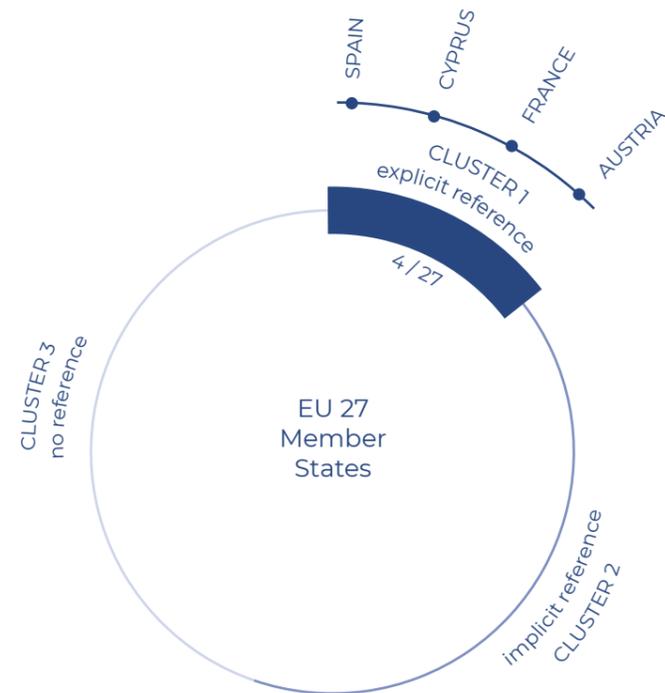


Figure 21 | Cluster 1 Explicit References to Climate Shelter (Source: Author's elaboration)

4.2.1 Spain

Spain presents clear and repeated use of direct terminology for climate shelter in both NAS and NAP. In Spain, climate change adaptation is built as a comprehensive national framework. The National Climate Change Adaptation Plan 2021–2030 (PNACC) functions as the NAS (EEA, n.d.). The latest NAS was approved in 2020 and forms part of a strategic energy and climate framework that consists of a set of instruments and is operationalised through Work Programmes (WP), which function as NAP (EEA, n.d.). The work programs are updated every five years. The currently valid work programme, the Work Programme 2021-2025, was approved in 2021 (EEA, n.d.).

- The direct references to climate shelters identified in NAS are as follows:

“Measures to adapt habitat types to climate change. Adaptive management measures include measures to lower non-climate pressures impacting habitat types, improve the resilience of habitat types, maintain the abiotic conditions required by habitat types, reduce the impact of extreme weather events, and identify climate refugia” (MITECO, 2020, p.123).

“There is also a need to promote the incorporation of urban climate mapping into urban planning and management tools, which can encourage the creation of climate refugia” (MITECO, 2020, p.152).

- The direct references to climate shelters identified in NAP are as follows:

“Pima Climate Change

- *Adaptation of public buildings to prevent excessive heat*
- *Opening of urban “climate refuges” for public use*

- Application of nature-based solutions aimed at preventing risks arising from climate change” (MITECO, 2021, p. 18, author’s translation).

“Promotion of the creation of ‘climate refuges’ as a tool for biodiversity adaptation to climate change. Potential ‘climate refuges’ are identified, and the information is made available to the departments of biodiversity conservation and planning and management of protected areas” (MITECO, 2021, Annexe 1, p. 8, author’s translation).

As evidenced from the citations in both NAS and NAP, climate refugia, or climate refuges (translated from *refugios climáticos*), are used repeatedly to describe the concept of climate shelter. They are presented in a descriptive context as measures to be implemented in the city to support adaptation to climate change.

4.2.2 Cyprus

Cyprus’s national adaptation policies include NAS, titled the National Adaptation Strategy to Climate Change and NAP, titled the National Adaptation Action Plan to Climate Change 2025- 2030. NAS was initially adopted in 2017 and revised in 2025. It provides a comprehensive framework for climate resilience by defining the long-term vision, strategic priorities, and guiding principles. The implementation of NAS is put into work by NAP, which translates the strategies into actions through 118 concrete measures spanning 15 thematic sectors

and two cross-cutting domains (EEA, n.d.).

- The direct references to climate shelters identified in NAS are as follows:

“Enhancing public transport to withstand heat stress is a key priority, with measures like self-sufficient climate shelters, radiant cooling, and nature-based solutions being explored to improve passenger comfort.” (MARDE, 2025, p. 55)

“Public transport stops in cities are transformed into self-sufficient short-stay climate shelters.” (MARDE, 2025, p. 139)

“Promote the incorporation of urban climate risk mapping into urban planning, which can encourage the creation of climate refugia.” (MARDE, 2025, p. 145)

- The direct references to climate shelters identified in NAP are as follows:

“Number of community centres operational as climate shelters” (MARDE, 2025, p. 162)

“Promote the incorporation of urban climate risk mapping into urban planning, which can encourage the creation of climate refugia.” (MARDE, 2025, p. 239)

As shown above, two different terms for referring to climate shelters are identified in the NAS and NAP. The differences in the terms are identified during further context analysis. The term climate shelter is used when it refers to interventions located at public transportation stops. The term climate refugia is used in a broader urban planning context by referring to spaces identified through mapping of climate risks. They are further differentiated by their support for biodiversity and contribution to climate resilience in the long term.

4.2.3 France

The first NAS of France, titled Stratégie nationale d’adaptation au changement climatique, was published in 2006, and it is still currently valid. As highlighted before, this NAS is also one of the first NAS in Europe that exemplified other Member States to develop their national adaptation strategy policies. The first NAP was adopted in 2011 and updated in 2018. The third and currently valid NAP was adopted in March 2025, named 3ème Plan national d’adaptation au changement climatique (PNACC-3). It consists of three core documents: the French Strategy for Energy and Climate (SFEC), the National Low-Carbon Strategy and the Multi-Annual Energy Programming. It is designed to ensure coherence

between adaptation, mitigation, and energy policies (EEA, n.d.). The direct references to climate shelters identified in NAP are as follows:

“The Green Fund’s urban and village rewilding measure co-finances climate change adaptation solutions based on the presence of nature in urban areas. Eligible projects include rewilding—in the sense of recreating or improving the ecological functions—of soils, vegetation, or aquatic/wetland environments, located within urbanised areas and adapting them to the effects of climate change (cool islands, on-site rainwater infiltration)” (Ministère de la Transition écologique, 2025, p. 114, author’s translation).

“Conduct methodological definition and mapping of urban cool islands in the largest urban areas, then develop an application to find the nearest cool island” (Ministère de la Transition écologique, 2025, p. 115, author’s translation).

“Urban heat island mapping work, mapping and development of an application for identifying cool islands: €200k/year” (Ministère de la Transition écologique, 2025, p. 115, author’s translation).

“Indicator. Areas covered by the mapping of urban heat islands and cool islands” (Ministère de la Transition écologique, 2025, p. 115, author’s translation).

“The initial action plans for the core area discussed in the local authorities working group of the PNACC are: Conducting an assessment of urban heat islands; Identifying cool islands and public fountains” (Ministère de la Transition écologique, 2025, p. 174, author’s translation).

On the basis of the screening, the climate shelter concept is referenced through the usage of the term îlots de fraîcheur, which can be translated into cool islands in English. The term is usually used to describe a cooling measure as well as an indicator.

4.2.4. Austria

Austria’s climate adaptation policy is implemented through successive NAS and corresponding NAP. The first NAS and NAP were adopted in 2021, and the currently valid ones were adopted in 2024 (EEA, nd). The documents are built in a continuous framework consisting of two separate documents: Die Österreichische Strategie zur Anpassung an den Klimawandel – Teil 1: Kontext, which presents NAS, and Die Österreichische Strategie zur Anpassung an den Klimawandel – Teil 2: Aktionsplan Handlungsempfehlungen für die Umsetzung, which represents NAP. The direct references to climate shelters identified in NAP are as follows:

“In general, ‘cooling spots’ should be strategically located so that they are increasingly closer together in areas with an increased risk of overheating and high crowding” (BMK, 2024, p.191, author’s translation).

“Establishment of public, cool, and accessible spaces (‘cool spots’) in urban areas (especially in pronounced urban heat islands). This includes, for example, massive historical (often sacred) buildings or planted, shaded, and ventilated squares” (BMK, 2024, p.191, author’s translation).

Drawing on the analysis of the Austrian NAP, the terms cooling spots and cool spots are used to refer to climate shelters. These terms are presented in English, even though the document is written in German. They are utilised in NAP to describe the implementation of the cooling measures.

To conclude, some interpretations are made from the findings. To start with, the identified explicit references in the national adaptation policies are usually embedded in a wider adaptation and mitigation strategy and described typically as cooling projects accessible to the public for mitigating heat events and their adverse effects. Secondly, the findings support the hypothesis of a lack of standard terminology for the concept by revealing the diverse terms identified in the NASs and NAPs. As illustrated in Figure 22, these terms are climate shelter, îlots de fraîcheur, refugios climáticos, climate refugia, cool spots, and cooling spots. The results are also presented spatially in Figure 23.

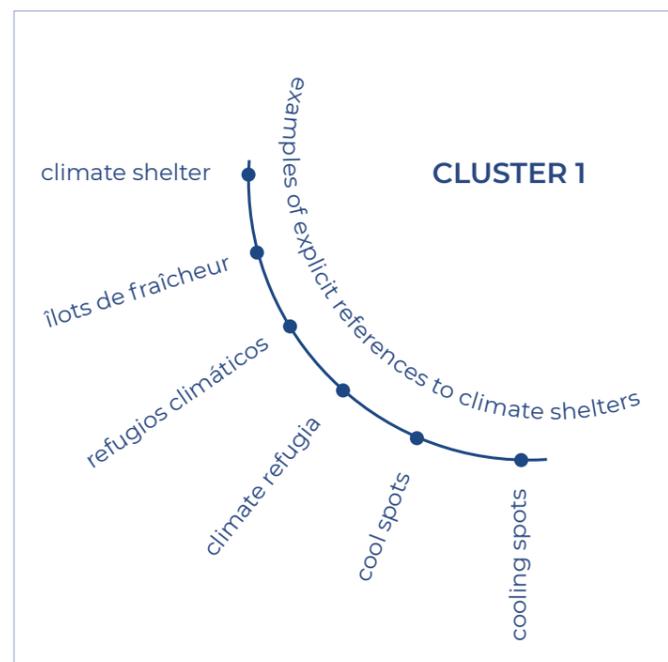
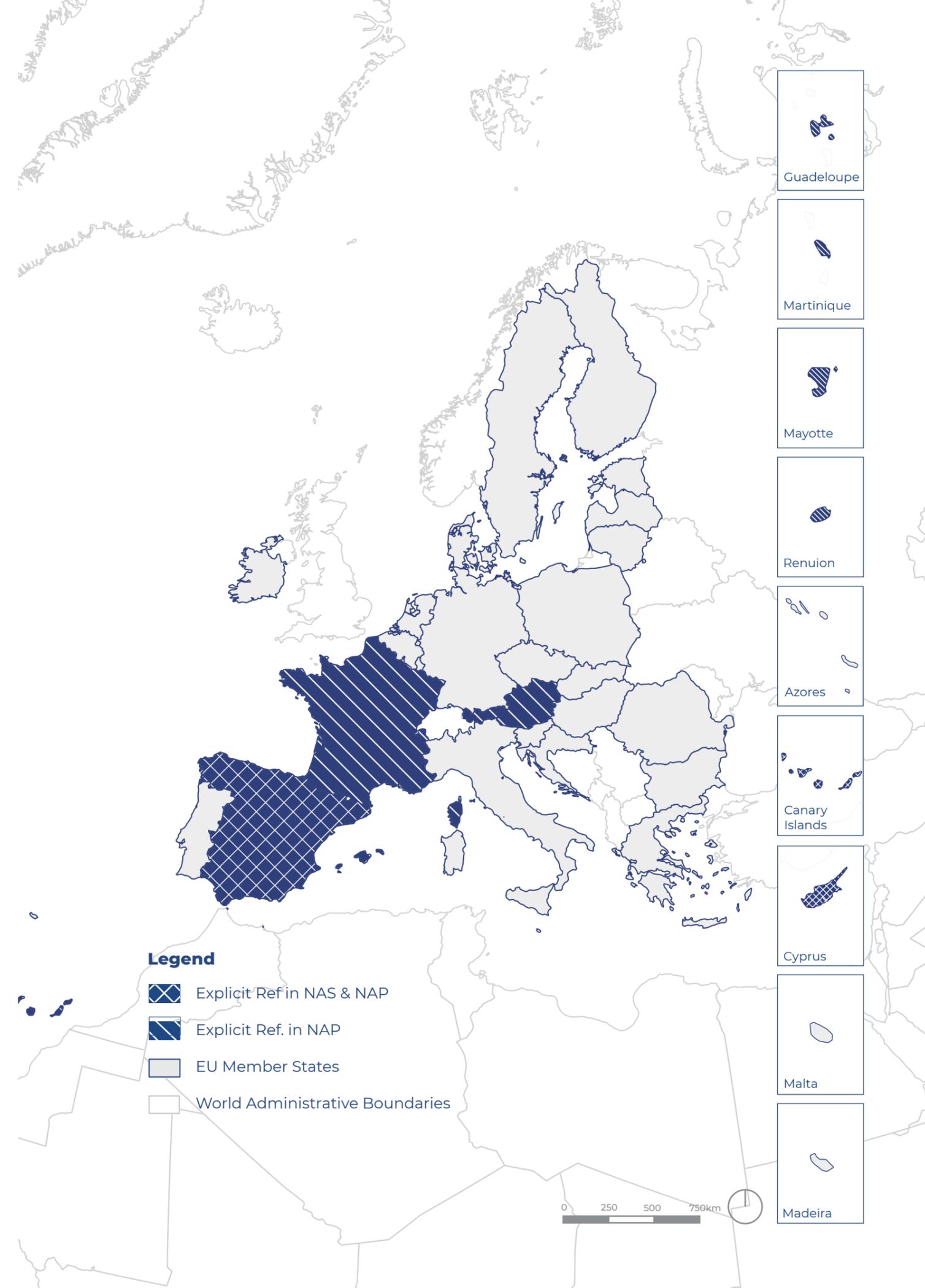


Figure 22 | Identified Explicit References to Climate Shelter as Presented in the NASs and NAPs (Source: Author’s elaboration)

Figure 23 | Cluster 1 Explicit References to Climate Shelters in NAPs and NASs across Member States (Source: Author’s elaboration)



4.3 Cluster 2 | Implicit Reference to Climate Shelters

This section explains the references identified in NAS and/or NAP of Member States which are assigned to Cluster 2. It provides country-by-country examples similar to the previous section. As illustrated in Figure 24, the cluster includes eleven Member States. The details of each identified implicit reference are presented in the following section.

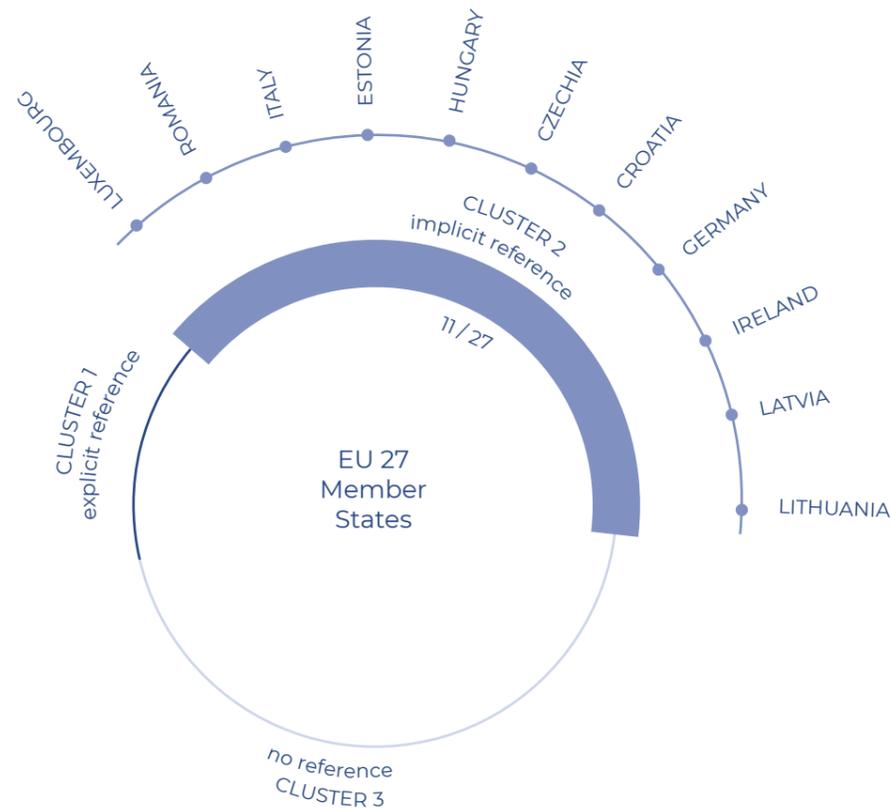


Figure 24 | Cluster 2 Implicit References to Climate Shelter (Source: Author's elaboration)

4.3.1 Luxembourg

The latest NAS and NAP of Luxembourg are together an integrated single document named *Stratégie et plan d'action pour l'adaptation aux effets du changement climatique* and adopted in 2018 (EEA, n.d.) The legal frameworks for NAS and NAP are established by the Luxembourg Climate Law, which introduces long-term planning and regular updates that are mandatory to develop (EEA, n.d.). Identified references are as follows:

“Designate climate-regulating areas, e.g. for night cooling or water retention, or use climate-regulating areas for multiple purposes: e.g. as retention areas, parks, urban agricultural areas” (Ministère de l'Environnement, du Climat et

du Développement durable, 2018, p. 101, author's translation).

“Create parks distributed throughout the area, accessible to people with reduced mobility, particularly the elderly and children, functional (trees with shade and high evaporation, ensured irrigation) and attractive (e.g. play equipment, cafes). Dual uses could also be considered, e.g. as retention areas” (Ministère de l'Environnement, du Climat et du Développement durable, 2018, p. 120, author's translation).

In the analysed documents, the used phrases clearly lack any direct terminology. They emphasise thermal comfort, protection from heat stress, and accessibility for vulnerable groups and multifunctional open spaces. These qualities could be interpreted as an indirect reference to climate shelter but embedded in broader spatial and environmental measures.

4.3.2 Romania

Romania updated its NAS (*Strategia Națională privind Adaptarea la Schimbările Climatice – SNASC*) and adopted a new NAP (*Planul Național de Acțiune privind Adaptarea la Schimbările Climatice – PNASC* in 2024) in 2024 (EEA, n.d.). They are developed as a continuous framework for the period of 2024–2030, with a perspective toward 2050 (EEA, n.d.). The references identified in the NAS part are as follows:

“Promoting healthy ecosystems, green infrastructure, and nature-based solutions should be systematically integrated into urban planning, particularly in public spaces, infrastructure, and the design of buildings and their surroundings” (România, 2024, p. 71, author's translation).

“Integrating nature-based solutions through the development of green and blue infrastructure by creating, expanding, diversifying, and rehabilitating existing green spaces and managing them efficiently, such as green roofs and urban gardens, including the rehabilitation/regeneration of riverbanks and their reintegration into settlements” (România, 2024, p. 78, author's translation).

The identified phrases reveal that there is no direct terminology used to refer to climate shelter. However, the document guides the implementation of nature-based solutions in public spaces as a coping strategy to the adverse effects of climate change and encourages their integration into urban planning practices. These could be interpreted as an indirect

reference to climate shelters in a descriptive context.

4.3.3 Italy

The NAS of Italy (Strategia Nazionale di Adattamento ai Cambiamenti Climatici) establishes a framework for adaptation strategies, such as strategy priorities and assessment of the impacts related to climate change. It was adopted in 2015 and is still valid as of December 2025 (EEA, n.d.). The latest NAP of Italy (Piano Nazionale di Adattamento ai Cambiamenti Climatici) was adopted in 2024. It sets a comprehensive framework to operationalise the strategies defined in NAS (EEA, n.d.) The identified implicit references in NAS are as follows:

“Urban settlements. Promote a redistribution of urban green spaces to interrupt the heat-island effect” (Ministero della Transizione Ecologica / Ministero dell’Ambiente e della Sicurezza Energetica, 2015, p. 124, author’s translation).

“Urban settlements. Increase the provision of urban green spaces by adopting the logic of green and blue infrastructure, preparing measures to contain the climatic impacts on existing public green areas, and safeguarding biodiversity in urban areas” (Ministero della Transizione Ecologica / Ministero dell’Ambiente e della Sicurezza Energetica, 2015, p. 136, author’s translation).

As indicated in the references, urban green spaces are framed as measures for protection against heat. Their benefit in protecting the biodiversity is also recognised. These qualities could all be interpreted as indirect references to climate shelters.

4.3.4 Estonia

In 2017, Estonia adopted the currently valid NAS, Development Plan for Climate Change Adaptation until 2030. The document provides a strategic framework for actions to decrease the vulnerability to climate change. In 2021, the NAP Kliimamuutustega kohanemise arengukava rakendusplaan aastateks 2021–2025, was adopted to promote climate adaptation activities which are aligned with the development plan’s goals and support adaptation efforts both at national and local scales (EEA, n.d.). The following implicit references were identified in the NAS:

“To avoid illnesses and mortality, the effects of the heat island effect should be already mitigated by limiting the accumulation of heat with planning and construction solutions and by implementing microclimatic cooling measures

in the urban environment, maintaining and expanding green areas, landscaping and bodies of water” (Estonian Ministry of Climate, 2021, p. 14).

Evidence from the obtained reference suggests that certain measures that are emphasised in the documents align with the climate shelter concept. These include the use of cooling measures in urban areas, the maintenance and expansion of green spaces and landscaped areas, and the inclusion of water features, while being incorporated into planning and construction activities.

4.3.5 Hungary

In Hungary, NAS is part of a comprehensive framework, the Second National Climate Change Strategy (második Nemzeti Éghajlatváltozási Stratégia, NCCS-2). It was adopted in 2018 by the Parliament and outlines the climate policy with three main pillars: Mitigation through the National Decarbonization Roadmap, adaptation through the NAS, and raising climate awareness. NAS is implemented through a series of National Climate Change Action Plans (NCCAPs) (EEA, n.d.). However, they are not accepted as NAPs, and at present, Hungary does not have an officially adopted NAP (EEA, n.d.). The observed implicit reference to climate shelter in NAS is as follows:

“By expanding the green space system and including water surfaces, creating a site-specific green infrastructure system that ensures ecological permeability, promotes ventilation of settlements, and reduces the heat island phenomenon.” (Országgyűlés, 2018, p. 196, author’s translation)

The observed implicit reference indicates that nature-based solutions and green infrastructure measures are considered key tools for reducing heat stress and improving microclimatic conditions. They cover similar measures as climate shelter and are interpreted as an indirect reference.

4.3.6 Czechia

NAS (Strategie přizpůsobení se změně klimatu v podmínkách ČR) and NAP (Národní akční plán adaptace na změnu klimatu,) of Czechia were both adopted in 2021. They were updated based on the knowledge from the previous policies and include several measures which were not mentioned in the previous ones (EEA, n.d.). The identified implicit reference in NAS is as follows:

“Urban green infrastructure (mature trees, shrub and herbaceous vegetation, grassed areas, etc.), water bodies (streams, reservoirs) and the connection of stormwater runoff from paved surfaces to settlement greenery, together with extensive green roofs, green façades with climbing plants, and sustainable drainage systems (stormwater management), generate many ecosystem services at the local level, particularly microclimate regulation and the associated cooling of the urban environment and the entire settlement landscape” (Ministerstvo životního prostředí České republiky, 2021, p.60, author’s translation)

The observed reference suggests that cooling of the urban environment and microclimate regulation are described analytically through the role of green and blue infrastructure, thereby indirectly referring to the concept of climate shelter and thus falling into the category of implicit references.

4.3.7 Croatia

The climate adaptation policies of Croatia lie within the responsibility of the Ministry of Environmental Protection and Green Transition. Policies such as NAS, NAP, Programmes for Climate Change Mitigation and Adaptation, and the Protection of the Ozone Layer at the local and regional level are developed and implemented by within this responsibility (EEA, n.d.). The recent NAS (Strategija prilagodbe klimatskim promjenama u Republici Hrvatskoj za razdoblje do 2040. godine s pogledom na 2070. Godinu) was adopted in 2020. Based on the information on the Climate-ADAPT platform, there is currently no NAP adopted. The identified implicit reference in NAS is as follows:

“renaturalisation and regeneration of the urban fabric using nature-based solutions” (Hrvatski sabor, 2020, p. 28, author’s translation)

Detected reference specifically uses the phrase implementing nature-based solutions for urban regeneration, which is interpreted as an indirect emphasise to climate shelters.

4.3.8 Germany

In Germany, the recent NAS titled 2024 German Strategy for Adaptation to Climate Change (Deutsche Anpassungsstrategie an den Klimawandel 2024 - DAS) was approved in 2024. It introduces the measurable adaptation targets within the responsibility of the federal government. The NAS and NAP are developed as a continuous framework where NAP is

the annexe of the NAS document (EEA, n.d).

The identified references in the NAS part are as follows:

“Target S-1: Activate urban green spaces to reduce heat stress. The goal is to reduce the health risks posed by heat in particularly thermally stressed areas and in areas with heat-sensitive populations, and to improve the cooling capacity, accessibility and recreational function of urban green spaces and open spaces for urban residents” (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2024, p.64).

“The accessibility to cooling green spaces indicator (S-1.a) (see box), which is intended to measure progress towards the target activate urban green spaces to reduce heat stress for all towns and cities with 10,000 inhabitants or more (S-1.a) (see box) is a heat-related variant of the existing accessibility to urban green spaces indicator (green accessibility for short) and is currently being developed. In priority areas (see below), the green volume indicator will also be used as a measure of greenery in these areas” (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2024, p.64).

“Accessibility to cooling green spaces is achieved when a publicly accessible, cooling green space can be reached easily by foot and can be used for cooling off during heat events close to where people live and/or work.” (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2024, p.64)

“To develop the accessibility to cooling green spaces indicator, the plan is to modify the accessibility to urban green spaces indicator (green accessibility for short) that is used in the monitoring conducted by the Leibniz Institute of Ecological Urban and Regional Development (IÖR-Monitor)” (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2024, p.65)

“To help create a cooling green space, the potential for evaporation and shade should be taken into account, for example, by the green volume. It measures the vegetation on green spaces (m³/m²) and indicates the above-ground volume of all plants growing on a surface, including building greenery” (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2024, p.65)

“compiling standardised basic data for the whole of Germany, such as

accessibility to cooling green spaces and green volume, and making it available to towns, cities and municipalities on geodata portals, and by developing and providing digital tools (S-0.5)” (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2024, p.65)

Screened implicit references in NAS serve as evidence for indirect climate shelter references. The identified phrases frame these indirect references both as a target to reach and an indicator to measure. Another point that needs to be highlighted is that these references occur the highest in number in comparison to other documents. Particularly in this case, several assumptions that are made needs be explained about the classifications. Such as the references using cooling green spaces are classified as indirect rather than direct because they emphasise general cooling functions and accessibility of urban green infrastructure rather than designated spaces as climate shelters. Therefore, the indicator name, cooling green space, which measures the accessibility to these spaces, is also accepted as indirect.

4.3.9 Ireland

The NAS of Ireland is named the National Adaptation Framework (NAF). It was initially adopted in 2018 and updated in 2024. It was constructed under the Climate Action and Low Carbon Development Acts 2015–2021 to construct the national adaptation strategy by setting priorities. It also mandates the sectoral and local adaptation planning through Sectoral Adaptation Plans and Local Authority Climate Action Plans. The NAP of Ireland was recently adopted in 2025, and it is named Climate Action Plan 2025. The identified reference in NAS is as follows:

For example, creating urban green spaces and wetlands lessens the impact of urban stormwater by absorbing excess rainfall and cooling urban areas during heatwaves, while also bolstering a community wellbeing and cultural heritage” (Department of the Environment, Climate and Communications, 2024, p. 66).

The phrase of urban green and blue infrastructure, which provides secure space during extreme climate events while contributing to the community’s well-being and cultural heritage, is interpreted as an indirect reference to climate shelter. It provides a descriptive profile of climate shelter without using any explicit term for it.

4.3.10 Latvia

The Latvian National Plan for Adaptation to Climate Change Until 2030 (NAP20130), which is still the valid NAP, was adopted in 2019. It covers more than 80 adaptation measures and five strategic goals to address the climate change risks. The document is under the responsibility of the Ministry of Climate and Energy (MoCE), which is the sole entity for developing the adaptation policies in Latvia. However, the implementation responsibility belongs to several corresponding ministries (EEA, n.d.). At present, there isn’t an adopted NAS according to the information on the Climate-ADAPT platform. The observed implicit reference to climate shelter in NAP2030 is as follows:

“Review the legal framework and improve the implementation thereof with regard to the necessity to install and maintain air cooling systems in public spaces, as a priority – in health care institutions, social care and social rehabilitation institutions, kindergartens, trains stations (where relevant)” (Ministry of Environmental Protection and Regional Development, 2019, p. 59).

As it is shown in the reference, the implementation of air-cooling systems in public spaces is emphasised. The phase of air-cooling systems is interpreted measure that are implemented outside, which can be both technical and nature-based solutions, since it is not specified. Therefore, the phrase is understood as an indirect reference to climate shelter.

4.3.11 Lithuania

Lithuania adopted its latest NAS (National Climate Change Management Agenda) in 2021, which is still in force. It identifies the objective and targets for climate change management policy up to 2030 and 2040 in Lithuania. The NAP, which is part of the National Energy and Climate Action Plan (NECP), was approved in 2024. It establishes measures for the most vulnerable sectors, focuses on risk management and preparation for future challenges (EEA, n.d.). The detected implicit reference is as follows:

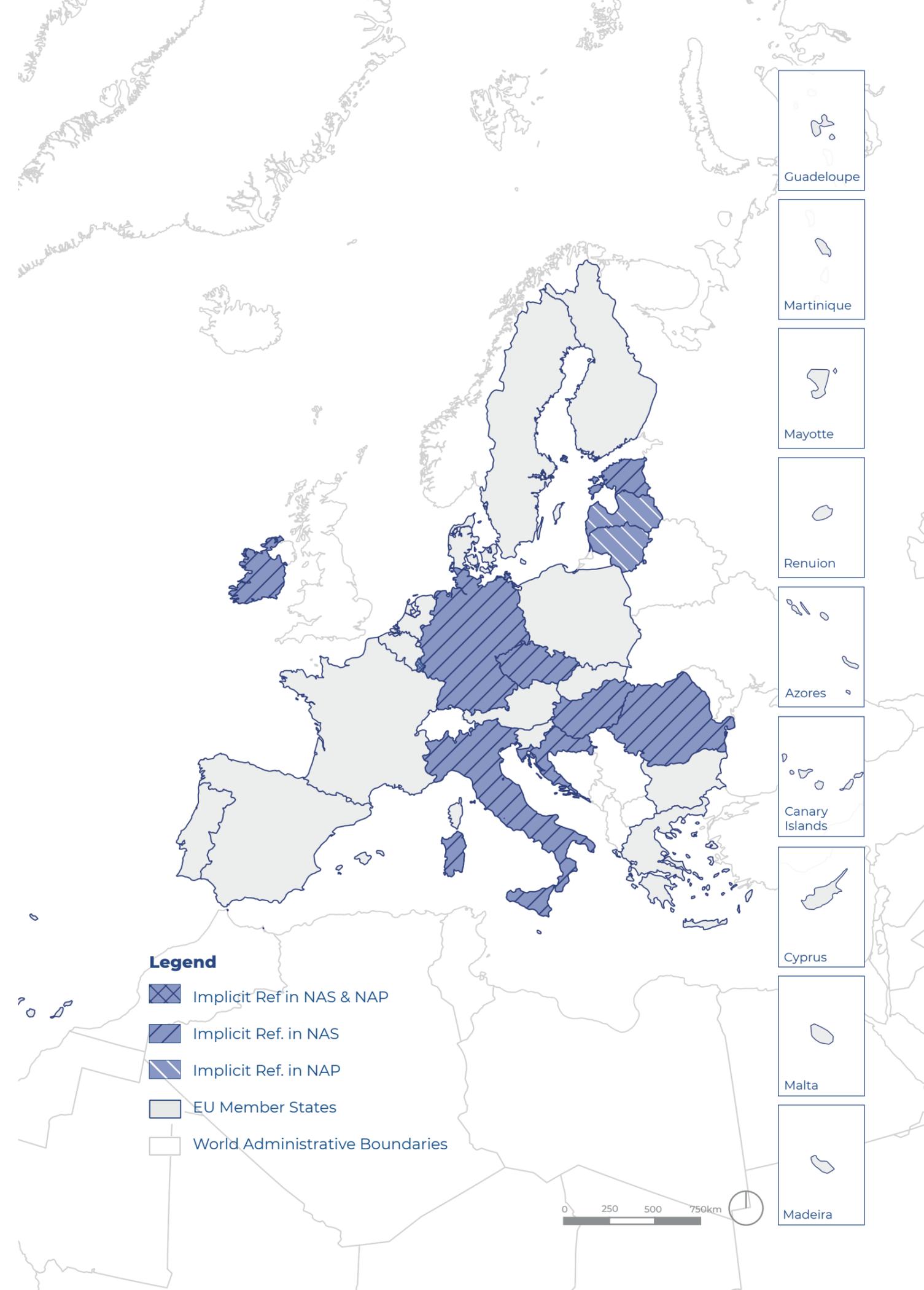
“PR31-P: Introduction of public cooling centres ensuring 24 hours a day, 7 days a week” (Ministry of Energy of the Republic of Lithuania, 2024, Chapter 6: Implementation, Table 3).

From the reference, it could be understood that there is a provision of accessible public spaces that can provide cooling, and it is similar enough to a climate shelter that it could

be interpreted as an indirect reference.

To conclude this section, it could be said that the concept of climate shelter is widely referenced without using direct terminology in the national adaptation documents of Member States. They are usually located in the context as an effective adaptation measure, target or indicator. Moreover, the qualities associated with the concept of climate shelter can also be found in these references, such as the use of nature-based solutions, the importance of public accessibility, measures related to heat mitigation and community well-being. Among all, the cooling function emerges as the most popular, which also supports the relevance of this concept as a local experimentation to tackle the highly felt heat effect of climate change. The results are further illustrated spatially (see Fig. 25).

Figure 25 | Cluster 2
Implicit References
to Climate Shelters in
NAPs and NASs (Source:
Author's elaboration)



4.3 Cluster 3 | No Reference to Climate Shelters

Cluster 3 comprises EU Member States whose national adaptation frameworks don't include any reference to climate shelters. Accordingly, no direct terminology or equivalent conceptual coverage has been observed in their NASs or NAPs during the screening process. Among the three clusters, this cluster represents the largest group, with a total of 12 Member States. These Member States are Portugal, Belgium, the Netherlands, Denmark, Sweden, Finland, Poland, Slovenia, Malta, Greece, Bulgaria, and Slovakia (see Fig. 26 and Fig. 27).

Overall, it is noteworthy that this absence of any reference does not imply that these documents fail to address heat-related risks or adaptation measures; rather, such risks are typically addressed through other concepts and measures. Given the relative novelty of the climate shelter concept, it is also possible that earlier policy documents do not refer to climate shelters as a response to heat-related climate exposure.

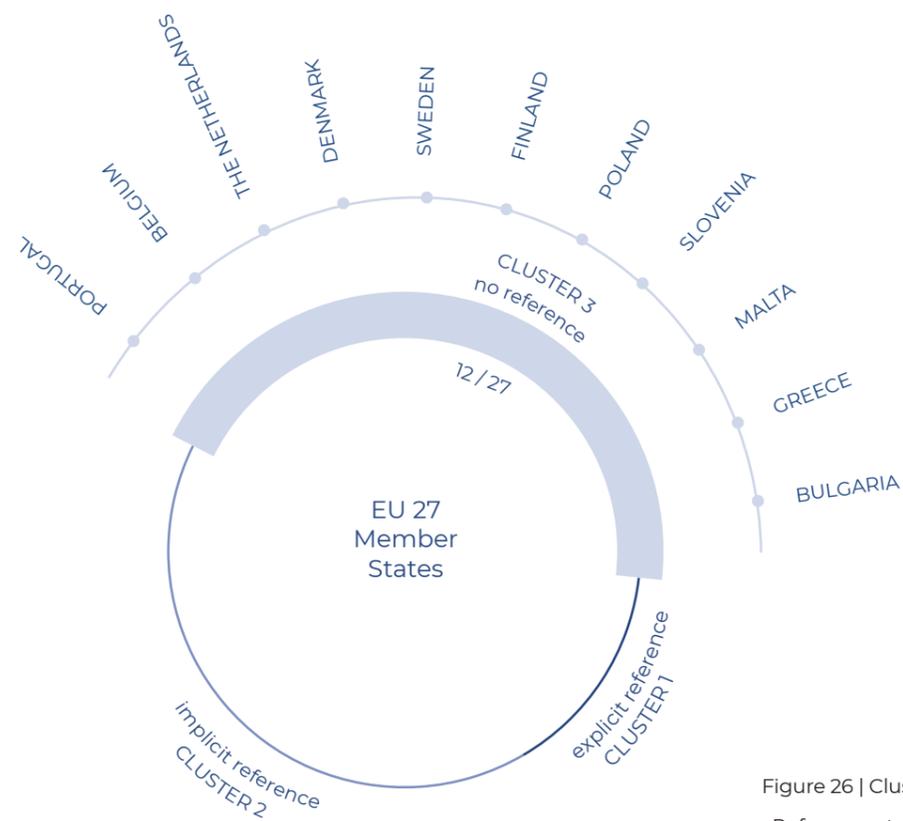
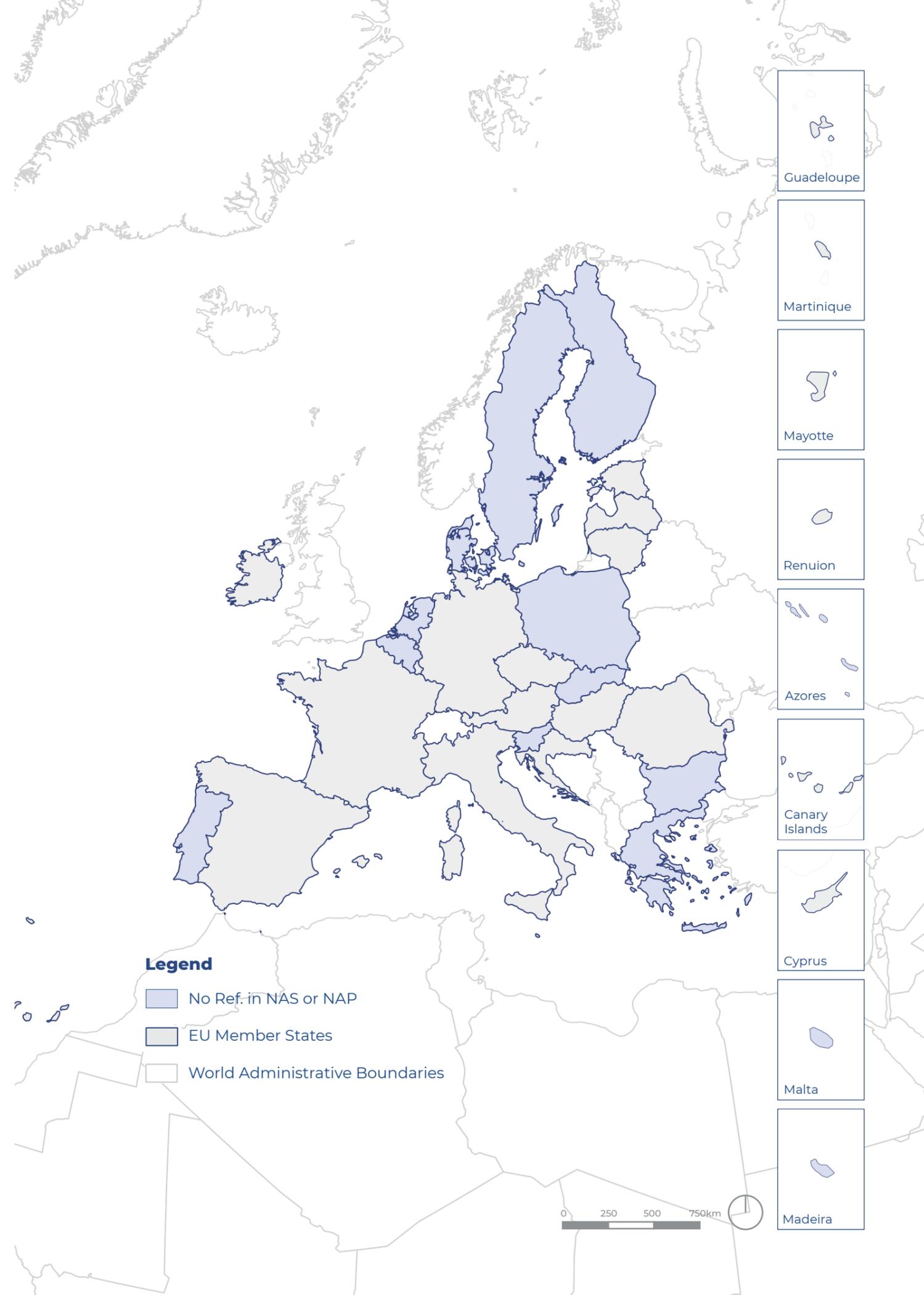


Figure 26 | Cluster 3 No References to Climate Shelter (Source: Author's elaboration)

Figure 27 | Cluster 3 No Reference to Climate Shelters (Source: Author's elaboration)



Legend

- No Ref. in NAS or NAP
- EU Member States
- World Administrative Boundaries

CHAPTER 5

CHAPTER 5 | Analysis of the Local Level

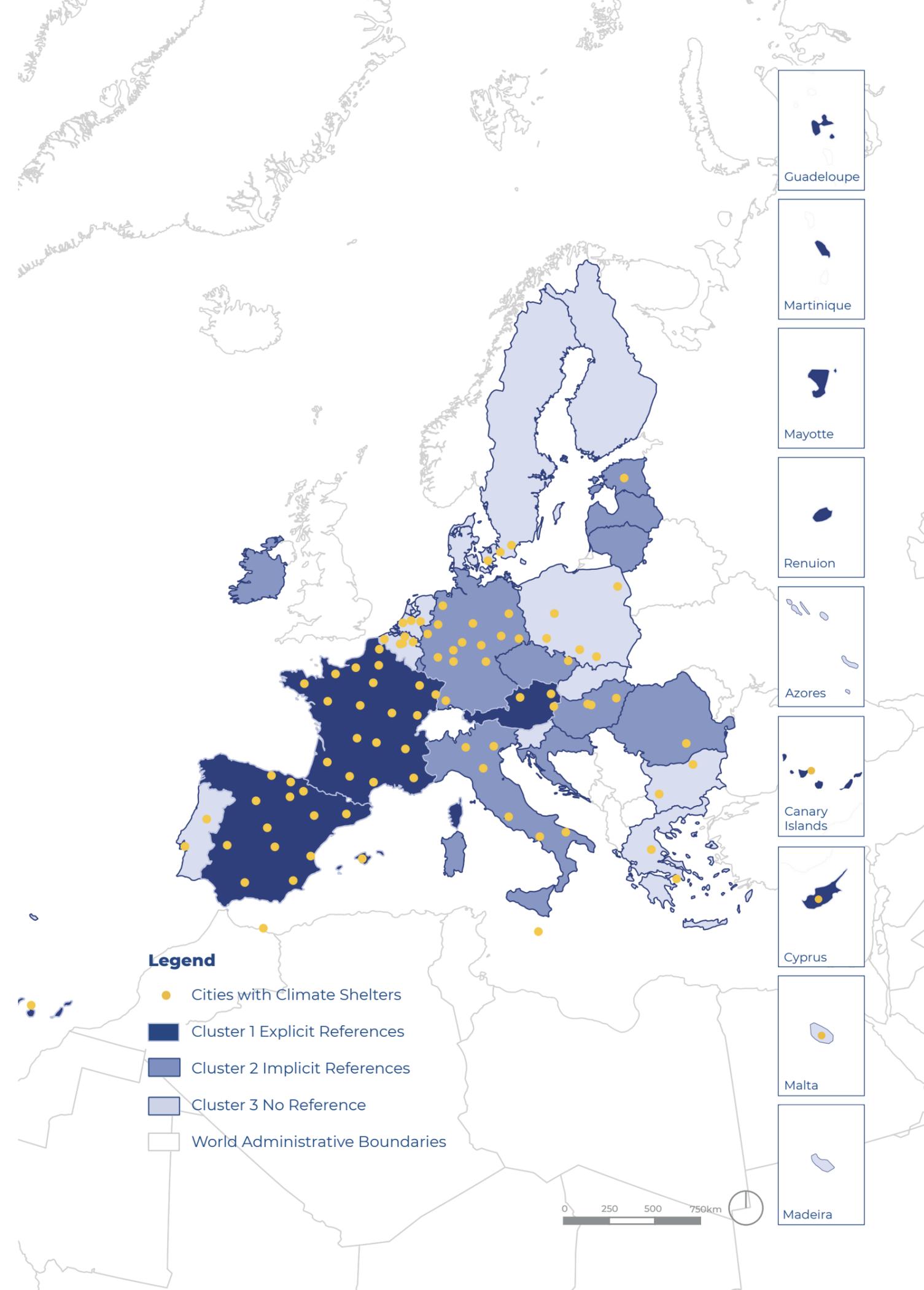
In this chapter, the results of the Phase 2, local-level analysis are presented. As outlined, Phase 2 starts by overlaying the map of clusters with the map of the MAINCODE case study analysis (see Fig. 28).

The spatial overlay illustrated in Figure 28 reveals that the national-level cluster classification and the local-level presence of climate shelters showcase some variation. First of all, no strong correlation is observed between the two levels. While some Member States assigned to Cluster 1 do not showcase climate shelters at the local level, other Member States in Cluster 3 yet have climate shelters at the local level. Cyprus can be an example of this, which refers to climate shelters in both its NAS and NAP using two different direct terms, yet it does not have any climate shelters at the local level. In contrast, Poland, which has a few climate shelters at the local level, does not refer to the concept at the national level. Moreover, while some Member States assigned to Cluster 2 displayed climate shelters at the local level, others did not. Overall, the most striking findings are from Spain and France, belonging to Cluster 1. These Member States also showcase the highest presence of climate shelters among all and display an outstandingly strong relationship between the two levels.

In the following step, three representative Member States from each cluster that demonstrate climate shelter initiatives are selected. The selected Member States for each cluster are as follows:

- France (Cluster 1 Explicit Reference)
- Germany (Cluster 2 Implicit Reference)
- The Netherlands (Cluster 3 No Reference)

Figure 28 | MAINCODE Case Studies with Clusters
(Source: Caldarice et al. 2025a, Author's elaboration)



Following this identification, the cities that showcase climate shelters in these Member States are analysed by their size and the type of urban space in which the climate shelters are implemented. Based on these factors, the three cities selected are as follows (see Fig. 29):

- Lille (France)
- Erfurt (Germany)
- The Hague (The Netherlands)

All three cities are medium-sized cities with populations of approximately 200,000 to 550,000, with the presence of climate shelters all implemented in schoolyards. This ensures consistency across the research and supports a coherency for interpreting the findings. The selection of the cities and the case study analysis are further explained in the following sections.

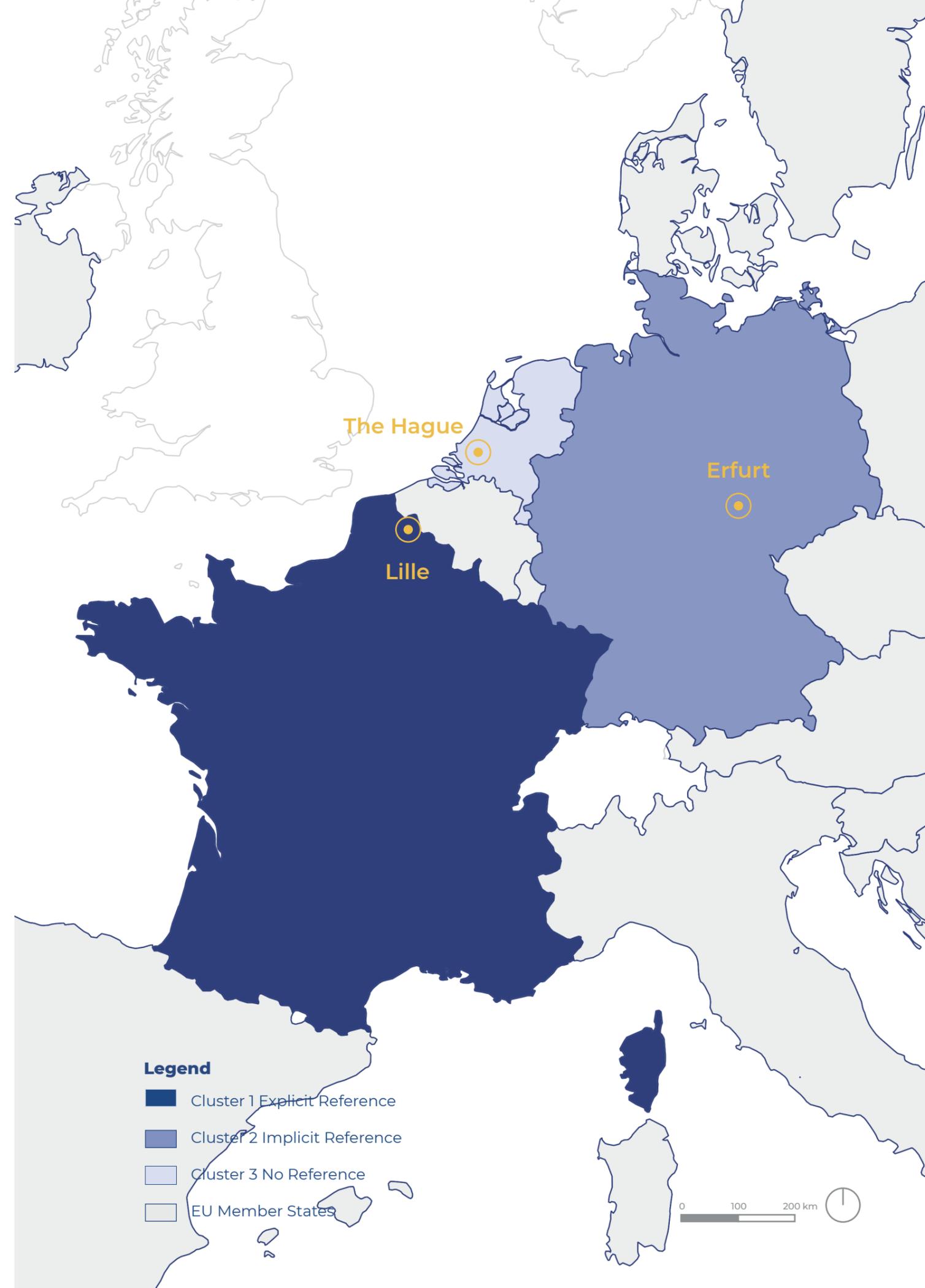


Figure 29 | Selected Member States and Case Study Cities (Source: Author's elaboration)

5.1 Lille - France | Cluster 1

France is selected as the representative of Cluster 1. It demonstrates 19 climate shelter case studies in its cities within the MAINCODE analysis. These cities are broadly distributed across the country, so it is possible to find a case study in almost every NUT2 level regions. The cities are characterised as both metropolitan areas and mid-sized cities. The names of the cities with climate shelters are as follows:

NUTS 2 Level Region	City Name	Type of Urban Space
Île-de-France	Paris	Schoolyard
Centre-Val de Loire	Orléans	Schoolyard
Bourgogne	Dijon	Schoolyard
Franche-Comté	Besançon	Schoolyard
Basse-Normandie	Caen	Schoolyard
Haute-Normandie	Rouen	Schoolyard
Picardie	Amiens	Schoolyard
Nord-Pas-de-Calais	Lille	Schoolyard
Alsace	Strasbourg	Schoolyard
Lorraine	Metz	Schoolyard
Pays de la Loire	Nantes	Schoolyard
Bretagne	Rennes	Schoolyard
Aquitaine	Bordeaux	Schoolyard
Limousin	Limoges	Schoolyard
Languedoc-Roussillon	Montpellier	Schoolyard
Midi-Pyrénées	Toulouse	Schoolyard
Auvergne	Clermont-Ferrand	Schoolyard
Rhône-Alpes	Lyon	Schoolyard
Provence-Alpes-Côte d'Azur	Marseille	Schoolyard

Table 2 | Case Studies in France (Source: Caldarice et al, 2025a)

According to the MAINCODE case study analysis, all the identified case studies in France have one thing in common: They are located in schoolyards to tackle the heat-related climate hazards. This pattern aligns with the references identified in the NAP of France, where such projects are presented as examples of climate shelter interventions. It is important to highlight that these case studies are selected as they display a transformation in the urban fabric, in this case, schoolyards. However, existing urban green areas are also accepted as climate shelters without any transformation in other case studies in France, which were purposefully outlined in the MAINCODE analysis.

For local-level analysis, Lille is selected due to being a medium-sized city with the presence of climate shelters located in schoolyards.

a. General Profile

The city of Lille is in northern France. It is the capital of the Hauts-de-France region. According to INSEE (n.d.), the population of the city of Lille was 238,695 in 2022. The area of the city is 34.8 km², resulting in 6,853 inhabitants per square kilometre, approximately (INSEE, nd).

The climate profile is typical of northern France. It is characterised by mild summers and cool winters, and even precipitation all year. The average annual temperature is around 10 °C (Weatherspark, n.d.). The summers are not reaching above 29°C, while winters are often between 4°C and 7°C. The rainfall varies throughout the year. October is the month with the most rain, with 51mm, while April is the month with the least rain, with 33mm.

The city is prone to increasing challenges of climate change and vulnerabilities. The temperature of the region has risen about 2 °C between 1955 and 2017, and this number is expected to further rise in the future (Bonneau, n.d.). This issue contributes to the increase in the frequency of heat events, particularly in city centres with densely built areas and low green spaces. The combination of dense urban fabric with a high proportion of impervious surface results in the occurrence of UHI in the city.

b. Local Climate Plan

Since 2010, France has obliged municipalities to adopt LCP, which is titled Local Climate-Air-Energy Plan (Plan Climat Air Énergie Territorial, PCAET) (Reckien et al., 2018). PCAET must address both climate change mitigation and adaptation. However, in practice, they tend to prioritise mitigation, in particular the links between energy policy, air quality, and greenhouse gas emissions. In the beginning, the municipalities with a population of more than 50.0000 were obliged to adopt LCPs, but this rule was extended to cover the small municipalities too with more than 20.000.

As part of the Métropole Européenne de Lille (MEL), the city of Lille adopted the Plan Climat Air Énergie Territorial (PCAET 2021-2026) in 2021 to accomplish the national requirement (Métropole Européenne de Lille, n.d.). The PCAET of Lille Metropole has ambitious climate goals, such as reducing emissions by 45 % till 2030 and pursuing carbon neutrality by 2050, which are similar to European Green Deal objectives.

The city of Lille also implements the PCAET through the initiative of the municipality by integrating adaptation measures, sustainable urban planning, energy transition projects, and resilience strategies that consider heat stress and water management (Métropole Européenne de Lille, n.d.). The approach reflects the multi-level governance of climate policy in France, where local authorities translate national policies into actions with a consideration of local contexts and vulnerabilities.

The City of Lille is a signatory to the Global Covenant of Mayors for Climate & Energy (GCoM), which is a voluntary global alliance of cities and local governments sharing a long-term vision and working towards climate resilient and low-emission future. Therefore, it showcases its commitment to tackling the challenges of climate change through involvement in transnational city networks and partnering with other local actors.

c. Reference to Climate Shelters in Local Climate Plan

The screening of PCAET showcases a direct reference to climate shelter through the use of the term îlots de fraîcheur. In PCAET, îlots de fraîcheur is described as cooling centres with the elements of greenery, water and nature-based solutions. It aims for thermal comfort in summer by reducing the UHI. The reference identified is as follows:

“Developing urban greening and nature in cities and preserving biodiversity is essential, as cities are warming more rapidly than the rest of the territory. Expanding nature and water in urban environments, whether in cities or village centres, represents a comprehensive response to ensure summer thermal comfort for residents, reduce the urban heat island effect, and create cooling islands (îlots de fraîcheur). These measures also provide numerous additional benefits for residents’ quality of life and territorial attractiveness, biodiversity, and recreational opportunities” (Métropole Européenne de Lille, 2021, p. 40, author’s translation).

The identified reference in PCAET is accepted as an explicit reference to climate shelter. It also aligns with the NAP since both of them use the same term, îlots de fraîcheur, to refer to the concept.

d. Climate Shelters as Local Adaptation Experiment

The results of the MAINCODE case study analysis revealed a climate shelter project called Végétalisation des Cours d’écoles. A climate adaptation project that aims to reduce heat stress by de-impermeabilization and greening of the public schoolyards of Lille, initiated as a response to the heatwaves that occurred in 2018. The project identified the most affected areas of the city centre from the phenomenon of UHI and prioritised the schoolyards for transformation due to their limited vegetation and high asphalt proportions (Ville de Lille, n.d.).

The project is planned in two phases. Firstly, greening one-third of schoolyard areas and secondly, de-paving them. The first phase is carried out between the years 2018 and 2021, focusing on the vegetation coverage of the schoolyards. As a result, all 79 public schoolyards of Lille currently include at least one-third green space (Ville de Lille, n.d.). The

second phase has been ongoing since 2021, and ten schoolyards have already been fully de-paved since 2023.

After the transformations, the schoolyard are frames as îlots de fraîcheur (cooling islands), and functions as climate shelters in the city. The interventions included are tree planting, shrubs and perennial vegetation, educational and community gardens, green play areas, and elements for biodiversity such as insect hotels, bird nesting boxes, and bat shelters. The stormwater management is also considered by using pervious materials. Overall, they aim to improve the quality of life of students and the residents by offering accessible and safe cooling spots in the city centre.

The project also has a strong participatory dimension in which the school community is fully involved in the transformation process of the schoolyards with regular meetings and design workshops. Education is also another important factor in the project, with educational activities for pupils focusing on climate awareness.

There are additional measures that promote sustainability in the transformed schoolyards. Many schools in Lille participate in the E3D (Établissement en Démarche de Développement Durable) label. It is earned for developing action plans that address the energy usage, air quality, waste management, sustainable mobility and biodiversity (Plus Fraîche Ma Ville, 2025). Another important measure is the promotion of active mobility by implementing infrastructures for bikes and scooters in the schoolyards and restrictions on car traffic during school hours to create safe streets for pupils.

Since 2022, as part of its local adaptation strategies, MEL provide map of Lieux de fraîcheur covering cool spots in the 95 municipalities as part of the PCAET 2021-2026 (Métropole Européenne de Lille, 2021). This map was upgraded and improved in 2025, including the locations of Time2Adapt experiments. A winning project of EUI, which aims to enhance access to, awareness of, and engagement with cool public spaces, particularly among vulnerable residents.

In the map, green spaces such as parks, forests and natural reserves, and water-related spaces, such as rivers, canals, and fountains, are highlighted as cooling spots. Moreover, public buildings such as libraries and museums are exhibited as cooling spots too (see Fig. 30). Unfortunately, the link to the map was not accessible at the time of the study in December 2025.

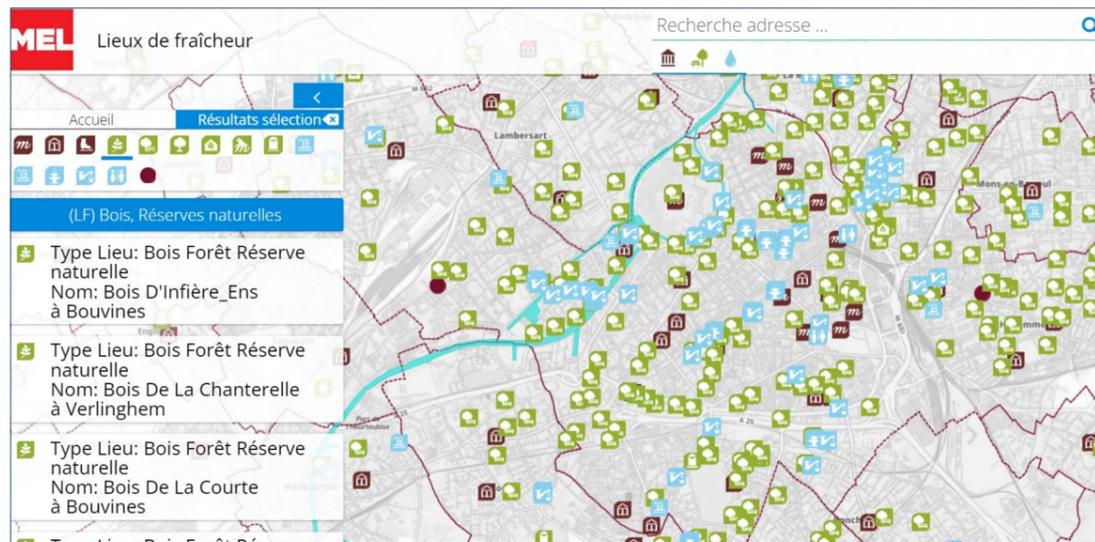


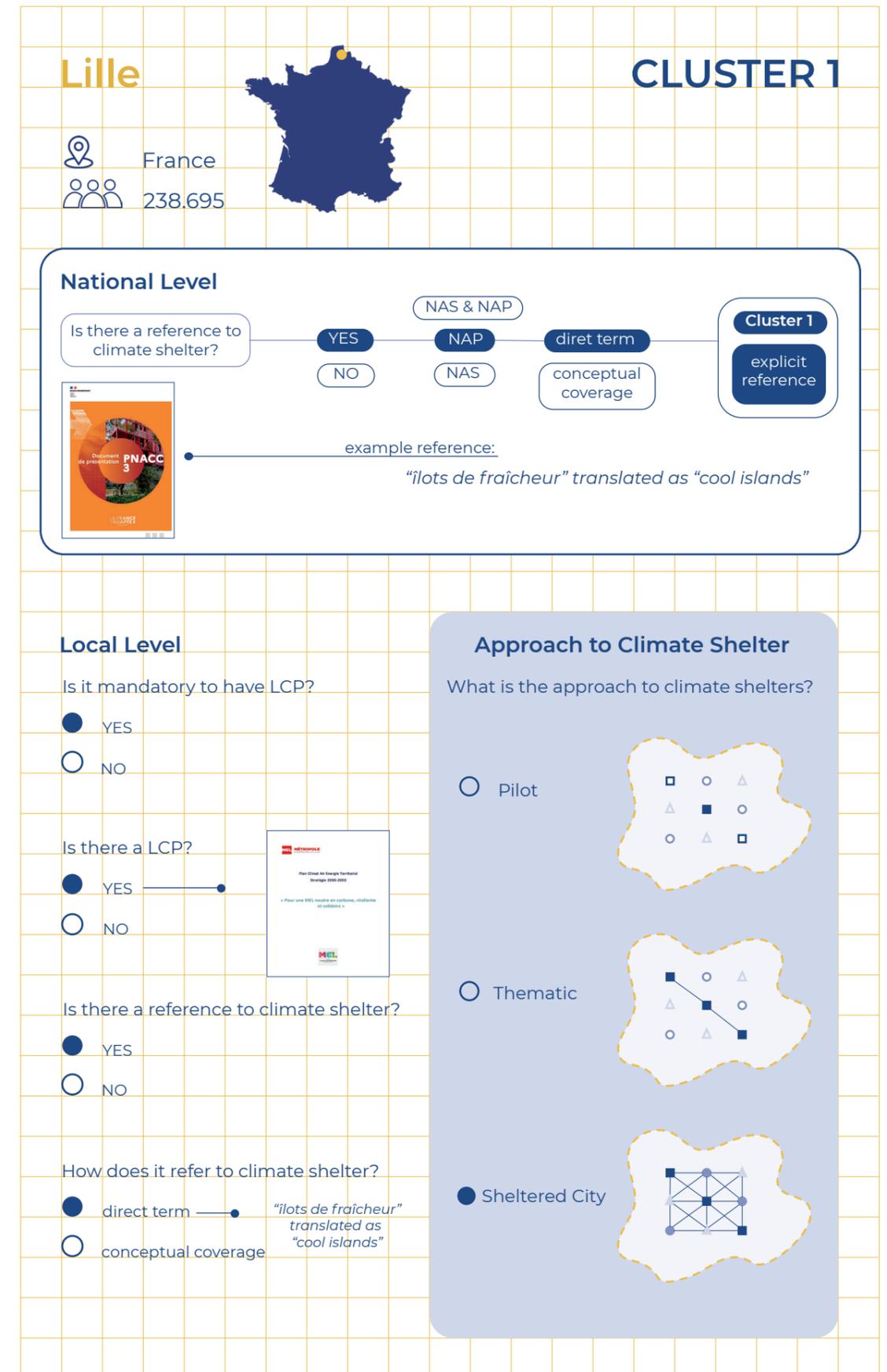
Figure 30 | Liex de fraicheur, Map of Climate Shelters in the City of Lille (Source: Lourenco, 2023)

e. Approach to Climate Shelters

The city of Lille exhibits strong local experimentation by transforming all its schoolyards into climate shelters as well as expanding the concept into other types of urban spaces. The concept is also identified in its LCP, showcasing that climate shelter is recognised as a city-wide strategy embedded within the city's climate policies. There is also a clear alignment between the local level and national level adaptation policies by the consistent use of the same terminology to refer to the concept. The presence of multiple climate shelters distributed across the city in various types of urban spaces reveals that Lille adopts the approach of the Sheltered city, rather than a thematic or pilot approach.

The summary of the case study analysis of Lille is presented in the city sheet, as illustrated in Figure 31.

Figure 31 | Case study sheet of Lille - France | Cluster 1 (Source: Author's elaboration)



5.2 Erfurt - Germany | Cluster 2

Germany is assigned to Cluster 2 due to the several references identified in the NAS, which indirectly referred to climate shelters. Findings from the MAINCODE case study analysis revealed 14 cities with climate shelters. These cities are as follows:

NUTS 2 Level Region	City Name	Type of Urban Space
Freiburg	Freiburg im Breisgau	Public Outdoor
Oberfranken	Bayreuth	Public Outdoor and Bus Stop
Berlin	Berlin	Schoolyard
Darmstadt	Darmstadt	Bus stop
Gießen	Giessen	Schoolyard
Kassel	Kassel	Public Outdoor and Public Indoor
Braunschweig	Braunschweig	Public Outdoor and Public Indoor
Weser-Ems	Oldenburg	Public Outdoor
Düsseldorf	Düsseldorf	Schoolyard
Münster	Münster	Bus stop
Koblenz	Koblenz	Schoolyard
Dresden	Dresden	Schoolyard
Leipzig	Leipzig	Public Outdoor
Thüringen	Erfurt	Schoolyard

Table 3 | Case Studies in Germany (Source: Caldarice et al., 2025a)

The identified cities with climate shelters represent less than half of the representative cities at the NUTS-2 regional level, where the total number of cities is 38. According to the MAINCODE case study analysis, these climate shelters are located across a range of urban spaces. They are located in schoolyards, public indoor spaces, public outdoors and bus stops. For conducting the local-level analysis, Erfurt is selected due to its characteristics as a medium-sized city and the presence of climate shelters in schoolyards.

a. The General Profile of Erfurt

Erfurt is the capital of the federal state of Thuringia in central Germany. As a district-free city, it has its own independent administrative authority. The city is one of the largest municipalities in the region, with an area of 270 km² (Thüringer Landesamt für Statistik, n.d.). The population was 215.000 in 2024, resulting in 811 inhabitants per km². Demographically, Erfurt is characterised by an ageing population due to the increase in the percentage of people over 65 years old. It is characterised by mild seasonal variations. The summer

temperatures range between 22 and 25 °C, while winter temperatures are around 0–3 °C (Deutscher Wetterdienst, n.d.). The mean annual temperature is 9–10 °C, and the annual total precipitation is approximately 650–700 mm, with even rainfall throughout the year.

The current projections reveal that by 2050, the average temperature in Erfurt is expected to rise by 2.6 °C (Thüringer Landesamt für Umwelt, Bergbau und Naturschutz, 2025). This results in the hottest years of today becoming average in the future. Moreover, an increase in the number of hot days and a decrease in the extended cold periods are further anticipated. Precipitation is expected to have a change with an increase in the winter and a decrease in the summer. This will result in longer, drier periods being interrupted by strong, heavy rains.

Altogether, the city is expected to face heat and water stress in the future. Notably, the risks are expected to amplify due to the increase in the ageing population, who are more vulnerable to climate events

b. Local Climate Plan

The research by the author reveals that at the time of the study, Erfurt did not have a standalone local LCP. Therefore, no further research is conducted in this section.

c. Reference to Climate Shelters in Local Climate Plan

Since there is no standalone LCP, the subsequent analysis on the presence of climate shelter references could not be performed either.

d. Climate Shelters as Local Adaptation Experiment

The identified case study in MAINCODE analysis is called Zehn grüne Schulhöfe für Thüringen 3.0. It is an initiative that focuses on the ecological redesign of the schoolyards by greening and nature-based solutions. The project started in 2022 with the transformation of ten schoolyards to make them greener and more climate resilient (Deutsche Umwelthilfe e.V., 2022). It emphasises the importance of schoolyards as a critical space in the urban fabric for climate adaptation and mitigation efforts and can be example models for the climate-friendly redesign of other public spaces.

A strong participatory dimension is observed within the project. School community and other stakeholders are actively involved in the planning, design and implementation processes. This allows for strong ownership of the space for easier maintenance and longer use, while strengthening the educational value for pupils too (Deutsche Umwelthilfe e.V., 2022).

To conclude, aside from this initiative, no further climate shelter projects were identified during the time of the analysis. This finding suggests that climate shelter implementation in Erfurt remains limited only in schoolyards and is not yet recognised as a city-wide network and adaptation strategy.

e. Approach to Climate Shelters

Overall, Erfurt demonstrates a limited and fragmented approach to climate shelter implementation. The city does not have an LCP, so there is no reference to climate shelters in the local-level climate policies. The concept is also not recognised as a city-wide strategy with other interventions of climate shelters in various types of urban spaces, rather than schoolyards. Therefore, there isn't a network of climate shelters showcased with mapping tools in the city. Consequently, Erfurt has a Thematic approach, where climate shelters are present in a single urban type of space.

A summary of the Erfurt case study analysis is presented in the city sheet, as illustrated in Figure 32.

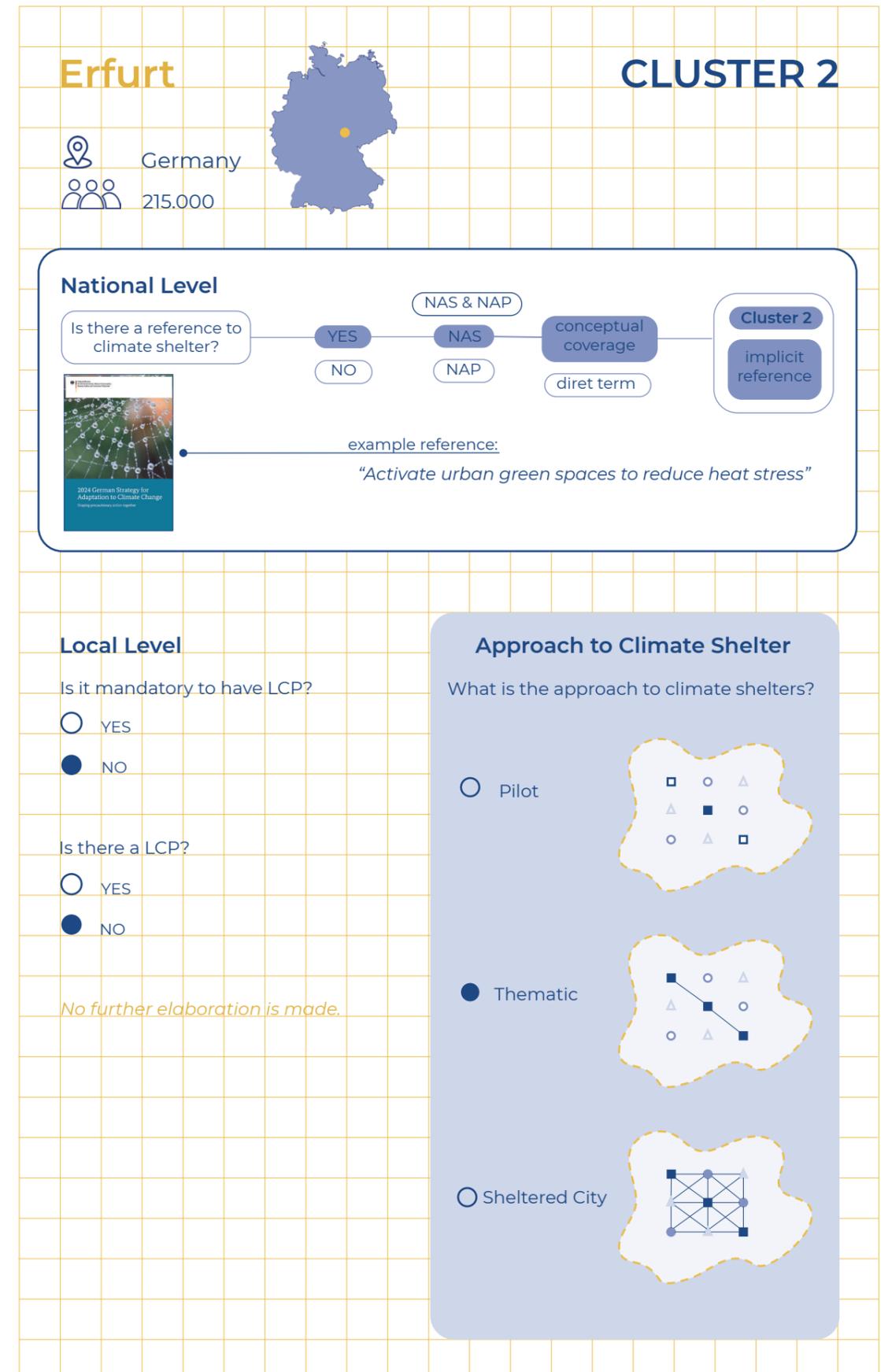


Figure 32 | Case study sheet of Erfurt - Germany | Cluster 2 (Source: Author's elaboration)

5.3 The Hague - The Netherlands | Cluster 3

The Netherlands is among the Member States in Cluster 3 due to the lack of any reference in NAS or NAP. The case study analysis of MAINCODE discloses only three cities with climate shelters. The identified cities are as follows:

NUTS 2 Level Region	City Name	Type of Urban Space
Gelderland	Arnhem	Public Outdoor
Utrecht	Utrecht	Bus stop
South Holland	The Hague	Schoolyard

Table 4 | Case Studies in the Netherlands (Source: Caldarice et al., 2025a)

According to the findings of the MAINCODE project, the climate shelters in the case studies are located in various urban spaces, such as bus stops, schoolyards and public outdoors. There are 12 NUTS2-level regions in the Netherlands, so only three identified cities represent a relatively small number. However, this could be explained by the methodological scope of the study, which focused exclusively on the capital cities of NUTS 2 regions.

As previously mentioned, The Hague is selected as a mid-sized city with climate shelters in schoolyards for further analysis.

a. The General Profile

The Hague is the third most crowded city in the Netherlands, with 569,387 residents in 2025 (Den Haag in Cijfers, n.d.). It has an area of 82,440 km², and approximately 6,900 people per square kilometre, it is the most densely populated city in the Netherlands (Gemeente Den Haag, 2025).

The city has a typical Dutch coastal region climate with a temperate oceanic climate. It is characterised by mild winters and cool to moderate warm summers due to its location (Climate-Data.org, n.d.). The average temperature annually is about 10.9 °C, summer highs are around 17–18 °C in the warmest months and the winter lows are near 4 °C in the coldest months. The amount of rainfall is significant in the city throughout the year, and it is distributed evenly across seasons, resulting in a humid, moderate climate.

The Hague faces air pollution due to the air pollutant concentration exceeding the European regulatory standards (RIVM, n.d.; Van Oorschot et al., 2021). The city also experiences IHA as a result of limited vegetation and surface water, high building density and impervious surfaces, and low solar reflectance (Van Oorschot et al., 2021 cited from van der Hoeven & Wandl, 2018).

Due to its geographic location, The Hague experiences higher levels of precipitation in comparison to other European cities (Covenant of Mayors, 2023). The current projections

reveal that the extreme precipitation events may increase by 25% to 108% in the future, causing floods with disruptions and damages (Van Oorschot et al., 2021 cited from Lenderink et al., 2011). Moreover, more extreme temperatures and longer, drier summer periods are expected to create an imbalance in water demand and supply (Covenant of Mayors, 2023).

b. Local Climate Plan

In the Netherlands, there is no obligation to develop LCPs by law at the local level. However, The Hague adopted multiple policy documents that are accepted as LCP.

Firstly, The Hague submitted its Climate City Contact (CCC) to the European Union and by October 2024, it has become one of the “100 Climate-Neutral and Smart Cities by 2030” or “NetZeroCities” (The Hague Partners, nd). By participating in NetZeroCities, The Hague benefits from international cooperation and exchange for its efforts to become climate neutral by 2030 as a city, as well as supporting Europe’s goal to become climate neutral by 2050 (City of The Hague, 2024). Moreover, it enables The Hague to benefit from the Climate City Capital Hun, which is an international financial resource designed to support cities for developing climate-related projects (The Hague Partners, n.d.).

The Climate City Contract of the Hague consists of three sections: Commitments, Climate Action Plan and Climate Investment Plan. The CCC is expected to be updated every two years until 2030 (City of The Hague, 2024).

Another important document is The Hague Climate Agreement (Haags Klimaatakkoord, HKA). It is a deal focusing on cooperation between professional organisations such as the regional transport company, housing associations, the water company, colleges, and universities, and active resident initiatives, such as car-sharing and energy cooperatives (City of The Hague, 2024).

Both documents’ main goal is to make the city climate neutral by 2030. While HKA mainly focuses on collaboration and cooperation between local stakeholders and local actions, the CCC focuses on exchanging knowledge and cooperation with partner cities of NetZeroCities, other Dutch governments, European cities and the EU. Both HKA and CCC complement and strengthen each other (City of The Hague, 2024).

Hague is also a signatory to the GCoM, demonstrating its commitment to sustainable futures. By joining this transnational city network, The Hague engages in cooperation, knowledge exchange, and collective initiatives to advance climate mitigation and adaptation with other local actors.

c. Reference to Climate Shelters in Local Climate Plan

The keyword screening process is applied to both documents of the Hague, CCC and HKA. Starting with CCC, the identified references are as follows:

“Opportunity Alliances: Bottom-up initiatives. The City of The Hague prides itself for its extensive array of initiatives and networks on sustainability, climate, and greening. These range from energy cooperatives and greening projects to youth groups on climate. Through events such as Stadmakersfestival, Smart@Sea or activities organised by Duurzaam Den Haag (all elaborated on in chapter 8)” (City of The Hague, 2024, p. 55)

In the highlighted reference, the mentioned “greening projects to youth groups” organised by Duurzaam Den Haag is accepted as an indirect reference to climate shelter. The organisation is an initiative assisting the residents to make their homes and surroundings more sustainable, and one of its focus areas includes providing step-by-step guidance for implementing climate shelters in schoolyards (Duurzaam Den Haag, n.d.) (see Fig. 33). Notably, this reference is interpreted as an indirect reference.



Figure 33 | Duurzaam Den Haag. Green Schoolyard. (Source: Duurzaam Den Haag, 2025)

The identified reference in HKA is as follows:

“And by investigating how the livability and sustainability in courtyard gardens can be increased, for example by creating green spaces for meeting, food-sharing areas, and creating space for water storage and mitigating heat stress” (Gemeente Den Haag, 2025, p. 32)

The reference is identified in the context of a climate adaptation project focusing on the greening of courtyards titled Healthy, livable, and sustainable inner courtyards (Gezonde, leefbare en duurzame binnentuinen). Therefore, it is accepted as an indirect reference since it lacks direct terminology but offers the same measures as climate shelters, such as cooling and water storage.

d. Climate Shelters as Local Adaptation Experiment

The identified climate shelters in The Hague are part of the wider initiative called The Green-Blue Schoolyards. It is a long-running program in the Netherlands that supports the transformation of grey and paved schoolyards into climate shelters to create climate adaptive outdoors for pupils and the neighbourhood since 2019. 46 schools of The Hague were transformed into green schoolyards and green-blue schoolyards as part of the initiative, while the program covers more than 250 schoolyards in South Holland (Groenblauwe Schoolpleinen, n.d.).

The main objective of the initiative is to improve the outdoor environment for children that enhances playing and learning opportunities, as well as contributing to climate adaptation. The program does not directly frame the transformed schoolyards as climate shelters but describes them as cool, shaded spaces where the rainwater can infiltrate effectively, reducing the heat and water stress during extreme climate events. Furthermore, they are positioned as key features of climate adaptation in the city (Groenblauwe Schoolpleinen, n.d.).

The implemented nature-based solutions in the existing climate shelters vary from shading green pergolas and green-blue roofs to biodiversity-friendly planting schemes, rainwater infiltration measures, and sunken areas for water storage. The design interventions include the removal of paving, the use of sustainable materials and the integration of water elements, play features and vegetable gardens (Groenblauwe Schoolpleinen, n.d.).

Participatory processes are encouraged and guided in the process, such as school communities are supported to initiate the process, build their team, manage and transform with the help of professional coaches. Brainstorming and step-by-step planning are emphasised throughout the processes (Groenblauwe Schoolpleinen, n.d.).

Extensive supporting materials for climate shelters include financial guidance and funding options, educational lesson packages for pupils and teachers, a guide catalogue of adaptive measures of the implemented projects, visuals and ratings of cost, difficulty and maintenance of each (Groenblauwe Schoolpleinen, n.d.).

Overall, the project reveals the city of Hague and the South Holland region’s wide long-term strategy for implementing climate shelters that is replicable and scalable.

In addition to the greening schoolyards project, there are other adaptation measures projects in the Hague. These examples are the Urban Water Buffer in Cromvliet Park, which

stores rainwater and provides cooling (Covenant of Mayors, 2023); citywide greening strategies with expanded street trees and green corridors; green roof installations on municipal and commercial buildings; and greening of streets and squares to improve shade and reduce heat. Furthermore, the project Healthy, liveable, and sustainable inner courtyards identified in HKA is another adaptation project contributing to cooling and water storage of the city. Nonetheless, none of these projects is designated explicitly as climate shelters, but they have the same measures and objectives.

e. Approach to Climate Shelters

The case study of The Hague showcased a different path from other selected case studies, showcasing no reference in the national adaptation policies while displaying indirect references to climate shelter at the LCPs and strong local experimentation.

Although none of the projects are designated as climate shelters, similar measures are implemented within different types of urban spaces. Moreover, the concept is also integrated into local planning frameworks. Consequently, The Hague showcases a Sheltered city approach where the concept is used as a city-wide adaptation strategy and implemented in various types of urban spaces to create a climate shelter network.

The results of the case study of The Hague are summarised as a city sheet in Figure 34.

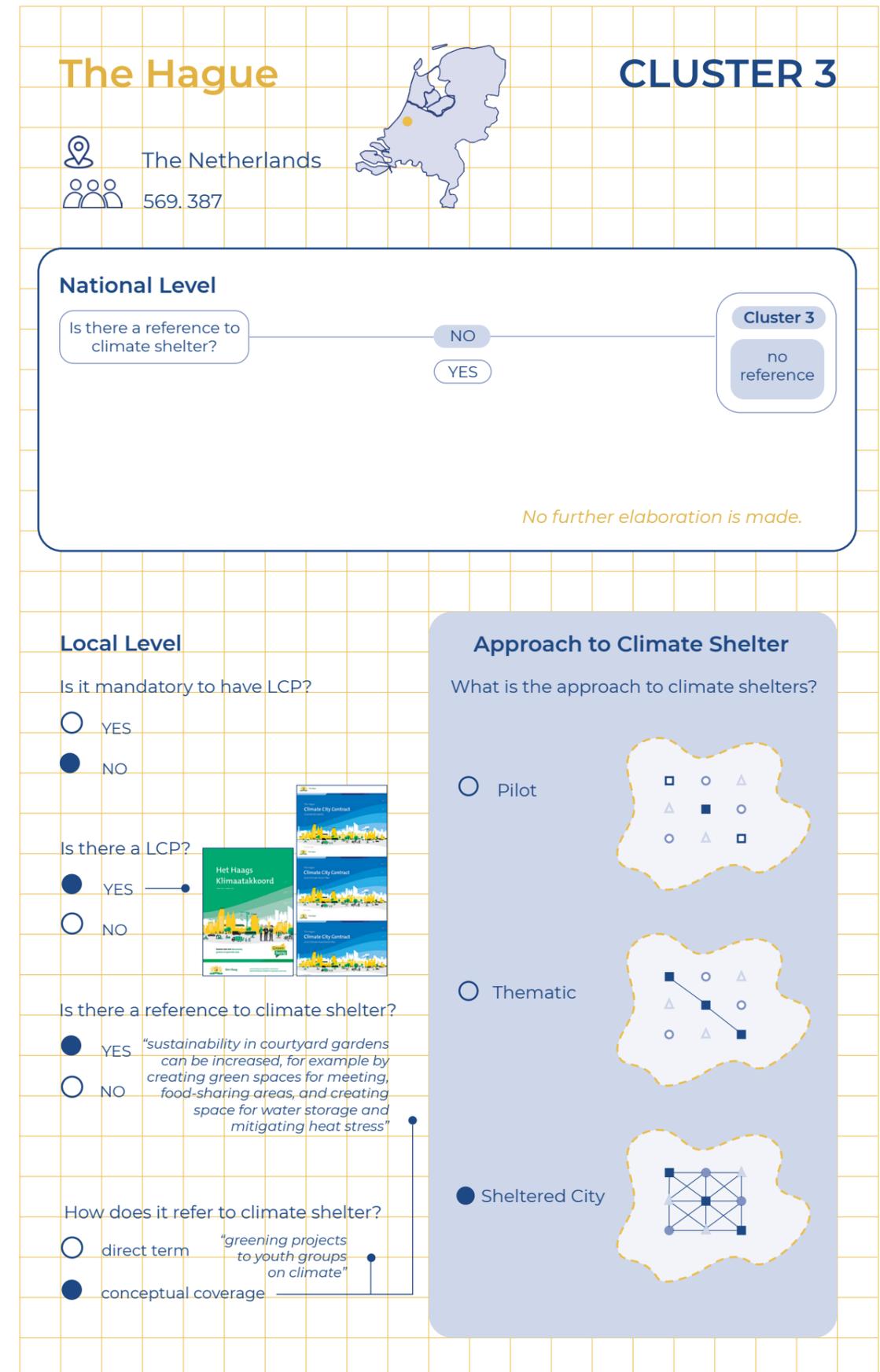


Figure 34 | Case study sheet of The Hague - The Netherlands | Cluster 3 (Source: Author's elaboration)

CHAPTER 6

• **Temporal trends in explicit and implicit references**

Another key finding is the temporal variation in the NASs and NAPs, which exhibits references to the concept. The temporal pattern showcases that only recently adopted NAS and NAPs are more likely to refer to the concept explicitly, particularly those after 2024 (see Fig. 36). Member States such as France, Cyprus and Austria display direct terms for climate shelters in their recently adopted NAS and NAPs. It is important to highlight that Spain is an exception within this group, with the oldest adoption dates of NAS and NAP that exhibit climate shelter terminology. This might be explained by its pioneering role in developing and implementing the concept at the local level.

Furthermore, earlier national adaptation policies, especially those adopted before 2020, tend to include implicit references or not at all (see Fig. 36). This finding could be related to the fact that climate shelter experimentation at the local levels was relatively new before 2020. On the other hand, adaptation efforts were recently started to gain momentum in the EU and internationally with key policies like the EU Adaptation Strategy (2013) and the Paris Agreement (2015). Overall, the temporal distribution of the NASs and NAPs with references might indicate that a learning effect might emerge over time, and there will be an increasing shift from implicit to explicit in the updated national adaptation policies.

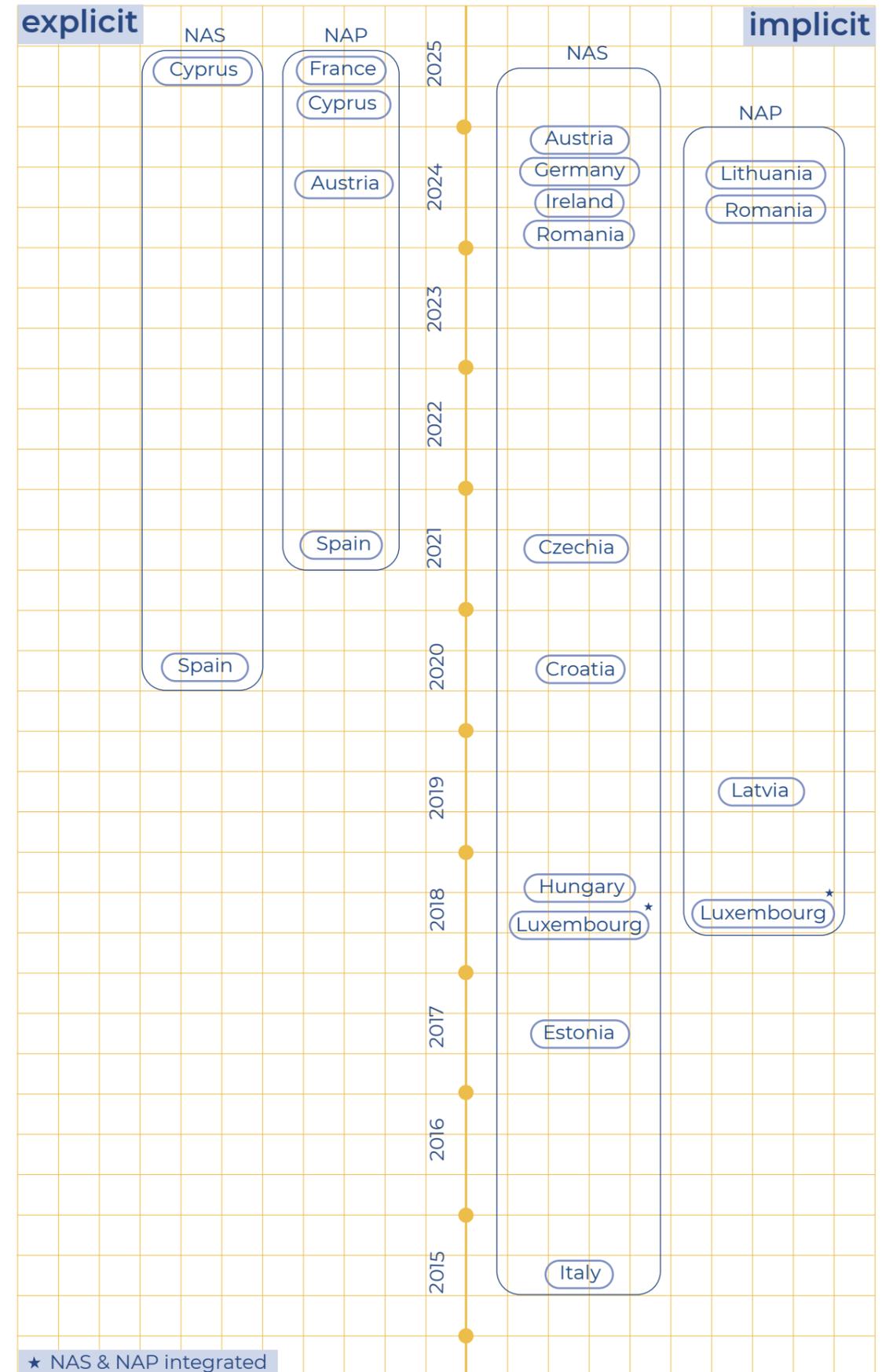
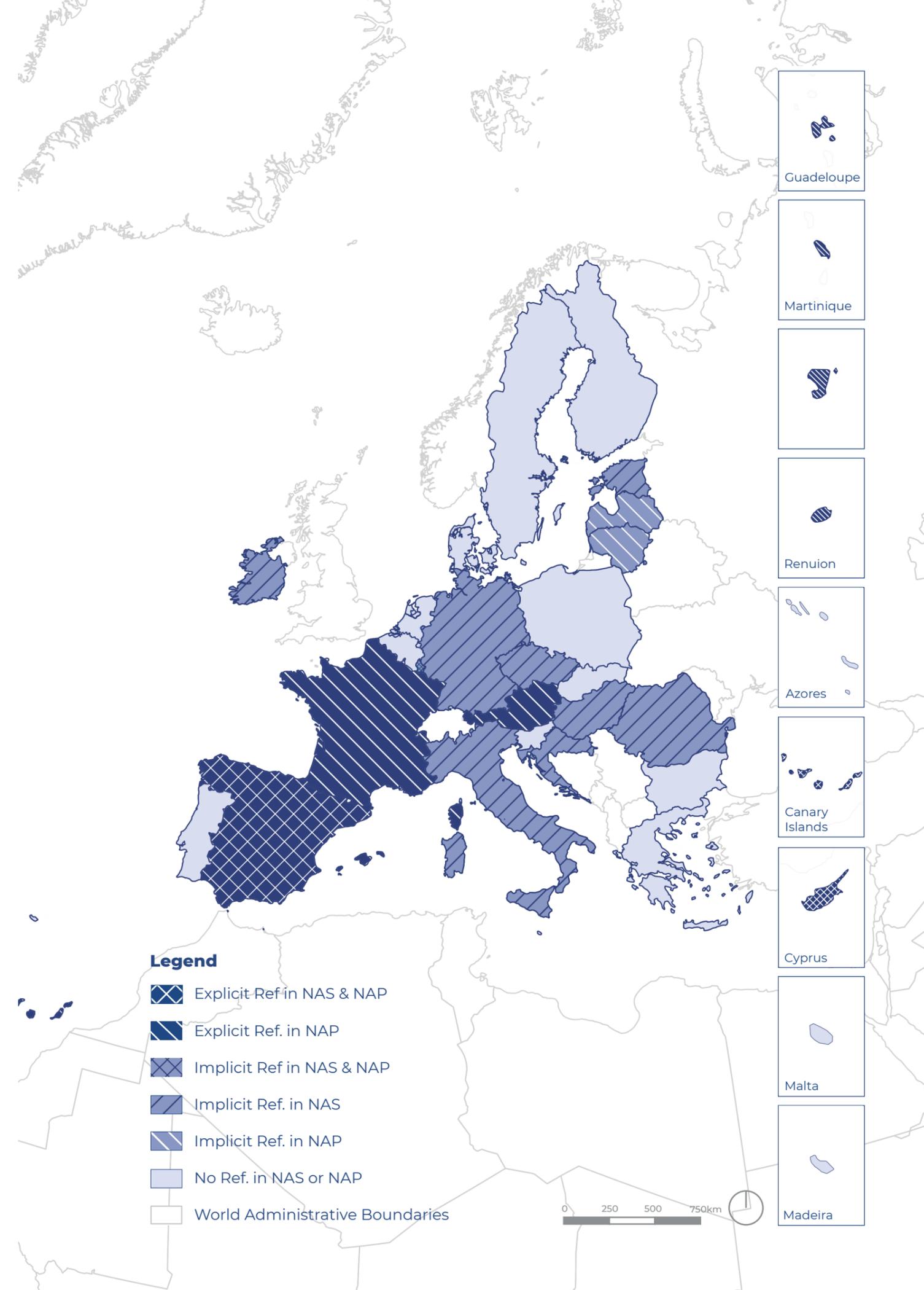


Figure 36 | Adoption Dates of NASs and NAPs with References (Source: Author's elaboration)

To conclude this section, the key findings support the results and make it possible to understand how the concept of climate shelters is reflected and framed within NASs and NAPs across EU-27 Member States (sub-question 1). Climate shelters are still an emerging and unevenly institutionalised concept in the national-level adaptation policies across Europe (see Fig. 37). Only a limited number of Member States demonstrate a clear understanding of the concept and integrate it accordingly into their national adaptation policies as an adaptation measure. These Member States have recently adopted NASs and NAPs within the 27 Member States, confirming the novelty of the concept. The results also show that Member States, such as France and Spain, have a designated name for the concept and apply it consistently within their frameworks. Lastly, temporal trends may indicate that there might be a gradual increase in recognition of the concept, suggesting a more homogenous diffusion in the national adaptation policies.

Figure 37 | Spatial Distribution of Explicit, Implicit and No References in NAS or NAP across 27 EU Member States (Source: Author's elaboration)



6.2 Key Findings from the Local Level

Several key findings emerge from the local level analysis of Lille, Erfurt, and The Hague. They are presented in three thematic points addressing how climate shelters are approached, integrated within local adaptation policies, observed vertical relationships and other similarities.

- **Cities demonstrate strong local experimentation with different implementation approaches.**

The three case studies all exhibit strong local actions where they implemented more than a single project within the city. However, there are differences in how they approach the concept. As previously mentioned, Lille and The Hague demonstrate the concept as a city-wide strategy by implementing it across various types of urban spaces to create a network. However, Erfurt focuses solely on transforming schoolyards. Therefore, while Lille and the Hague adopt the approach of Sheltered City, Erfurt adopts the approach of Thematic.

- **References to climate shelters in local adaptation plans vary across cities.**

The integration of the concept in LCPs also varies among the cities. Firstly, Erfurt does not have an LCP to be analysed for climate shelter reference. In terms of the presence of reference to climate shelter, Lille and The Hague both include them in their LCPs. Lille adopts the same term as in NAP ilots de fraîcheur to refer to the concept and uses it as a cooling adaptation measure to be implemented in the city. On the other hand, LCPs of The Hague refer to the concept indirectly without any specific terminology in both documents. The context for both of the references is also similar. They are used to refer to the ongoing adaptation practices in the city.

- **Transnational collaboration networks potentially influence local climate shelter implementation.**

One notable observation is that two of the case studies are part of transnational urban networks. Transnational urban networks are instrumental in disseminating innovations by promoting knowledge exchange through best-practice initiatives. Among these, the European Commission's Covenant of Mayors (CoM) represents a key climate-focused network (Grönholm et al., 2022). Both Lille and The Hague, which adopt the Sheltered City approach, participate in the Covenant of Mayors, whereas Erfurt, with the Thematic approach to climate shelters, does not hold any membership in such networks. The Hague also participates in the NetZeroCities Mission. Such networks can facilitate knowledge exchange, provide technical guidance, and access to funding opportunities, which can enable cities to design, implement, and upscale innovative adaptation initiatives. It is also relevant to mention that, like

the Time2Adapt project in Lille, several climate shelter initiatives in Barcelona and Paris were supported and financed under the European Urban Innovative Actions (UIA) programme. While further investigation is needed, this might indicate that participation in transnational collaborative networks and initiatives may also be supporting the strong local adaptation actions and supporting the upscaling of local experimentation into city-wide strategies.

These key findings support the results and make it possible to understand how climate shelter initiatives are implemented at the local level in selected case-study cities (sub-question 2). The analysis demonstrates that varying approaches to climate shelter are observed at the local level, including their adoption as a city-wide adaptation strategy, often accompanied by strong local actions. These variations may be linked to participation in transnational networks and the presence of local climate planning frameworks.

6.3 Comparative Policy Pathways for Climate Shelters

The synthesis of key findings from national - and local-level analyses reveals different degrees of vertical policy alignment across the three case studies. This subsection addresses how climate shelter initiatives are implemented at the local level in selected case-study cities (sub-question 3), by examining similarities and differences between national policy framings of climate shelters and their local implementation. The findings are summarised in Figure 38 and further discussed on a city-by-city basis.

Starting with Erfurt, the city lacks an LCP and shows only indirect references to the concept at the national level. This prevents any conclusions from being made regarding the vertical policy alignment in this case.

The Hague showcases strong action at the local level with climate shelter initiatives as early as 2019 and includes indirect references to the concept in the LCPs. However, it is missing any reference to the concept in the national adaptation policies. While this is understandable given the adoption date of the NAS in 2016, the absence of any reference in the NAP adopted in 2023 is more notable. This suggests that there isn't a vertical alignment between the local and national levels. A possible explanation might be the absence of a standard terminology for referring to the concept at the local level. If such terminology is established, the concept may be more clearly reflected in future national adaptation policies.

By contrast, Lille and, therefore, France show a strong policy alignment vertically, even exhibiting a standardised terminology to refer to the concept at all levels.

Considering the early emergence of climate shelters as a local experimentation, the case of Lille supports the hypothesis of this thesis, which is that local adaptation experimentations can inform and enrich national adaptation policies through bottom-up approaches.

Building on the conceptual framework and theoretical discussion presented in the previous chapters, the thesis finally addresses the main research question of how local climate shelter initiatives align with, diverge from, and inform national adaptation policies, and how local experimentation contributes to strengthening national adaptation governance. Taken together, the findings of this study demonstrate that climate shelter initiatives at the local level both align with and diverge from national adaptation policies, revealing varying degrees of vertical alignment across EU Member States. Across all case studies, climate shelters as local experimentations produce context-specific knowledge, practical implementation tools, and innovative governance approaches with the potential to inform and enrich national adaptation policies. They exemplify how bottom-up initiatives can strengthen national adaptation governance by testing solutions, demonstrating local needs and revealing opportunities for cross-sectoral and cross-actor cooperation. Strengthening mechanisms for knowledge exchange and policy feedback between local and national levels is essential for upscaling effective adaptation practices and advancing multilevel climate governance.

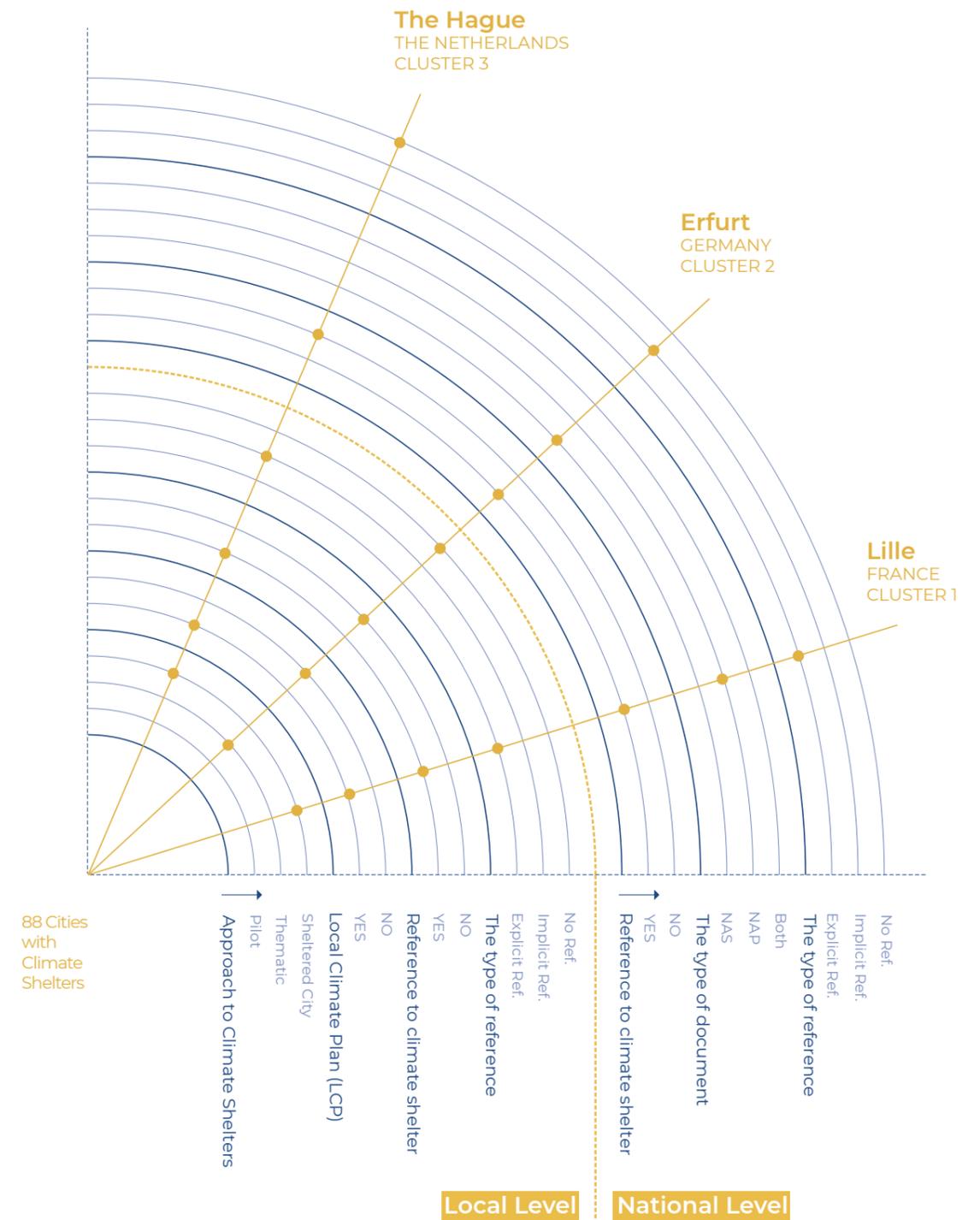


Figure 38 | Comparative Policy Pathways for Climate Shelters (Source: Author's elaboration)

6.4 Recommendations for Mainstreaming Climate Shelters in National Adaptation Policies

As a final step, the thesis outlines recommendations for mainstreaming the concept of climate shelters into national adaptation policies (sub-question 4), responding to existing research showcasing that local urban climate innovations are difficult to upscale and institutionalise, as differences in political priorities, institutional structures, and local governance capacities often limit the transfer of experimental practices into broader policy frameworks (Kern, 2019). Building on the insights from the findings, five main recommendations for integrating climate shelters into national adaptation policies are presented below. These recommendations are synthesised in a conceptual diagram, drawing on the diagram proposed by Dessai and Hulme (2003).

- **Strengthen and institutionalise vertical coordination mechanisms.**

National adaptation systems should strengthen coordination between national and local actors through regular meetings, working groups, or adaptation platforms. These mechanisms can help integrate local climate shelter experiences into national policies and support knowledge exchange. Establishing observation platforms on climate shelters, as seen in France (Observatoire des Cours Oasis, n.d.), can further promote learning and replication across cities.

- **Establish a shared understanding of the concept.**

A significant barrier observed in the national-level analysis is the non-existence of a common understanding of the concept with specific terminology. This is further confirmed by the findings, which showcase that explicit references to climate shelters are limited compared to implicit or no references, despite the presence of similar adaptation measures in the analysed documents. Establishing a shared understanding of the concept can reduce ambiguity surrounding the concept, support policy learning, and strengthen policy integration horizontally.

- **Introduce targeted funding mechanisms to support upscaling local experiments, including climate shelters.**

National governments should complement existing top-down adaptation finance mechanisms with funding instruments specifically designed to support the scaling of local adaptation pilots (Pörtner et al., 2022). Funding opportunities allow smaller cities and towns with limited capacity to initiate climate actions more in comparison to leading cities (Kern, 2019).

- **Build learning systems that translate climate shelters into national adaptation policy.**

National adaptation policies should include learning loops that translate local

climate shelter experiments into national policy development through systematic evaluation and knowledge sharing. Such learning loops should rely on continuous dialogue between science, policy, and practice, supported by vertical and horizontal integration, to ensure that local evidence effectively informs national adaptation decisions (Caldarice et al., 2021).

- **Support capacity-building for smaller municipalities to enable mainstreaming of climate shelters.**

To promote wider adoption of climate shelter initiatives, national authorities should support follower and laggard cities through technical guidance and capacity-building programmes while paying attention to local conditions (IPCC, 2022b; Kern, 2019). Strengthening local capacities, therefore, helps incentivise cities that are not yet at the forefront of climate action to catch up with leading municipalities (Kern, 2019). This promotes stronger horizontal upscaling, which in turn supports vertical upscaling by establishing the environment for climate shelter initiatives to be acknowledged, institutionalised, and mainstreamed into national adaptation policies.

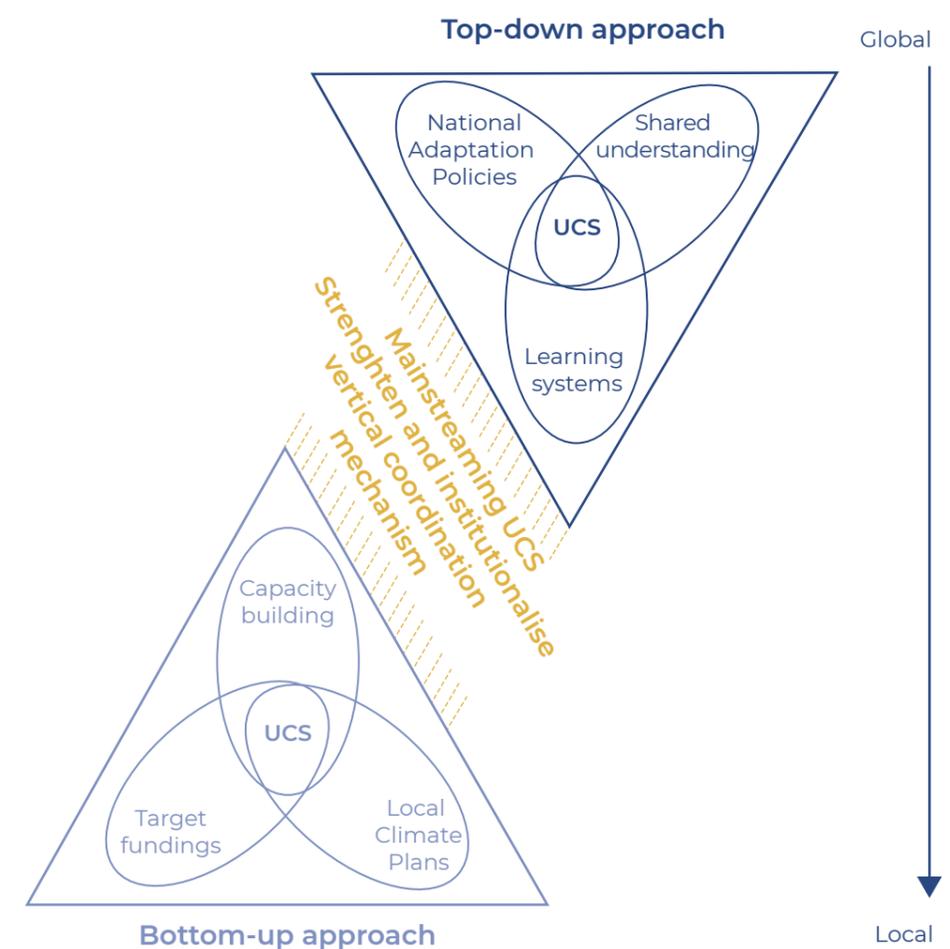


Figure 39 | Mainstreaming Urban Climate Shelters (Source: Author's elaboration)

6.5 Directions for Future Research

Building on the empirical findings and the MLG perspective adopted in this thesis, this section outlines key directions for future research on climate shelters as a lens for understanding the upscaling and institutionalisation of local adaptation experiments.

The outcomes of this thesis are consolidated into a scientific article recently submitted. Beyond this dissemination, the findings of this thesis also open several potential directions for future research. These potential directions are outlined in this section.

To begin with, this study examines whether local adaptation experiments inform national adaptation policies and how the concept aligns across local and national levels by focusing on climate shelters. Building on the findings of this study, follow-up research could focus specifically on Member States that demonstrate both explicit references to climate shelters in national adaptation policies and strong local actions. Future research could track temporal trends by examining when climate shelters were first implemented locally and when they first emerged as a designated concept in national adaptation policies. This would contribute to a more detailed understanding of how local-level implementation influences the national-level institutionalisation of the concept.

In addition, while this study defines its analytical scope as NASs and NAPs of EU Member States, there are other adaptation instruments that structure adaptation frameworks at the national level. These include legislative acts, sectoral plans, and other policy instruments. Future studies could take a broader approach by simultaneously examining a larger variety of adaptation tools at the national level. In a similar vein, local-level case studies could also be further enriched.

Furthermore, follow-up research can include on-ground perspectives on the role of the bottom-up approaches in mainstreaming adaptation experiments through the lens of climate shelters, where the results of this analysis are further explored by interviews, surveys, or field observations with experts.

Finally, future studies could explicitly investigate the multi-sectoral and multi-actor dimensions of MLG in the mainstreaming of local adaptation experiments. By focusing on how different sectors and actors interact in the development, diffusion, and institutionalisation of the climate shelters, such research could further elucidate the governance dynamics underpinning the scaling-up of local adaptation initiatives.

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ANNEXE

Annexe 1 | Database of NAS & NAP Documents of 27 EU Member States

COUNTRY CODE	COUNTRY NAME	NAP/NAS	YES/NO	DOCUMENT TYPE	ORIGINAL TITLE OF THE DOCUMENT	YEAR	LINK	LANGUAGE	MENTIONS CLIMATE SHELTER?	HOW?	TEXT EXCERPT (original language)	TEXT EXCERPT (English translation)	CLUSTER GROUP	COMPULSORY TO HAVE LCP?
BE	Belgium	NAS	YES	Separate	Belgian National Climate Change Adaptation Strategy	2010	https://www.cnc-nkc.be	English	NO	no reference	-	-	NO REF	NO
		NAP	NO	-	-	-	-	-	-	-	-	-		
BG	Bulgaria	NAS & NAP	YES	Integrated	National Climate Change Adaptation Strategy and Action Plan	2019	https://www.moew.gov.bg	English	NO	no reference	-	-	NO REF	NO
CZ	Czechia	NAS	YES	Separate	Strategie přizpůsobení se změně klimatu v podmínkách ČR	2021	https://www.mzp.gov.cz	Czech	YES	conceptual coverage	"Sídlní zelená infrastruktura (vzrostlé stromy, keřové a bylinné porosty, travnaté plochy apod.), vodní plochy (vodní toky, nádrže) a propojení dešťového odtoku ze zpevněných ploch se sídlní zelení, společně s extenzivními zelenými střechami, ozeleněnými fasádami z popínavých rostlin a udržitelným odvodňovacím systémem (hospodaření s dešťovou vodou) generuje mnohé ekosystémové služby na lokální úrovni, zejména regulaci mikroklimatu a s tím spojené ochlazování městského prostředí a celé sídlní krajiny." (p.60)	Urban green infrastructure (mature trees, shrub and herbaceous vegetation, grassed areas, etc.), water bodies (streams, reservoirs) and the connection of stormwater runoff from paved surfaces to settlement greenery, together with extensive green roofs, green façades with climbing plants, and sustainable drainage systems (stormwater management), generate many ecosystem services at the local level, particularly microclimate regulation and the associated cooling of the urban environment and the entire settlement landscape.	IMPLICIT	NO
		NAP	YES	Separate	Národní akční plán adaptace na změnu klimatu	2021	https://www.mzp.gov.cz	Czech	NO	no reference	-	-		
DK	Denmark	NAS	NO	-	-	-	-	-	-	-	-	-	NO REF	YES
		NAP	YES	Separate	Sådan håndterer vi skybrud og regnvand – Handlingsplan for klimasikring af Danmark	2012	https://www.regeringen.dk	Danish	NO	no reference	-	-		
DE	Germany	NAS	YES	Separate	German Strategy for Adaptation to Climate Change	2024	https://www.bundesumw.govt.de	English	YES	conceptual coverage	"Accessibility to cooling green spaces is achieved when a publicly accessible, cooling green space can be reached easily by foot and can be used for cooling off during heat events close to where people live and/or work." (p.64) "The goal is to reduce the health risks posed by heat in particularly thermally stressed areas and in areas with heat-sensitive populations, and to improve the cooling capacity, accessibility and recreational function of urban green spaces and open spaces for urban residents." (p.64)	-	IMPLICIT	NO
		NAP	YES	Separate	Deutsche Anpassungsstrategie an den Klimawandel 2024 Anhang 2: Aktionsplan Anpassung IV	2024	https://www.bmuv.de/fil	German	NO	no reference	-	-		
EE	Estonia	NAS	YES	Separate	Climate Change Adaptation Development Plan until 2030	2017	https://kliimaministeerium.ee	English	YES	conceptual coverage	"To avoid illnesses and mortality, the effects of the heat island effect should be already mitigated by limiting the accumulation of heat with planning and construction solutions and by implementing microclimatic cooling measures in the urban environment, maintaining and expanding green areas, landscaping and bodies of water" (p. 14).	-	IMPLICIT	NO
		NAP	YES	Separate	Kliimamuutustega kohanemise arengukava rakendusplaan aastateks 2021–2025	2021	not available link	-	-	-	-	-		
IE	Ireland	NAS	YES	Separate	National Adaptation Framework Planning for a Climate Resilient Ireland	2024	https://assets.gov.ie/stat	English	YES	conceptual coverage	-	-	IMPLICIT	YES
		NAP	YES	Separate	Climate Action Plan 2025	2025	https://assets.gov.ie/stat	English	NO	no reference	-	-		
EL	Greece	NAS	YES	Separate	ΕΘΝΙΚΗ ΣΤΡΑΤΗΓΙΚΗ ΓΙΑ ΤΗΝ ΠΡΟΣΑΡΜΟΓΗ ΣΤΗΝ ΚΑΙΜΑΤΙΚΗ ΑΛΛΑΓΗ	2016	https://ypen.gov.gr/wp-c	Greek	NO	no reference	-	-	NO REF	NO
		NAP	NO	-	-	-	-	-	-	-	-	-		

ES	Spain	NAS	YES	Separate	National Climate Change Adaptation Plan 2021-2030	2020	https://www.miteco.gob	English	YES	direct term	"There is also a need to promote the incorporation of urban climate mapping into urban planning and management tools, which can encourage the creation of climate refugia." (p.152) "Measures to adapt habitat types to climate change. Adaptive management measures include measures to lower non-climate pressures impacting habitat types, improve the resilience of habitat types, maintain the abiotic conditions required by habitat types, reduce the impact of extreme weather events, and identify climate refugia." (p.123)	-	EXPLICIT	NO
		NAP	YES	Separate	PROGRAMA DE TRABAJO 2021-2025 Plan Nacional de Adaptación al Cambio Climático	2021	https://www.miteco.gob	Spanish	YES	direct term	"Pima Adapta Parques - Restauración de hábitats (refugios climáticos) - Gestión forestal adaptativa - Investigación y seguimiento del cambio global en Parques Nacionales - Educación ambiental en materia de cambio climático" (p.17) "Pima Cambio Climático - Adaptación de edificios públicos para prevenir el exceso de calor - Apertura de "refugios climáticos" urbanos de uso público - Aplicación de soluciones basadas en la naturaleza orientadas a prevenir riesgos derivados del cambio climático" (p.18) "Impulso a la creación de "refugios climáticos" como herramienta de adaptación al cambio climático de la biodiversidad. Se identifican potenciales "refugios climáticos" y se pone la información a disposición de los departamentos de conservación de la biodiversidad y planificación y gestión de áreas protegidas" (annex) p.8)	"Pima Adapts Parks - Habitat restoration (climate refuges) - Adaptive forest management - Research and monitoring of global change in National Parks - Environmental education on climate change" (p.17) "Pima Climate Change - Adaptation of public buildings to prevent excessive heat - Opening of urban "climate refuges" for public use - Application of nature-based solutions aimed at preventing risks arising from climate change" (p. 18) "Promotion of the creation of 'climate refuges' as a tool for biodiversity adaptation to climate change. Potential 'climate refuges' are identified and the information is made available to the departments of biodiversity conservation and planning and management of protected areas" (Annex 1, p. 8)		
FR	France	NAS	YES	Separate	Stratégie nationale d'adaptation au changement climatique	2006	https://www.ecologie.g	French	NO	no reference	-	-	EXPLICIT	YES
		NAP	YES	Separate	Plan national d'adaptation au changement climatique 2	2025	https://www.ecologie.g	English	YES	direct term	"La mesure renaturation des villes et des villages du Fonds vert cofinance des solutions d'adaptation au changement climatique fondées sur la présence de la nature en ville. Est éligible la renaturation – au sens de la récréation ou l'amélioration des fonctionnalités écologiques – des sols, des végétaux ou des milieux aquatiques/humides, située dans l'espace urbanisé et qui adapte celui-ci aux effets du changement climatique (îlots de fraîcheur, infiltration des eaux de pluie à la parcelle)" (p. 114) "- Mener un travail de définition méthodologique et de cartographie des îlots de fraîcheur urbains dans les plus grandes agglomérations puis développer une application permettant de trouver l'îlot de fraîcheur le plus proche." (p. 115) "BUDGET. 1.1. Travaux de cartographie des îlots de chaleur urbains, cartographie et développement d'une application de repérage des îlots de fraîcheur : 200 k€ / an." (p. 115) "INDICATEUR.Superficies couvertes par la cartographie des îlots de chaleur et des îlots de fraîcheur" (p. 115) "Les premières pistes d'actions pour le socle évoquées dans le groupe de travail collectifs du PNACC sont : La réalisation d'un diagnostic des îlots de chaleur urbains ; Le recensement des îlots de fraîcheur et des fontaines publiques;" (p. 174)	"The Green Fund's urban and village rewilding measure co-finances climate change adaptation solutions based on the presence of nature in urban areas. Eligible projects include rewilding—in the sense of recreating or improving the ecological functions—of soils, vegetation, or aquatic/wetland environments, located within urbanized areas and adapting them to the effects of climate change (cool islands, on-site rainwater infiltration)" (p. 114) "Conduct methodological definition and mapping of urban cool islands in the largest urban areas, then develop an application to find the nearest cool island" (p. 115) "Budget. 1.1. Urban heat island mapping work, mapping and development of an application for identifying cool islands: €200k/year" (p. 115) "Indicator. Areas covered by the mapping of urban heat islands and cool islands" (p. 115) "The initial action plans for the core area discussed in the local authorities working group of the PNACC are: Conducting an assessment of urban heat islands; Identifying urban cool islands and public fountains..." (p. 174)		
HR	Croatia	NAS	YES	Separate	Strategija prilagodbe klimatskim promjenama u Republici Hrvatskoj za razdoblje do 2040. godine s pogledom na 2070. godinu	2020	https://narodne-novine.i	Croatian	YES	conceptual coverage	"renaturalizaciju i regeneraciju urbanog tkiva upotrebom rješenja temeljenih na prirodi" (p. 28)	"renaturalization and regeneration of the urban fabric using nature-based solutions" (p. 28)	IMPLICIT	NO
		NAP	NO	-	-	-	-	-	-	-	-	-		
IT	Italy	NAS	YES	Separate	Elementi per una Strategia Nazionale di Adattamento ai Cambiamenti Climatici	2015	https://www.mase.gov.it	Italian	YES	conceptual coverage	"Promuovere una ridistribuzione del verde urbano con funzione di interruzione dell'effetto isola di calore" (p. 124). "Incrementare la dotazione del verde urbano, adottando la logica delle green and blue infrastructure, predisponendo misure per il contenimento degli impatti climatici sul verde pubblico esistente, salvaguardando la biodiversità in ambito urbano" (p. 136).	"Promote a redistribution of urban green spaces to interrupt the heat-island effect" (p. 124). "Increase the provision of urban green spaces by adopting the logic of green and blue infrastructure, preparing measures to contain the climatic impacts on existing public green areas, and safeguarding biodiversity in urban areas" (p. 136).	IMPLICIT	NO
		NAP	YES	Separate	Piano Nazionale di Adattamento ai Cambiamenti Climatici - (PNACC)	2023	https://www.mase.gov.it	Italian	NO	no reference	-	-		

CY	Cyprus	NAS	YES	Separate	NATIONAL ADAPTATION STRATEGY TO CLIMATE CHANGE	2025	https://e-consultation.g	English	YES	direct term	"Enhancing public transport to withstand heat stress is a key priority, with measures like self-sufficient climate shelters, radiant cooling, and nature-based solutions being explored to improve passenger comfort."(p. 55) "Public transport stops in cities are transformed into self-sufficient short-stay climate shelters" (p. 139) "Promote the incorporation of urban climate risk mapping into urban planning, which can encourage the creation of climate refugia." (p.145)	-	EXPLICIT	NO
		NAP	YES	Separate	NATIONAL ADAPTATION ACTION PLAN TO CLIMATE CHANGE	2025	https://e-consultation.g	English	YES	direct term	"Indicator for verification of implementation progress - Number of community centres operational as climate shelters" (MARDE, 2025, p. 162) "Promote the incorporation of urban climate risk mapping into urban planning, which can encourage the creation of climate refugia." (MARDE, 2025, p. 239)	-		
LV	Latvia	NAS	NO	-	-	-	-	-	-	-	-	-		
		NAP	YES	Separate	Latvian National Plan for Adaptation to Climate Change until 2030	2019	https://www.varam.gov.l	English	YES	conceptual coverage	"Review the legal framework and improve the implementation thereof with regard to the necessity to install and maintain air cooling systems in public spaces, as a priority – in health care institutions, social care and social rehabilitation institutions, kindergartens, trains stations (where relevant)" (p. 59).	-	IMPLICIT	NO
LT	Lithuania	NAS	YES	Separate	National Strategy for Climate Change Management Policy	2021	https://e-seimas.lrs.lt/por	English	NO	no reference	-	-		
		NAP	YES	Separate	FINAL UPDATED NATIONAL ENERGY AND CLIMATIVE ACTION PLAN of the Republic of Lithuania for the period 2021-2030	2024	https://commission.europ	English	YES	conceptual coverage	"PR31-P: Introduction of public cooling centres ensuring 24 hours a day, 7 days a week" p. 420 (in a table in annex with no page number)	-	IMPLICIT	NO
LU	Luxembourg	NAS & NAP	YES	Integrated	Stratégie et Plan d'Action pour l'Adaptation aux effets du Changement Climatique au Luxembourg 2018-2023	2018	https://environnement.g	French	YES	conceptual coverage	"Désigner les surfaces de régulation climatique, p. ex. pour le rafraîchissement nocturne ou la rétention des eaux, o Utiliser les surfaces de régulation climatique à plusieurs fins : p. ex. en tant que zones de rétention, parcs, zones agricoles en milieu urbain" (p. 101) "Créer des parcs répartis sur le territoire, accessibles aux personnes à mobilité réduite, notamment les personnes âgées et les enfants, fonctionnels (arbres à effet ombrageant et à forte évaporation, irrigation assurée) et attrayants (p. ex. équipements de jeux, cafés). On peut éventuellement songer à des usages doubles, p. ex. en tant que surfaces de rétention" (p. 120).	"Designate climate-regulating areas, e.g. for night cooling or water retention, or use climate-regulating areas for multiple purposes: e.g. as retention areas, parks, urban agricultural areas" (p. 101) "Create parks distributed throughout the area, accessible to people with reduced mobility, particularly the elderly and children, functional (trees with shade and high evaporation, ensured irrigation) and attractive (e.g. play equipment, cafes). Dual uses could also be considered, e.g. as retention areas." (p. 120).	IMPLICIT	NO
HU	Hungary	NAS	YES	Separate	a 2018–2030 közötti időszakra vonatkozó, 2050-ig tartó időszakra is kitekintést nyújtó második Nemzeti Éghajlatváltozási Stratégia (NÉS-2)	2018	https://njt.hu/document	Hungarian	YES	conceptual coverage	"A zöldfelületi rendszer bővítésével és a vízfelületek bevonásával olyan helyspecifikus zöldinfrastruktúra-rendszer létrehozása, amely biztosítja az ökológiai átjárhatóságot, valamint elősegíti a települések átszellőzését, mérsékli a hősziget jelenséget." (p.196)	"By expanding the green space system and including water surfaces, creating a site-specific green infrastructure system that ensures ecological permeability, promotes ventilation of settlements, and reduces the heat island phenomenon." (p.196)	IMPLICIT	NO
		NAP	NO	-	-	-	-	-	-	-	-	-		
MT	Malta	NAS & NAP	YES	Integrated	Malta's Low Carbon Development Strategy	2021	https://unfccc.int/sites/d	English	NO	no reference	-	-	NO REF	NO
NL	Netherlands	NAS	YES	Separate	National Climate Adaptation Strategy 2016	2016	https://klimaadaptatie	English	NO	no reference	-	-	NO REF	NO
		NAP	YES	Separate	National Climate Adaptation Implementation Programme	2023	https://klimaadaptatie	English	NO	no reference	-	-		
AT	Austria	NAS	YES	Separate	Die Österreichische Strategie zur Anpassung an den Klimawandel Teil 1 – Kontext	2024	https://www.bmluk.gv.a	German	YES	conceptual coverage	"Verbesserung der mikro/mesoklimatischen Bedingungen im Rahmen der Gebäude-, Stadt- und Freiraumplanung Optimierung der Lebensbedingungen für die Bevölkerung durch Reduktion des Hitzeinseleffekts, Entsiegelung und Verbesserung der Versickerungsfähigkeit von Böden im Rahmen der Gebäude-, Stadt- und Freiraumplanung." (p. 110)	"Improvement of micro/mesoclimatic conditions within the framework of building, urban and open space planning. Optimisation of living conditions for the population through reduction of the heat island effect, unsealing and improvement of the infiltration capacity of soils within the framework of building, urban and open space planning." (p. 110)		
		NAP	YES	Separate	Die Österreichische Strategie zur Anpassung an den Klimawandel Teil 2 – Aktionsplan Handlungsempfehlungen für die Umsetzung	2024	https://www.bmluk.gv.a	German	YES	direct term	"Generell sind „cooling spots“ strategisch so zu situieren, dass sie zunehmend dichter in Bereichen mit erhöhtem Risiko der Überhitzung und starkem Personenaufkommen situiert sind;" (P. 191) " Einrichtung von öffentlichen, kühlen und barrierefreien Räumen („Cool spots“) in urbanen Räumen (speziell in ausgeprägten städtischen Hitzeinseln). Darunter fallen beispielsweise auch massive historische (oft sakrale) Bauten oder bepflanzte, beschattete und durchlüftete Plätze;"(p. 191) "Stadtbewohnerinnen beeinflussen direkt durch die eigenen Vorstellungen von Nützlichkeit und Attraktivität die Ausgestaltung privater Grün- und Freiflächen und damit die biologische Vielfalt in Städten. Information und die Schaffung von Anreizen für eine angepasste biodiversitätsverträgliche Gestaltung durch naturbasierte Lösungen sind unerlässlich, um auch unter geänderten klimatischen Bedingungen die bioklimatischen Vorteile grüner und blauer Infrastruktur nutzen zu können. Dazu zählen unter anderem der Temperatursausgleich, die Erhöhung der Luftfeuchtigkeit, die Filterung von Luftschadstoffen und der Luftaustausch sowie die Beschattung. Sie sind auch wichtige Freizeit- und Erholungsgebiete und bieten Raum für soziale Kontakte." (p. 467)	"In general, "cooling spots" should be strategically located so that they are increasingly closer together in areas with an increased risk of overheating and high crowding;" (P.191) "Establishment of public, cool, and accessible spaces ("cool spots") in urban areas (especially in pronounced urban heat islands). This includes, for example, massive historical (often sacred) buildings or planted, shaded, and ventilated squares;" (p. 191)	EXPLICIT	NO

PL	Poland	NAS	YES	Separate	Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020 z perspektywą do roku 2030	2013	https://bip.mos.gov.pl/fil	Polish	NO	no reference	-	-	NO REF	NO
		NAP	NO	-	-	-	-	-	-	-	-	-	-	-
PT	Portugal	NAS	YES	Separate	Estratégia Nacional de Adaptação às Alterações Climáticas (ENAAAC)	2015	https://www.dge.mec.pt	Portuguese	NO	no reference	-	-	NO REF	NO
		NAP	YES	Separate	Programa de Ação para a Adaptação às Alterações Climáticas (P-3AC)	2019	https://files.diariodarepu	Portuguese	NO	no reference	-	-	-	-
RO	Romania	NAS	YES	Separate	Strategia națională privind adaptarea la schimbările climatice pentru perioada 2024-2030 cu perspectiva anului 2050	2024	https://www.mmediu.ro	Romanian	YES	conceptual coverage	"Promovarea unor ecosisteme sănătoase, a infrastructurii verzi și a soluțiilor bazate pe natură ar trebui să fie integrată în mod sistematic în planificarea urbană, respectiv în spațiile publice, în infrastructură, în proiectarea clădirilor și a împrejurimilor acestora." (P. 71) "Integrarea soluțiilor bazate pe natură prin dezvoltarea infrastructurii verzi și albastre prin crearea, extinderea, diversificarea, reabilitarea spațiilor verzi existente și gestionarea eficientă a acestora, precum acoperișuri verzi, grădini urbane, inclusiv reabilitarea/regenerarea malurilor cursurilor de apă și reintegrarea acestora în localități." (P. 78)	"Promoting healthy ecosystems, green infrastructure, and nature-based solutions should be systematically integrated into urban planning, particularly in public spaces, infrastructure, and the design of buildings and their surroundings." (p. 71) "Integrating nature-based solutions through the development of green and blue infrastructure by creating, expanding, diversifying, and rehabilitating existing green spaces and managing them efficiently, such as green roofs and urban gardens, including the rehabilitation/regeneration of riverbanks and their reintegration into settlements." (p. 78)	IMPLICIT	NO
		NAP	YES	Separate	Planul național de acțiune pentru implementarea Strategiei naționale privind adaptarea la schimbările climatice pentru perioada 2024-2030 (PNASC)	2024	https://www.mmediu.ro	Romanian	NO	-	-	-	-	-
SI	Slovenia	NAS	YES	Separate	STRATEGIC FRAMEWORK FOR CLIMATE CHANGE ADAPTATION	2016	https://www.gov.si/asset	English	NO	no reference	-	-	NO REF	NO
		NAP	NO	-	-	-	-	-	-	-	-	-	-	-
SK	Slovakia	NAS	YES	Separate	STRATÉGIA ADAPTÁCIE SLOVENSKEJ REPUBLIKY NA ZMENU KLÍMY	2018	https://www.minzp.sk/fil	Slovak	NO	no reference	-	-	NO REF	YES
		NAP	YES	Separate	Akčný plán pre implementáciu Stratégie adaptácie SR na zmenu klímy	2021	https://www.minzp.sk/fil	Slovak	NO	no reference	-	-	-	-
FI	Finland	NAS	NO	-	-	-	-	-	-	-	-	-	NO REF	NO
		NAP	YES	Separate	Government Report on Finland's National Climate Change Adaptation Plan until 2030	2024	https://julkaisut.valtione	English	NO	no reference	-	-	-	-
SE	Sweden	NAS & NAP	YES	Integrated	Nationell strategi och regeringens handlingsplan	2024	https://www.regeringen	Swedish	NO	no reference	-	-	NO REF	NO

Last screening date: 10/12/2025

